



The  
University  
Of  
Sheffield.

**Ensembles working towards performance:  
Emerging coordination and interactions in self-organised groups**

By:

Nicola Pennill

A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

The University of Sheffield

Faculty of Arts and Humanities

Department of Music

June 2019

## Acknowledgements

I would of course like to thank my supervisory team. Renee Timmers Catherine Laws, and Dermot Breslin been incredible in so many ways, and have each helped made the experience of research extraordinary. I count myself very fortunate to have been part of the WRoCAH network on Expressive Nonverbal Communication in Ensemble Performance. As well as the doctoral studentship award which made the PhD possible, it enabled me to be part of a wonderful team of people, who were an important source of ideas and encouragement throughout. Thanks also, therefore, go to Helena Daffern, Freya Bailes, Luke Windsor and Guy Brown, and to fellow students Ryan Kirkbride and Sara D’Amario, with whom it was such a joy to share my PhD experience. A special extra thank you must also go to Sara for the work we did together, it was a really important part of my research, and I will always value our friendship.

There are many more people who have helped me along the way. The WRoCAH team, especially Caryn and Clare, took great pains to ensure the PhD was positive and productive at every stage. Thanks also to fellow students at The University of Sheffield who in different ways and at different times have been a great source of support, especially Shen, Henrique, Jonathan, Ioanna, Tim, Kate, and Caroline. Thanks also go to some very special friends. First, Lindsey, who truly went above and beyond what I could have ever expected to provide the most amazing practical help at the perfect time. Michelle, as always, was a constant source of inspiration and energy.

This research was motivated by my love of group music-making, so I would like to thank the musicians I have played and collaborated with, who made this research possible, and who brought the ideas to life. Thanks therefore go the musicians who participated in this study, especially the singers who gave their time so willingly, and the members of the Australian Chamber Orchestra who made me so welcome during my unforgettable time with them in Sydney. I am especially grateful to Alistair and other fellow members of the Equinox Saxophone Ensemble for keeping me connected to the joy of being part of an ensemble.

Finally, thanks go to my wonderful family – to my Mum and Dad whose faith in me has been so important when I doubted myself; and to Jo, Steve, Erin,

Georgia, and Jamie, for reminding me what life is really all about. A final, special thank you must go to Andrew, who has patiently encouraged and supported me in what has at times seemed like a never-ending undertaking, and that has meant the world to me.

Supervisors:

Dr Renee Timmers, Department of Music, The University of Sheffield

Dr Catherine Laws, Department of Music, the University of York

Dr Dermot Breslin, School of Management, The University of Sheffield

This work was supported by The University of Sheffield through the White Rose College of Arts and Humanities (WRoCAH).

This research was conducted as part of the WRoCAH network on Expressive Nonverbal Communication in Ensemble Performance. As such, I had the privilege of working with fellow network members in the Universities of Leeds and York, as well as The University of Sheffield.



# Abstract

## *Background*

For small ensembles, preparing for ensemble performance is often achieved through a framework of rehearsals and performance goals. The ways that groups work together varies widely, but generally involves the concurrent evolution of social and task behaviours. Time as factor within and across a series of ensemble rehearsals has not been extensively studied. Research on organisations increasingly recognises the value of studying groups as dynamic, emergent entities. As well as the specific musical tasks and processes involved, this research takes a broader perspective, incorporating investigations of moment-by-moment verbal interactions between group members, and the way the explicit and implicit communication processes evolve over time.

## *Aims*

This research aimed to address the central question of how behavioural interactions in small ensembles emerge and change over time. It aimed to investigate the ways that ensembles work together in rehearsal, in particular as a way of preparing for performance. The key theoretical perspectives on which this research is based are concerned with processes of coordination in small groups, in which the ensemble is viewed as a dynamic, self-managed collective.

## *Method*

This was a mixed methods study including a questionnaire study, quantitative measures of verbal interactions, and qualitative analysis of participant experiences and perceptions. A background survey on rehearsal methods was conducted with small ensembles (< 12 members), along with two longitudinal case studies of newly formed *a cappella* vocal quintets. Rehearsals were video-recorded in the field (Case 1) and in a laboratory setting (Case 2) over a three-month period. Verbal interactions were captured, and the rehearsal utterances were time-stamped and coded. Behaviours were analysed using the software Theme (Patternvision Ltd) to identify recurrent temporal interaction patterns ('T-patterns'). In Case 2, further aspects were incorporated – two contrasting pieces were provided for rehearsals, and musical and verbal interactions were explored. Finally, a qualitative study combined interview,



observation and visual methods explored experiences from participants of both case studies.

### *Results*

The emergence of interactions, implicit communication and rehearsal activities were subject to a series of transitional changes triggered by exogenous factors, including approaching deadlines and social familiarity. Survey findings showed differences in rehearsal structure at different stages of preparation, but also commonalities across a range of types and sizes of ensembles. In the case studies, patterns in behaviour were evident at two main levels of analysis – emergent, inter-individual interactions ‘in the moment’, and in progressions through phases over a series of rehearsals. Verbal interaction patterns contributed were evident from first encounters onwards; patterns appeared very early and increased in complexity over time, as implicit communication modes became more established. Three phases were identified – an initial *exploration* phase where social and task familiarity were established, a *transition* phase where differences were surfaced and resolved, and a final *integration* phase in which a shared plan for performance was realised. The findings also showed that over time, implicit coordination increased and explicit coordination modes decreased. A new model of ensemble processes was proposed, in which the emergent interactions and larger-scale transitional phases are combined.

### *Implications*

This research provided a new perspective on collaboration in music ensembles. It offered implications for further research on small group processes and their emergence over time, and for music ensemble performers and teachers seeking to reflect on practice. In describing these processes and their predictable ‘transition’ points, the metaphor of a river was used as a powerful image of change and renewal. It recognised ways that small groups, including music ensembles, need to balance paradoxical forces for predictability and structure with creativity and sharing of ideas. It also contributed to methods, both in its longitudinal design and the combination of approaches to investigation. Finally, the thesis highlighted further possibilities for interdisciplinary research in self-organised music ensembles and small group research.

# List of Tables

Table 2.1 Levels of structure, and areas of consideration identified in the study of collaboration and practice techniques in chamber ensemble rehearsals (reproduced from King, 2004, p.12).....	22
Table 2.2 Three four-phased development models of teams.....	46
Table 3.1 Dimensions that require attention when learning a new piece of music for performance (reproduced from Chaffin & Imreh, 2002, p. 344).....	58
Table 3.2 Mix of methods used in the thesis.....	62
Table 3.3 Main methods of investigation of explicit and implicit coordination in case studies.....	66
Table 3.4 Coding scheme for musical tasks in rehearsal (based on Chaffin et al., 2002; Ginsborg et al., 2006).....	67
Table 3.5 Behaviour Analysis (BA) coding scheme (Farley, Evison, Rackham, Nicolson, & Dawson, 2018).....	69
Table 3.6 Summary of literature gaps, research questions and methods.....	79
Table 4.1 Ensemble type and size ( $N=129$ ).....	83
Table 4.2 Frequencies: Professional status and duration of groups' existence ( $N=129$ ).....	84
Table 4.3 Survey structure (see Appendix B for full survey).....	86
Table 4.4 Stage of rehearsal – assigned groups.....	88
Table 4.5 Professional status and stage of group preparation.....	88
Table 4.6 Summary of principal component analysis results for the importance of rehearsal elements; pattern matrix ( $n=126$ ).....	91
Table 4.7 Summary of inclusion and general timing of rehearsal tasks.....	93
Table 4.8 Frequency of planning behaviour: Predetermined nature of rehearsal structure ( $N=129$ ).....	94
Table 4.9 Frequency of planning behaviour: Decision making and rehearsal structure ( $N=129$ ).....	95

Table 4.10 Amount and importance of rehearsal talk type in the ensemble. Mean ratings (on a scale of 1–5) and standard deviations ( $N=129$ ) vs test value of 3.0 .....	103
Table 4.11 Nonverbal communication in rehearsal. Percentage of respondents reporting use in rehearsal and performance ( $N=129$ ) .....	105
Table 4.12 Nonverbal communication type – percentage of respondents reporting use by rehearsal stage ( $n=108$ ).....	106
Table 4.13 Reported methods of conflict resolution: Mean ratings and standard deviation (on a scale 1-5) vs hypothetical mean.....	108
Table 4.14 Reasons for conflict reported by members of groups at different rehearsal stages.....	109
Table 4.15 Frequency of reported roles ( $N=129$ ) .....	110
Table 4.16 Frequency of ‘clearly defined’ roles reported ( $n=26$ ) .....	111
Table 4.17 Leadership style by group size ( $N=129$ ).....	112
Table 5.1 List of rehearsal activities from rehearsal log.....	123
Table 5.2 Summary of recorded rehearsals .....	124
Table 5.3 Duration (minutes/seconds) and total number of singing episodes in first 30 minutes of rehearsals by week (all singing together) .....	126
Table 5.4 Self-reported rehearsal activities by week (from rehearsal logs) .....	129
Table 5.5 Duration of each behaviour type (minutes and seconds).....	131
Table 5.6 Main behavioural tendencies by singer .....	134
Table 5.7 Summary of sub-patterns in Week 1 .....	139
Table 5.8 Summary of sub-patterns in Week 3 .....	141
Table 5.9 Detailed description of Week 5 sub-patterns.....	144
Table 5.10 Detailed description of Week 7 sub-patterns.....	146
Table 5.11 Summary of pattern data by rehearsal .....	147
Table 5.12 Summary of key features of pattern data by week .....	149
Table 5.13 Singer behaviour types occurring in patterns, by week.....	149

Table 5.14 Summary of main features of observation data: Group 1 .....	151
Table 6.1 Study design .....	163
Table 6.2 Summary of main patterns by rehearsal and piece; number of main patterns, events, number of dyads and actor switches .....	168
Table 6.3 Main recurrent patterns and dyadic sub-patterns by rehearsal .....	169
Table 6.4 Frequency of verbal utterances by singer, by rehearsal.....	180
Table 6.5 Number of times each singer (or group of all/some singers) appeared in unique significant patterns (P) and instances of dyadic patterns (D).....	184
Table 6.6 Ranking of verbal (VC), patterned (PC) and dyad (DC) contributions by members of the ensemble .....	185
Table 6.7 Summary of key features of rehearsals over time .....	194
Table 7.1 Data collection timeline.....	200
Table 7.2 Self-reported activities for Group 1, from rehearsal logs .....	215
Table 7.3 Rehearsal process established by Group 2 over time, and consolidated during their later rehearsals.....	216
Table 7.4 Critical events and emotional highs and lows – combined from both groups .....	221
Table 8.1 Group performance preparation – summary of findings .....	233
Table 8.2 Summary of Group 1 and 2 mix of social and task behaviours appearing in patterned interactions, by rehearsal .....	258
Table 11.1 Confidence interval $1 p < .005$ , minimum occurrences of patterns = 3 ...	297
Table 11.2 Confidence interval $p < .05$ , minimum occurrences of patterns = 3 .....	297
Table 11.3 Confidence interval $p < .001$ , minimum occurrences of patterns = 3 .....	297
Table 11.4 Confidence interval $p < .005$ , minimum occurrences of patterns = 2 .....	298
Table 11.5 Confidence interval $p < .005$ , minimum occurrences of patterns = 4 .....	298
Table 11.6 Frequencies of behaviour type by singer (shown as % of total of each behaviour) .....	313
Table 11.7 Total frequency of verbal behaviour type and subtype by week (n occurrences and % total).....	314

Table 11.8 Airtime (% total time) by member of Group 1: by week, and mean (S.D.) .....	315
Table 11.9 Weekly summaries of event types .....	315
Table 11.10 Week 1 verbal exchanges during patterned behaviours .....	316
Table 11.11 Week 3 verbal exchanges during patterned behaviours .....	317
Table 11.12 Week 5 verbal exchanges during patterned behaviours .....	318
Table 11.13 Week 7 verbal exchanges during patterned behaviours .....	320
Table 11.14 Summary of pattern statistics from rehearsals of homophonic and polyphonic pieces .....	321
Table 11.15 Correlations of pattern statistics and rehearsal .....	321
Table 11.16 Responses from reflective questionnaires – Group 2 .....	322
Table 11.17 Summary of the main themes with illustrative quotes Group 1: Singers A, B, C, D, E, and Group 2: Singers V, W, X, Y, Z.....	359

# List of Figures

Figure 2.1 The ‘field of interaction’: Examples of explicit and implicit, and individual and collective processes in a string quartet (reproduced from Tovstiga et al., 2005, p. 224) .....	29
Figure 2.2 A process model of team compilation (reproduced from Kozlowski et al., 1999, p. 280).....	44
Figure 2.3 Pattern of changes that typify the punctuated equilibrium model (reproduced from Sundarasaradula et al., 2005, p. 371).....	47
Figure 2.4 The temporal nature of team task transitions (reproduced from Bush et al., 2017, p. 425).....	48
Figure 3.1 A typology of approaches for studying organisational change (reproduced from Van de Ven and Poole, 2005, p. 1387) .....	61
Figure 3.2 Mixed methods research design and chapter organisation.....	63
Figure 3.3 Example of T-patterns within a hypothetical series of events (Casarrubea et al., 2015, p. 34) .....	71
Figure 3.4 Basic template for trajectory drawings (dotted line shows example of participant’s drawing).....	75
Figure 3.5 Approach to qualitative data analysis (based on Corley & Gioia, 2004; Gioia et al., 2013) .....	76
Figure 4.1 Mean rating (+S.E.) of importance of rehearsal elements to group preparation for performance .....	90
Figure 4.2 Summary of basic groupings of rehearsal task, based on factors identified using principal component analysis.....	94
Figure 4.3 Type of planning behaviour by groups at different rehearsal stages (error bars indicate standard error of mean). Significant differences ( $p < .01$ ) indicated by brackets. ....	99
Figure 4.4 A framework for ensemble rehearsal .....	100
Figure 4.5 Frequency distribution of amount of rehearsal talk (% of total rehearsal time) N=129.....	101

Figure 4.6 Rehearsal talk amount and importance by type, relative to mid-point (hypothetical mean) of 3.0 .....	102
Figure 4.7 Amount of talk type by topic, mean score by rehearsal stage. Error bars indicate standard error of mean. (Group 0=no performance, Group 1=early, Group 2=late stage). Significant differences ( $p<.01$ ) indicated by brackets ...	104
Figure 4.8 Reported reasons for conflict – frequency shown as % (all respondents, $N=129$ ) .....	107
Figure 4.9 Rating of conflict (amount and severity) as performance approaches. Ratings on scale, error bars indicated standard error of mean). Group 0=no performance, Group 1=early, Group 2=late stage .....	109
Figure 4.10 Most frequently reported reasons for conflict by groups at different stages of rehearsal. Error bars indicate standard error of mean. (Group 0=no performance, Group 1=early, Group 2=late stage) .....	110
Figure 5.1 Timeline of study showing weeks of data collection .....	123
Figure 5.2 Music-making (all singing together) shown as % of total rehearsal time, and number of episodes .....	127
Figure 5.3 Percentage of total number of utterances by week: types of rehearsal task observed, categorised as basic, strategic, or interpretive/expressive .....	128
Figure 5.4 Frequency of behaviour type by week (% total) .....	130
Figure 5.5 Breakdown of Clarifying behaviour subtypes by week, all members (% of total) .....	131
Figure 5.6 Time allocated to main behaviours, including Music-making (duration, mins) .....	132
Figure 5.7 Total airtime by member (% total time) by week, for Singers A-E .....	133
Figure 5.8 Distribution of verbal behaviours over time for Group 1 .....	135
Figure 5.9 Events by participant (A-E) by week .....	136
Figure 5.10 Pattern diagram output from Theme analysis, Week 1 .....	139
Figure 5.11 Pattern diagram output from Theme analysis, Week 3 .....	141
Figure 5.12 Pattern diagram, Week 5 .....	143

Figure 5.13 Pattern diagram, Week 7 .....	145
Figure 5.14 Amount of patterned behaviour in Weeks 1, 3, 5 and 7 (% total behaviour) .....	148
Figure 5.15 Length of patterns in Weeks 1, 3, 5 and 7 (mean and S.D.).....	148
Figure 5.16 Emerging patterns and progress of the group from formation to performance .....	153
Figure 6.1 Frequency and severity of situational changes (reproduced from Gersick and Hackman,1990, p. 74).....	157
Figure 6.2 Piece 1: ‘homophonic’ structure, with identical rhythmic features, so that all parts moved together throughout. ....	160
Figure 6.3 Piece 2: ‘polyphonic’ structure, whereby parts moved more independently. Entries were staggered so that all individual parts were required to ‘lead’ at least one phrase; Mezzo-Soprano 2 (Singer X) entered first in bar 3, Soprano (Singer V) in bar 5, Mezzo-Soprano 1 (Singer W) in bar 7, Tenor (Singer Y) in bar 9, and Bass (Singer Z) in bar 11 .....	161
Figure 6.4 Total amount of rehearsal talk and singing by Rehearsal 1–5, as percentage of rehearsal time .....	165
Figure 6.5 Distribution of behaviour types for Rehearsals 1–5 (% total frequency of behaviours) .....	166
Figure 6.6 Mean pattern length by rehearsal session. Error bars represent S.D.....	169
Figure 6.7 Pattern diagram from Theme – Rehearsal 1 .....	171
Figure 6.8 Pattern diagram from Theme – Rehearsal 2 .....	172
Figure 6.9 Pattern diagram from Theme – Rehearsal 3 .....	173
Figure 6.10 Pattern diagram from Theme – Rehearsal 4.....	174
Figure 6.11 Pattern diagram from Theme – Rehearsal 5.....	175
Figure 6.12 Amount of singing and talking as percentage of rehearsal time, by rehearsal number (1–5) and by Piece 1 (homophonic, H) or Piece 2 (polyphonic, P) .....	177
Figure 6.13 Perception score (%): how satisfied each group member was in getting ideas across in rehearsal of Piece 1 and Piece 2 .....	177



Figure 6.14 Pattern length, level and number of actor switches, mean and S.D. by homophonic and polyphonic structure.....	178
Figure 6.15 Contribution of verbal utterances for each singer, expressed as percentage of rehearsal time. Error bars represent 95% confidence level.....	180
Figure 6.16 Contribution of singers by rehearsal, from residuals of observed-expected frequency data calculated from chi-squared goodness-of-fit. ....	181
Figure 6.17 Frequency of four main behaviour types (Clarifying, Initiating, Reacting and Participating) over rehearsals 1–5, by Singers V, W, X, Y and Z .....	182
Figure 6.18 Ranking of amount of verbal contributions by singer, for each rehearsal .....	183
Figure 6.19 Distribution of performer precedence across rehearsals, based on number of occurrences each singer preceded all co-performers. Singer V (here referred to as Soprano (S1)), Singer W (Mezzo (S2)), Singer X (Mezzo (S3)), Singer Y(Tenor (S4)), Singer Z (Bass (S5)). (Reproduced from D’Amario, Daffern et al., 2018, p. 10). ....	189
Figure 6.20 Effect of five rehearsals on precision of synchronisation (A) and effect of the interaction between rehearsals and the two pieces on precision of synchronisation (B). Error bars represent 95% confidence interval of the mean, *** $p < .001$ (reproduced from D’Amario, Daffern et al., 2018, p. 8).....	189
Figure 6.21 Consistency of tuning by rehearsals 1-5 (R1-R5), and by singers V (S1), W (S2), X (S3), Y (S4) and Z (S5). Error bars represent 95% confidence interval of the mean (** $p < .01$ , *** $p < .001$ ) (reproduced from D’Amario, Howard et al., 2018, p. 9) .....	191
Figure 7.1 Data structure showing emergent themes.....	204
Figure 7.2 Key milestones over performance preparation period, as reported by group members, showing exploration, transition, (grey shaded area), and integration .....	220
Figure 7.3 Main themes shown as bracketed time periods of exploration, transition and integration .....	225
Figure 8.1 A dynamic process for groups preparing for performance.....	231

Figure 8.2 River profile showing 'knickpoints', impacting the gradient of flow (reproduced from Foster & Harvey, 2012, p.405) .....	236
Figure 8.3 Timeline of group progression from formation to performance .....	238
Figure 8.4 Moving from verbal to nonverbal communication.....	248
Figure 8.5 Number of dyadic interactions appearing in patterned behaviour by rehearsals, Groups 1 and 2 .....	257
Figure 8.6 Explicit and implicit team work and task work in the ensemble.....	261
Figure 11.1 Trajectory drawing – Singer V .....	353
Figure 11.2 Trajectory drawing – Singer W .....	354
Figure 11.3 Trajectory drawing – Singer X.....	354
Figure 11.4 Trajectory drawing – Singer Y .....	355
Figure 11.5 Trajectory drawing – Singer Z .....	355

# Table of Contents

<b>1</b>	<b><i>CHAPTER ONE Introduction</i></b> .....	<b>1</b>
1.1	<b>Areas of investigation</b> .....	<b>3</b>
1.1.1	Changes over time .....	4
1.1.2	Interactions between co-performers .....	4
1.1.3	Explicit and implicit communication .....	5
1.2	<b>Contexts of investigation</b> .....	<b>6</b>
1.3	<b>This research</b> .....	<b>7</b>
1.4	<b>Aims and research questions</b> .....	<b>7</b>
1.5	<b>Approach to investigation</b> .....	<b>8</b>
1.5.1	Comparative survey of ensemble rehearsal practices.....	9
1.5.2	Longitudinal case studies .....	9
1.6	<b>Summary of main contributions</b> .....	<b>10</b>
1.7	<b>Structure of the thesis</b> .....	<b>11</b>
<b>2</b>	<b><i>CHAPTER TWO Literature review</i></b> .....	<b>13</b>
2.1	<b>From rehearsal to performance</b> .....	<b>14</b>
2.1.1	Contexts for ensemble rehearsal.....	15
2.1.2	Rehearsal strategies and methods.....	17
2.1.3	Rehearsal goals and processes.....	18
2.2	<b>Social interactions and roles in rehearsal</b> .....	<b>24</b>
2.2.1	Collective action.....	24
2.2.2	Shared leadership in ensembles.....	25
2.3	<b>Communication and interactions in ensembles</b> .....	<b>26</b>
2.3.1	Verbal and nonverbal communication .....	26
2.3.2	Verbal communication .....	28
2.3.3	Nonverbal communication .....	28
2.3.4	Summary: Communication and interaction in ensembles .....	30
2.4	<b>Development over time in ensemble rehearsal</b> .....	<b>30</b>
2.4.1	Within a rehearsal.....	31
2.4.2	Across a series of rehearsals.....	32
2.4.3	Summary: Time and ensemble interactions .....	34

2.5	<b>Small group interactions and coordination</b> .....	<b>35</b>
2.5.1	Coordination in groups and teams .....	36
2.5.2	Time as an organising factor .....	44
2.5.3	Summary: Small group interactions and coordination .....	50
2.6	<b>Literature gaps and implications for this research</b> .....	<b>51</b>
<b>3</b>	<b><i>CHAPTER THREE Methodology</i></b> .....	<b>55</b>
3.1	<b>Research scope</b> .....	<b>55</b>
3.1.1	Researching ensembles as small groups .....	56
3.1.2	Researching ensemble rehearsal .....	57
3.1.3	A ‘process’ perspective .....	59
3.2	<b>Research design</b> .....	<b>62</b>
3.2.1	Survey .....	63
3.2.2	Longitudinal case studies .....	64
3.2.3	Case study methods .....	65
3.2.4	Group interaction analysis .....	70
3.2.5	Use of Theme in the present study .....	71
3.2.6	Measurement of other musical interactions .....	73
3.2.7	Qualitative research methods .....	73
3.2.8	Interviews .....	74
3.2.9	Ethics .....	76
3.2.10	Approach to interpretation – a process lens .....	77
3.3	<b>Philosophical viewpoint and assumptions</b> .....	<b>77</b>
3.4	<b>Summary</b> .....	<b>78</b>
<b>4</b>	<b><i>CHAPTER FOUR Time and self-organisation of chamber ensembles in rehearsal</i></b> .....	<b>81</b>
4.1	<b>Aims of the current study</b> .....	<b>82</b>
4.2	<b>Methods</b> .....	<b>82</b>
4.2.1	Participants .....	83
4.2.2	Materials .....	84
4.2.3	Procedure .....	86
4.2.4	Analysis .....	87
4.3	<b>Results</b> .....	<b>88</b>
4.3.1	Rehearsal activities, structure and goals .....	89
4.3.2	Rehearsal communication and roles .....	100

4.4	<b>Discussion and conclusions .....</b>	<b>114</b>
<b>5</b>	<b><i>CHAPTER FIVE Verbal interactions in a newly formed vocal quintet .....</i></b>	<b><i>119</i></b>
5.1	<b>Aims and research questions .....</b>	<b>121</b>
5.2	<b>Method .....</b>	<b>121</b>
5.2.1	Participants .....	121
5.2.2	Materials and apparatus .....	122
5.2.3	Data selection .....	122
5.2.4	Data collection.....	123
5.3	<b>Analysis .....</b>	<b>125</b>
5.3.1	Observation data.....	125
5.3.2	Pattern detection .....	125
5.4	<b>Results .....</b>	<b>125</b>
5.4.1	Observation data.....	125
5.4.2	Behaviour data over time .....	134
5.4.3	T-pattern detection .....	136
5.5	<b>Patterned interactions across rehearsals .....</b>	<b>146</b>
5.6	<b>Summary of findings .....</b>	<b>150</b>
5.6.1	Talking and singing .....	150
5.6.2	Rehearsal methods.....	151
5.6.3	Interaction patterns .....	151
5.7	<b>Conclusions.....</b>	<b>153</b>
<b>6</b>	<b><i>CHAPTER SIX Emergence of coordination in a vocal quintet: time, tasks, and contributions .....</i></b>	<b><i>155</i></b>
6.1	<b>Aims .....</b>	<b>157</b>
6.2	<b>Methods .....</b>	<b>159</b>
6.2.1	Participants .....	159
6.2.2	Materials.....	160
6.2.3	Apparatus.....	161
6.2.4	Procedure.....	162
6.2.5	Analysis .....	163
6.3	<b>Results.....</b>	<b>164</b>

6.3.1	Group interactions .....	164
6.3.2	Individual contributions during rehearsals .....	179
6.3.3	Parallel studies on ensemble synchronisation and tuning .....	187
6.4	<b>Summary of findings .....</b>	<b>191</b>
6.5	<b>Conclusions.....</b>	<b>194</b>
<b>7</b>	<b><i>CHAPTER SEVEN Shared experiences of preparing for performance in newly formed groups .....</i></b>	<b><i>197</i></b>
7.1	<b>Aims .....</b>	<b>197</b>
7.2	<b>Method .....</b>	<b>198</b>
7.2.1	Participants .....	198
7.2.2	Procedure.....	199
7.2.3	Data coding and analysis.....	201
7.3	<b>Findings .....</b>	<b>202</b>
7.3.1	Overall group experiences and trajectories .....	202
7.3.2	Main aggregated theme 1 – Exploration .....	204
7.3.3	Main aggregated theme 2 – Transition.....	209
7.3.4	Main aggregated theme 3 – Integration.....	213
7.3.5	Emergent, time-bracketed periods.....	219
7.3.6	Changing communication over time .....	223
7.4	<b>Summary of findings .....</b>	<b>224</b>
7.5	<b>Conclusions.....</b>	<b>226</b>
<b>8</b>	<b><i>CHAPTER EIGHT Discussion.....</i></b>	<b><i>227</i></b>
8.1	<b>Main contribution: towards a dynamic model of performance preparation</b>	<b>228</b>
8.2	<b>Musicians in transition – groups preparing for performance</b>	<b>231</b>
8.2.1	Phases of performance preparation .....	232
8.2.2	Use of metaphor .....	233
8.2.3	Flow and change – the river .....	234
8.3	<b>A dynamic process for groups preparing for performance...</b>	<b>236</b>
8.3.1	Interaction patterns .....	238
8.3.2	Communication .....	243
8.3.3	Rehearsal strategies and methods.....	250

8.4	<b>Transitions and emergence</b> .....	<b>254</b>
8.5	<b>Summary</b> .....	<b>260</b>
<b>9</b>	<b><i>CHAPTER NINE Conclusions</i></b> .....	<b>265</b>
9.1	<b>Summary of contributions</b> .....	<b>267</b>
9.1.1	Contributions to theory.....	267
9.1.2	Contributions to practice .....	268
9.1.3	Contributions to method.....	270
9.2	<b>Limitations and strengths</b> .....	<b>272</b>
9.3	<b>Future research</b> .....	<b>273</b>
9.4	<b>Closing remarks</b> .....	<b>275</b>
<b>10</b>	<b><i>References</i></b> .....	<b>276</b>
<b>11</b>	<b><i>Appendices</i></b> .....	<b>297</b>
11.1	<b>Appendix A</b> <i>Settings for Theme software – effect of varying confidence interval and minimum occurrences</i> .....	<b>297</b>
11.2	<b>Appendix B</b> <i>Survey of chamber ensembles, Chapter 4</i> .....	<b>299</b>
11.3	<b>Appendix C</b> <i>Behaviour and pattern data, Chapter 5</i> .....	<b>313</b>
11.3.1	Behaviour types by singer.....	313
11.3.2	Airtime by singer .....	315
11.3.3	Event types by rehearsal .....	315
11.3.4	Verbal exchanges during patterns: Weeks 1, 3, 5 and 7 .....	316
11.4	<b>Appendix D</b> <i>Pattern and questionnaire data, Chapter 6</i> .....	<b>321</b>
11.4.1	Patterns from rehearsal of two pieces .....	321
11.4.2	Reflective questionnaire responses .....	322
11.5	<b>Appendix E</b> <i>Parallel studies</i> .....	<b>324</b>
11.5.1	Overview of parallel study 1: A longitudinal study investigating synchronisation in a singing quintet.....	324
11.5.2	Overview of parallel study 2: A longitudinal study of intonation in an a cappella singing quintet.....	325
11.5.3	Full text of article: A Longitudinal Study of Intonation in an a cappella Singing Quintet Sara D'Amario, David M. Howard, Helena Daffern, and Nicola Pennill.....	326
11.6	<b>Appendix F</b> <i>Trajectory drawings</i> .....	<b>353</b>

11.7	<b>Appendix G <i>Interview guide and assessment criteria</i></b> .....	<b>356</b>
11.7.1	Semi-structured interviews – guide questions .....	356
11.7.2	MA Music (Solo Voice Ensemble Singing) assessment criteria .....	357
11.8	<b>Appendix H <i>Main themes and quotes from qualitative analysis</i></b>	<b>359</b>



# 1 CHAPTER ONE

## Introduction

*The phenomenon of music is given to us with the sole purpose of establishing an order in things, including, and particularly, the co-ordination between man and time.*

*Igor Stravinsky (Strawinsky, 1973, p. 54)*

Music is a temporal art, and the process of music-making is inherently social. An arc of rehearsal development, where a musical ensemble collaborates towards a future performance event, is established practice in the Western classical tradition. This process may take many forms; it may have a duration as short as a few hours, or may be distributed over months, or even years. Group members may have different personal motivations, experiences, and expectations, may or may not have worked together before, and the size and composition of the group may vary. There may be a conductor or leader present to guide and facilitate, or the group may be self-directed. The musical material may be straightforward, or demanding, or something in between. Ensemble members may or not be paid for all or part of their involvement.

With so many variables, the ensemble and its associated processes of performance and rehearsal have provided rich territory for researchers with a wide range of investigative perspectives. Whilst the literature is burgeoning in this area, there remain many unanswered questions about how the ensemble uses a framework of rehearsals to prepare for performance. The concept of rehearsal can be regarded as somewhat static and even homogenous, whereas in reality it is dynamic, heterogenous, and often part of a larger process. The collaborative journey through rehearsal to performance is complex, and has many layers of creative processes and interpersonal interactions (Bayley, 2011; Bayley & Lizée, 2016; McCaleb, 2014).

It is also culturally situated; the context of Western classical chamber music engenders certain behavioural norms when working in rehearsals. In a narrative account of observations of the Detroit String Quartet in rehearsals, Butterworth (1990) remarked on a number of features and characteristics that, she considered, enabled the group to work together effectively. Amongst these she includes a type of ‘invisible’ management, whereby the organisation of the quartet happened without

apparent explicit attention. She described how, having noticed this, she prompted group members for their perceptions:

... I decided to ask the group specifically how often members worked on their own process. “Constantly” was the answer, and Jim in particular talked about all the time the members spent discussing how the quartet could function better. But in all of my observations, I never saw any such thing happen (p. 211).

Butterworth (1990) later reflected that shared knowledge of the task and outcomes appeared to be happening at a level and in a way which she was unable to observe directly.

Once I asked ... if it was clear to members when they had played better or worse. At the next rehearsal, after playing through the Debussy ... he turned to me and said, “That time was better.” Then he turned to the group and explained what my question had been. The others nodded in assent, affirming a consensus that was so obvious to them it had not been necessary to make it explicit (p. 216).

Even those who work in close collaboration with ensembles can remain outside the performers’ close circle of interaction. Working with a string quartet on an upcoming performance of a new work, composer Brian Ferneyhough reflected on the process in a short film (Archbold, 2012). Whilst unique to the demands of the work, preparation had many of the features common to self-directed ensembles: a series of rehearsal episodes, shared goals, and a mix of social and technical discourse. Describing his experience as insider (but non-player), the composer expressed the view that, “there is something about the quartet which is inherently embroicated in what we understand human relations to be, but at a highly evolved level.” (Brian Ferneyhough, in Archbold, 2012). It is in part, perhaps, this opacity of process that gives music ensembles some of their mystique as a type of organisation, leading to their study by those interested in more general aspects of organisational effectiveness (Sicca, 2000). For the performers themselves, the experience is of course different, and therein lies one of the many challenges of researching musical ensembles – how to surface and examine their internal processes, without disrupting or changing them. First-hand accounts by musicians reflecting on rehearsal processes offer a source of insight; for example, pianist Susan Tomes kept a diary during preparation with her ensemble for the Cheltenham Festival. After some

disagreements and tension arose, Tomes (2004) tried to make sense of the shifting social dynamics of the group:

I often feel I could draw a kind of graph of the dynamics of a group during rehearsal. It's fascinating that people whom I feel socially close to and at ease with are sometimes quite remote from me, or I from them, while playing. And conversely, people with whom I feel quite awkward in conversation can feel like an extension of my own thinking during a piece of music (p. 12).

As well as musical examples, there are many features of the rehearsal process that would be recognised in other settings. For example, in considering parallels between music ensembles and surgical teams, Kneebone (2009) draws attention to some of the similarities: high-speed processing of complex information, the need for manual dexterity, and mastery of individual skills and knowledge, which come together in a shared 'performance'. Other organisation types may use 'rehearsal' as a way of describing how they prepare for a future critical event. Examples include emergency teams preparing for disaster recovery, military personnel in exercises, or businesses making changes to information systems. Rehearsal is the safe intermediate stage between individual practice and an uninterrupted performance. It provides an opportunity to negotiate and resolve difficulties that may disrupt the performance. It requires preparation, so brings together individual contributions – and it requires prior knowledge both of performance 'rules' and of the temporal processes that play out in the moment and over time.

Given the rich potential for avenues of research in this area, scholars have considered rehearsal and related phenomena from a wide variety of perspectives. The main areas and contexts of investigation framing the research in this thesis are introduced in the following section.

## **1.1 Areas of investigation**

Recognising the challenges of studying ensembles, with their idiosyncratic ways of working and implicit knowledge sharing, this research considers three main areas of investigation relating to achieving coordination in performance through ensemble rehearsal. These are as follows: the influence of time on the rehearsal trajectory, the moment-by-moment verbal interactions between ensemble members,

and the explicit and implicit communication processes that facilitate progress towards performance. They are addressed in relation to the overall process of preparing for performance, which for the purposes of this thesis is rooted in a musical ensemble context. However, they also exist in wider organisational and social contexts, and this is recognised and embraced in the approach and methodology adopted.

### *1.1.1 Changes over time*

The rehearsal room provides a window offering researchers the chance to explore working practices and the evolutionary processes at work, and the way they develop from rehearsal to performance. A future performance is often a focus, and a culmination of a sequence of preparation activities of which rehearsals are a key part. A sequence of rehearsals facilitates progress towards performance, as group decisions are negotiated and embedded. This sequence may in itself be part of a longer group lifetime, or be more transient. Frequency and duration of rehearsals may vary, and may change as performance approaches (Blank & Davidson, 2007; Davidson & King, 2004), as may the nature of communication between performers as they become more familiar with the material and with each other. The social processes of moving from the individual 'I' to the vividly present 'we' is characterised by Schütz (1951) as a "mutual tuning-in" (p. 79), in which there is a coming together around the shared musical task. Underpinning this is a temporal framework, within which these relationships unfold, and in which Schütz (1951) describes an "inner" time, relating to musical structures, and an "outer" time, in which minutes, hours, and days may pass (p. 89). This forms a useful distinction and focus that situate this research. Much research in ensemble performance has focused on what might be described as Schütz's 'inner' time – that is, the internal cohesion of the ensemble and the temporal synchronisation of the performers. Fewer scholars have explored rehearsal in relation to 'outer' time – the larger-scale processes and interactions that happen during, between, and across rehearsal sequences.

### *1.1.2 Interactions between co-performers*

Membership of groups is a common human experience. Being with familiar or unfamiliar fellow performers in an ensemble setting is a part of normal working

life for many musicians in the Western classical tradition. Groups may form in order to prepare for a specific performance, often with a short preparation period already mapped out, and so the ability to establish effective working relationships quickly is essential for success. When this works well, musical and social skills contribute to a shared, productive working environment. Paradoxically, however, although musicians recognise the importance of establishing effective working relationships, they may regard it as a ‘chance’ element beyond their power to influence (Murnighan & Conlon, 1991) and, as a result, the processes associated with early group formation may not be a priority. By better understanding the ways that ensembles establish their early interactions and develop sustained ways of working, there is potential to enhance groups’ experiences and subsequent performance outcomes. The importance of early interactions is borne out in research with other types of small groups, in which the initial encounters have been shown to affect subsequent interactions (Gersick & Hackman, 1990; Zijlstra, Waller, & Phillips, 2012).

### *1.1.3 Explicit and implicit communication*

As a type of organisation, the music ensemble has some unique communication challenges. Preparing for performance requires negotiation of individual perspectives in order to reach a common understanding and achieve coordination. This is achieved through verbal and nonverbal communication and interactions (for review, see King & Gritten, 2017). The development of coordination processes is closely linked to social aspects, and related to particular performance and cultural contexts. Moran (2014) highlights a ‘linear’ model of musical communication, predicated on the view of music as a social phenomenon. She also argues for a holistic research view of music performance, which seeks to understand the social, and where performance is viewed as an emergent phenomenon. This perspective, which views the ensemble as an emergent system, has been advanced by a number of scholars (Badino, D’Ausilio, Glowinski, Camurri, & Fadiga, 2014; Bishop, 2018; Borgo, 2005; Glowinski et al., 2013; Tovstiga, Odenthal, & Goerner, 2005). Many also recognise the distributed, emergent nature of creativity and the power of collaboration in groups (e.g. Sawyer, 2006; Sawyer & Dezutter, 2009). In making the case for music as a form of ‘relational’

communication, which provides means to align (social) attitudes as well as (musical) actions, (Cross, 2014) highlights the study of emergent interaction as a key theme for future research.

## 1.2 Contexts of investigation

Musicians and singers working in ensembles generally seek to contribute creatively and effectively to shared goals, often through a series of rehearsals that build towards a performance (Keller, 2008). Ensembles are an extremely common format for music-making for professionals, students, and amateurs, and exist in many forms. However, the route to performance can be hard to predict and is subject to wide variation, as groups seek to balance artistic and social elements. By understanding the ways that rehearsal interactions evolve over time, performers and educators are better able to predict potential barriers and be prepared for their management. However, the development of rehearsal processes over time is not well understood, particularly in newly formed groups. The context of ensemble rehearsal provides a window through which to understand the interactions and coordination of ensembles. The research opportunities identified relate to the specific demands of self-directed rehearsal in newly-formed groups. This includes the ‘arc’ of rehearsal – how groups adapt and progress over time – and the integration of explicit and implicit coordination mechanisms.

As small groups, ensembles seek to balance paradoxical tensions of stability and change. Stability is needed for effective operation, and change provides a way of accommodating experiences acquired through interactions (Grote, Kolbe, & Waller, 2018; Tsoukas & Chia, 2002). Dynamic organisations manage these tensions in various ways, both implicitly and explicitly. In seeking to coordinate activities and achieve alignment, groups find ways to create energy and momentum (through change) but ensure they are stable enough to be effective and coherent. Mechanisms that give rise to coordination generally foster collaboration and integration through social bonding, accountability through assignment of roles, and other constraints. For example, one frequently cited definition of coordination is, “a temporally unfolding and contextualised process of input regulation and interaction articulation to realise a collective performance” (Faraj & Xiao, 2006, p. 1157). On the other hand, groups that work in creative environments such as music need to find ways to break away

from constraining forces and ‘de-integrate’, in order to enable more emergent processes and interactions to happen, such as those involved in idea generation and exploration (Harrison & Rouse, 2014). Therefore, through coordination, interaction, and collaboration, groups can achieve alignment of ideas to gain the stability needed for sustainable and effective function, whilst balancing transition points, emergence, and creativity as forces for constant change and renewal.

### **1.3 This research**

The approach taken in this research is to harness frameworks, tools, and methods from the organisational literature. Specifically, it adopts a process perspective in which changes over time are a primary focus, through the use of longitudinal case studies. Data collection and analysis combines quantitative methods for behaviour pattern analysis with qualitative methods in which perspectives and experiences of participants are foregrounded. Building on paradigms of emergence and process, it also draws on theoretical frameworks for group dynamics and coordination. By exploring the literature relating to team coordination as it relates to the ensemble, and applying a novel combination of methods and frameworks, it offers new insights into the ways in which ensembles coordinate over time.

### **1.4 Aims and research questions**

This thesis aims to investigate the ways that ensembles work together in rehearsal over time. It takes a broad view and adopts a range of perspectives, methods, and theoretical frameworks to examine this process. The key theoretical perspectives on which this research is based are concerned with processes of coordination in small groups, in which the ensemble is viewed as a dynamic, self-managed collective. It also draws on existing research and frameworks from musicological research, in which scholars have identified multiple contributing factors to ensemble coordination, including a model of coordination in expressive ensemble performance (Keller, 2014). By exploring interpersonal ensemble coordination as an emergent, processual phenomenon, this research contributes to both theory and practice, offering a new integrative model of ensemble rehearsal.

Looking at groups over time, this research investigates emergent group processes in which explicit and implicit coordination mechanisms contribute to the

achievement of common goals. These ideas and constructs have previously been applied in a range of workplace settings, although so far not in music. This perspective provides the basis for the design and implementation of this study. In the context of the small musical ensemble, coordination is both a requirement for effective ensemble function, as members work towards shared goals, and the desired outcome in musical performance.

The following central research question was addressed:

How do behavioural interactions in self-organised music ensembles emerge and change over time?

A number of sub-questions were also identified:

- How are rehearsal activities structured in self-organised Western art music ensembles of different types and at different stages of preparation for performance?
- How do interaction patterns form and how do they impact changing group behaviours in a newly formed ensemble?
- How does verbal and nonverbal communication vary by stage of preparation?
- How do interaction patterns relate to other aspects of the rehearsal context, including rehearsal methods, roles, and musical interactions as manifested in timing and intonation?
- In what ways do interaction patterns vary depending on the task at hand? For example, does the musical organisation of performed repertoire have an influence?
- How do members of newly formed ensembles experience the process of preparing for performance?
- How are stages of rehearsal perceived and managed over time?

### **1.5 Approach to investigation**

This research adopted a blended approach to theory development (Oswick, Fleming, & Hanlon, 2011), combining selected research from music and organisation studies. The questions were addressed through a mixed methods strategy of inquiry, with two main studies: firstly, a background survey to establish a broad framework and context; and secondly, longitudinal case studies of rehearsal to investigate the emergence and development of coordination in ensembles. For the case studies, two newly formed small ensembles were studied from first rehearsals to performance. Both were vocal quintets in advanced (tertiary) level education at a UK



University, providing the opportunity for close observation and in-depth investigation of each, and for comparisons between groups.

### *1.5.1 Comparative survey of ensemble rehearsal practices*

A survey study of UK-based musicians and singers was conducted, which explored rehearsal strategies, methods, and organisation in relation to group type, size, and stage of rehearsal. It therefore provided information to support the central questions of how groups progress over time, the nature of ensemble goals, and how groups use rehearsal to achieve their goals. Comprising self-reports, the survey necessarily focused primarily on explicit coordination mechanisms, including the nature of ensemble planning, roles, goals, verbal versus non-verbal communication, and rehearsal tasks. However, there were also findings related to implicit elements of rehearsal, including rehearsal routines, proximity, and familiarity, which were reported as contributors to coordinative behaviours in ensembles.

### *1.5.2 Longitudinal case studies*

Case Study 1 was a field-based study designed to capture the early weeks and months of a newly formed group rehearsing, in a setting as close to ecologically valid as was possible. A new group of singers used video camera equipment to self-record their rehearsals. The resulting recordings were coded for musical and verbal behaviours. To identify patterns of interactions in the behaviours the software program THEME<sup>1</sup> (Magnusson, 2000) was used. This software has been used in published research in a range of contexts, including the detection of ‘hidden’ patterns of interaction in team research (Lei, Waller, Hagen, & Kaplan, 2016; Stachowski, Kaplan, & Waller, 2009; Zijlstra et al., 2012).

Case Study 2 also followed a newly formed group, but in a laboratory setting, where they rehearsed short musical pieces of contrasting structure, which were specially composed for the study. Their rehearsals were video-recorded, and musical and verbal behaviours coded and analysed as with Case Study 1, including verbal interaction patterns. Pre- and post-rehearsal recordings of the group singing both pieces over a period of 16 weeks enabled analysis of synchronisation of vocal timing

---

<sup>1</sup> Patternvision Ltd, Tjarnargotu 40, IS - 101 Reykjavik, Iceland

and tuning; these provided examples of musical outcomes and offered a way to track ensemble development.

For both case studies, follow-up semi-structured interviews were conducted with participants on topics related to individual perceptions of group development.

## 1.6 Summary of main contributions

Research on ensemble performance preparation is active and diverse, and, in small group research, scholars are interested in real-life contexts for theory building in group coordination and interactions. Building on these two existing fields of inquiry, this research used a novel combination of methods, including a survey, longitudinal case studies, and analysis of patterns in behaviours, to provide new perspectives on the processes of interaction experienced by newly formed music ensembles in rehearsal. The population studied comprised members of small, self-directed ensembles preparing for performance of music in the Western classical tradition. Viewing the ensemble as a small team, it takes its departure points from the current understanding of chamber ensemble rehearsal, whilst drawing on the insights of researchers who have explored small group interactions.

This research contributes to knowledge in three main ways. Firstly, it proposes a new model of ensemble processes in which emergent interactions and larger-scale transitional phases are combined, and within which there is a ‘flexible framework’ for rehearsal structure. The metaphor of a river is used to describe these processes and the way they are influenced by their context, and how a continuous ‘flow’ of moment-by-moment interactions is also subject to external or environmental pressures and influences. A three-phase model is proposed, comprising *exploration*, *transition* and *integration* phases, which combines emergent, moment-by-moment interactions with predictable transition points. Secondly, it suggests ways that ‘hidden’ verbal interaction patterns contribute to establishing and progressing ensemble interactions over a series of rehearsals from first encounters onwards. Thirdly, it supports and extends previous work on communication in ensembles, showing that, over time, implicit coordination increases and explicit coordination modes decrease.

This approach recognises the need for balancing predictability and structure with creativity and sharing of ideas in the artistic setting required for performance.

For practitioners, therefore, these findings and framework provide tools for improved understanding of how groups negotiate key milestones (for example, through transitional phases), and how creative collaboration arises from emergent interactions during rehearsals.

## 1.7 Structure of the thesis

The thesis is structured in three main parts. Chapters 1–3 introduce the research, the background literature, and the rationale for the choice of methods and research design. Chapters 4–7 report the results of a series of empirical investigations. To contextualise the study, findings from a survey of rehearsal practices of small chamber ensembles are reported in Chapter 4. In Chapters 5 and 6, longitudinal case studies of two newly formed vocal quintets provide the research setting for exploration of the emergence of patterns of verbal interactions, and their relationship to ensemble processes and communication. Evidence from interviews and observations from both case studies provides the basis for a qualitative analysis in Chapter 7. Finally, Chapters 8 and 9 present the discussion of the key findings, drawing the threads of research together and concluding with the main contributions, implications, limitations, and suggestions for future research.



## 2 CHAPTER TWO

### Literature review

*Rehearsals are the foundation for making music; when rehearsing music, listening skills become vitally important, and in listening well, the musician becomes a more co-operative creature. (Sennett, 2012, p. 14)*

As a type of organisation, the music ensemble has some unique coordination challenges. Not only does performance require the integration of micro-timed coordination tasks, but also its preparation requires processes of negotiation in which individual ideas, experiences, and perspectives need to come together. Development of coordination processes is linked to social interactions, and prepared and embedded in rehearsal. The ways in which these processes have become established are strongly related to particular performance and cultural contexts.

In theatre studies, the process of creating a dramatic performance is commonly referred to as taking a text ‘from page to stage’, in which elements of a theatrical production are ordered and created, and in which a series of rehearsals play a key role in surfacing and transferring knowledge (Rossiter et al., 2008). Western classical music generally involves the realisation of a sounded performance from composed, notated music. Despite obvious parallels, no terminology or single framework exists to describe the equivalent set of processes involved in taking a musical score to performance. One reason for this could lie in the differences in the ultimate goal, which for a music performance is generally to achieve a coordinated rendition through highly implicit (nonverbal) mechanisms. A core purpose of this research is to explore this process – the role of rehearsal in the achievement of a coordinated ensemble performance.

In this chapter, rehearsal is defined, and current understanding of rehearsal in terms of its processes, methods, strategies, and communication reviewed. Key literature from small work group research is also explored in so far as it is concerned with coordination and emergent group processes.

## 2.1 From rehearsal to performance

Formal definitions of rehearsal link it inextricably with performance. For example, the *Collins Dictionary* defines rehearsal as “practice in preparation for a performance” (Anon, 2019b), and the *Oxford Dictionary* as “a practice for later public performance” (Anon, 2019a). In fact, for many music ensembles, rehearsal may be an end in itself, and happen without any clear intention for public performance. Rather, the purpose may be social, or to gain skills, working with colleagues, or purely for the pleasure of playing music with others (Blank & Davidson, 2007).

In a chamber music setting, this may be especially the case, blurring the lines between rehearsal and performance. *Grove Music* (Bashford, 2001) defines chamber music as follows, and cites as one of the most important elements the “social and musical pleasure for musicians of playing together”:

*Chamber music*: Music written for small instrumental ensemble, with one player to a part, and intended for performance either in private, in a domestic environment with or without listeners, or in public in a small concert hall before an audience of limited size. In essence, the term implies intimate, carefully constructed music, written and played for its own sake; and one of the most important elements in chamber music is the social and musical pleasure for musicians of playing together. (Bashford, 2001)

Rehearsal has also been described as a way to eliminate unwanted ‘noise’ from performance. Schechner (2017) describes rehearsal as a way to prepare for a performance that represents “the least rejected of all things tried”;

... in every successful work (however defined) the rehearsal process will have sifted out what does not belong – will have simplified in the sense of keeping “the least rejected of all things tried.” (Schechner, 2017, p. 236)

Across the arts, there is also a commonly held idea of rehearsal being a crucible of creativity, in which a sense of something new arising can illuminate the possibilities that a future performance might bring. Talking to master theatre director Peter Brook about rehearsals of a Shakespeare play, David Selbourne (Selbourne & Shakespeare, 1982) shared Brook’s experience of these elusive ‘creative moments’, reinforcing their unpredictability and reliance on the “running of a current”:

... these moments, when feelings, words, and movements came together and fused into new life, depended on the “running of a current”, an opening in which all present

contribute. I asked him whether he thought that these and other experiences of rehearsal could be described, captured in words, he replied, “Not at all. Of course not.” (Selbourne & Shakespeare, 1982, p. 39)

The use of metaphorical language to describe group processes such as rehearsal is not new; indeed it is commonly used in organisation research (Cornelissen, Oswick, Thøger Christensen, & Phillips, 2008). The idea of the “running of a current” as a metaphor has not to my knowledge been used in organisation studies, although a ‘river’ metaphor has been used in teaching of leadership (Burns, 2000) and in strategic management (Lamberg & Parvinen, 2003).

Given the lack of clear defining boundaries for what constitutes rehearsal, for the purpose of this thesis, music ensemble rehearsal will be defined as *the activities and processes through which musicians collaborate in shared music-making, which may or may not culminate in public performance.*

### *2.1.1 Contexts for ensemble rehearsal*

The evolving group dynamics of ensembles have been studied in a range of settings, including student and professional groups. Previous work has established the contribution of shared task knowledge, expertise, and familiarity as key factors in effective communication and coordination in groups (Blank & Davidson, 2007; Davidson, 1997; Davidson & Good, 2002; Ginsborg & King, 2012; Marchetti & Jensen, 2010; Wilson & Macdonald, 2017). Both verbal and nonverbal communication play a role in facilitating this, as social musical relationships develop (Seddon & Biasutti, 2009, 2009a; Williamon & Davidson, 2000, 2002). In a newly formed group, ensembles construct shared musical and social identities (Seddon & Biasutti, 2009a). Verbal interactions play a key role in establishing and supporting these emergent identities. Advancing a model for ‘interactional forces’, based on research with improvising jazz ensembles, Sawyer (2006) draws parallels between musical turn-taking and dialogic conversation in characterising group creativity. In this model, which comprises the performer, co-performer(s) and conventions of musical genre, there is an emergent quality in these interactions, whereby the combination of action and reaction to what has gone before plays an important part in how rehearsals progress, and the resultant performance.

Rehearsal practices may differ depending on the type of ensemble and its size, although there is limited research in this area. For example, in vocal ensembles, whilst there is a significant literature on rehearsal in choral singing (where there is a conductor present), research on the rehearsal practices of unconducted vocal ensembles is more limited. Available literature has a strongly pedagogical focus; for example, Potter (1998) describes technical dimensions of rehearsal, aimed at inexperienced groups, and Paparo (2013) studied the *a cappella* vocal group Accafellows to investigate their social and technical approaches. Aimed at practitioners, both offer limited systematic insights for scholarly research. Responding to this gap, Havrøy (2015) investigated the special nature of small vocal ensemble practice using a case study approach. In this he advanced the notion that vocal ensembles represent a distinctive practice in which, to succeed, members must balance the skills required of solo performer and ensemble member. Similar findings were reported in a study of professional string quartets by Murnighan and Conlon (1991), in which a delicate balance between individual soloist aspirations and the needs of the ensemble were required, particularly in the two violin parts. There may also be an effect of group size on the effective shared leadership, as in larger groups the time taken to take musical decisions ‘democratically’ can become impractical. From his studies of temporal synchronisation in groups, Rasch (1988) found that groups of up to nine players can be self-leading, whilst ten or more require a conductor. In practice, there are groups larger than this that run effectively without a conductor, and smaller groups may use a conductor where repertoire demands; however, they are relatively unusual cases.

Chamber music ensembles can be regarded as a type of ‘expert’ group, in which there is a high degree of homogenous knowledge (Cooke, Salas, Cannon-Bowers, & Stout, 2000). In amateur or student groups where there is more limited experience, participation still requires technical facility and score-reading ability. In such a case, whilst there may be specialised roles, each member requires a degree of understanding of the demands and execution of other roles. Newly formed groups are commonly encountered; many musicians and singers join temporary groups that are formed for a particular event or purpose. Musicians, particularly at professional level, may already have exposure to many thousands of hours of rehearsal and therefore share a ‘schema’ or outline process that facilitates rapid progress.



However, familiarity between co-performers has been shown to be a factor in ensemble performance, and to influence ways of working in a range of musical settings (Ginsborg & King, 2012; King & Ginsborg, 2011; Ragert, Schroeder, & Keller, 2013). Whilst this phenomenon has been widely observed and studied, the underlying group cognitive processes are not well understood to explain how incremental improvements are achieved in the context of rehearsals by newly formed ensembles.

Viewing rehearsal as an unfolding process, which results in qualitative changes, is an important departure point for this research. Twentieth-century philosopher, sociologist, and musicologist Theodor Adorno argued that music's truth is its 'Becoming' (Adorno's capitalisation), and that art is 'processural' (Adorno, Leppert & Ritzarev, 2006). Sicca (2000) emphasises the time-based, process aspects of chamber ensemble organisation, which he describes as, "a voyage of self-discovery ... leading to a qualitative change in both individual and group" (p. 153).

### *2.1.2 Rehearsal strategies and methods*

The small but growing body of research on strategies for group rehearsal reflects its multi-faceted nature. Research includes investigations of social interactions (Butterworth, 1990; Davidson & Good, 2002; V. M. Young & Colman, 1979), rehearsal talk (Blank & Davidson, 2007; Ginsborg, Chaffin, & Nicholson, 2006; Ginsborg & King, 2012; King, 2016), organisation and roles (Ford & Davidson, 2003; King, 2006; Lim, 2013; Murnighan & Conlon, 1991), rehearsal structure and content (Bayley, 2011; Ginsborg & King, 2012; King, 2004), and nonverbal and verbal communication (King & Ginsborg, 2011; Seddon & Biasutti, 2009; Williamon & Davidson, 2000). These studies show, for example, that the amount of nonverbal versus verbal behaviour may increase as musicians work together towards a performance goal (King, 2016; King & Ginsborg, 2011; Williamon & Davidson, 2002). Rehearsal further provides the opportunity for group members to develop the necessary familiarity with each other, and their own and others' parts, which in turn results in changes in the balance and types of verbal and nonverbal behaviour (Canonne & Aucouturier, 2016; Ginsborg & King, 2012; King, 2016; Ragert, Schroeder, & Keller, 2013).

Research on rehearsal practices has been conducted in a range of ensemble settings, including string quartets (e.g. Bayley, 2011; Butterworth, 1990; Davidson & Good, 2002; Murnighan & Conlon, 1991; Young & Colman, 1979), singer-piano duos (e.g. Ginsborg, Chaffin, & Nicholson, 2006), vocal ensembles (e.g. Lim, 2013) and wind quintets (Ford & Davidson, 2003). In relation to group expertise, there have been studies conducted in professional, student, and amateur groups. There are also a number of survey studies, focusing on single ensemble types (e.g. string quartets (Murnighan & Conlon, 1991), piano duos (Blank & Davidson, 2007), and wind quintets (Ford & Davidson, 2003). However, no large-scale survey studies exist to my knowledge that examines rehearsal practices across group types. Although it is known that rehearsal practices are highly variable between groups (Davidson & King, 2004), their variation, underlying mechanisms for this variation, and the ways rehearsals progress over time are not well understood.

### *2.1.3 Rehearsal goals and processes*

There are relatively few studies of rehearsal that take a process view, although Keller (2014) summarised the process of rehearsal as comprising the establishment of shared goals, the strategic pursuit of those goals, and the creation of individual and shared representations, which provides a useful basis for further investigations.

Goal setting is acknowledged as a prerequisite to success in many domains. Musicians may develop performance goals through a combination of prior experiences, such as score study, listening to recordings, private practice, and collaborative rehearsal, in which individually conceived goals are shared and negotiated and joint goals established. Rehearsal goals vary widely, as reasons for participation may arise from a range of professional, social, or personal motivations (Macritchie, Herff, Procopio, & Keller, 2018). Equally, the process of negotiation that gives rise to the precise nature of these goals in a group may be different in amateur, student, and professional settings (Burt-Perkins & Mills, 2009; Ford & Davidson, 2003; Lamont, 2011). These negotiations may be conducted both verbally and nonverbally (Seddon & Biasutti, 2009; Williamon & Davidson, 2002), and be influenced by social, conventional, and pragmatic considerations (Keller, 2008). Once established, these goals become part of an idealised mental representation of a

musical performance. At an individual level, mental representations reflect the intentions and expectations of a performer; and at a group level, they represent a key part of the shared concept of sound and performance plans. These plans in turn help to guide motor processes and body movements required for coordinated action in performance (Keller & Appel, 2010; Macritchie et al., 2018).

In the establishment of shared goals in ensemble music-making, coordination of actions needs to be both precise and flexible. Trained musicians may employ a range of strategies to achieve coordination when playing together, in which individual concepts of the sound are accommodated, to achieve a balance between expressive freedom and entrainment to a shared pulse. Underpinning this is a complex mix of cultural, social, and psychological factors that come together amongst skilled ensemble members in the development of performance goals, and which in the pursuit of performance excellence are highly specific to the ensemble. However, there are some commonalities, such as those identified in ensemble pianists by Kokotsaki (2007). She categorised these as ‘searching for balance’, ‘externalisation of attention’, ‘regulating’ (responding and reacting), ‘time availability’, and ‘achieving integration’.

Regardless of their type, however, it is recognised that shared performance goals are key to the success of collaborative rehearsals (Keller & Appel, 2010; Williamon & Davidson, 2002). Groups will generally try to reach a consensus for goals when individual differences exist (Davidson & King, 2004). Once established, these goals can help to create shared representations (‘mental models’) of musical performance and guide the motor processes required for coordinated action (Palmer, 2013). However, it has also been shown that even when individual goals are different, for example with different concepts for changes of tempo, experienced musicians can achieve a high degree of synchrony through mutual adaptation (Macritchie et al., 2018). Hence, it is recognised that goals are dynamic and subject to change. However, it is not well understood to what extent goals change over time as performance approaches, and whether rehearsal actions are shaped by these changes.

### 2.1.3.1 Achieving consensus

Part of establishing effective coordination lies in the way that ensembles achieve consensus and resolve differences. Collaboration is key to achievement of ensemble goals, in which individual perspectives are negotiated and refined as they are assimilated in the group (Dolmans, Wolfhagen, Scherpbier, & Van der Vleuten, 2003). Small musical ensembles have been characterised as examples of ‘self-managed teams’, in which a lack of hierarchy places higher demands on achieving consensus (Gilboa & Tal-Shmotkin, 2012). As distinct from a conducted ensemble, a self-directed musical group must find ways to manage its internal processes in order to function effectively. The complex nature of musical tasks mean that negotiation may be both physically enacted (Macritchie et al., 2018) and yet also have a verbal component (Weingart, Todorova, & Cronin, 2010). Examples of such decisions might relate to repertoire choices, leadership, or deciding on an interpretation. In doing so, developing musicians learn to navigate the natural tension that arises between the individual and the collective, sharing goals and values but retaining a sense of individual agency.

Conflict, or at least contradictory views, are a natural consequence of these processes. In fact, conflict and its resolution have been shown to be positively associated with group cohesion and collaboration. Murnighan and Conlon (1991) termed this the ‘conflict paradox’ and found that successful groups were able to use compromise effectively if conflict arose. They found that successful quartets acknowledged the value of the temporary disruption of conflict, having strategies to resolve it through discussion and playing, and recognised that the process of resolution and renewal served to strengthen the group. Time pressures were also dealt with as an expected consequence of the process. In their case study of a newly formed student group, Davidson and Good (2002) showed that the need for effective communication was prioritised over disparities in technical ability and tended to minimise tensions. A difference was found between experts and novices in a study of newly formed cello-piano duos (Goodman, 2000), in which professionals rehearsed more efficiently, and with fewer disagreements, than students.

Shared mental representations support ensemble cohesion in a number of important ways (Keller, 2008), including matching of an actual performance to what was planned and matching of goals between performers. They can also provide a

mental ‘road map’ for reference during live performance, which can be particularly important for moments of ambiguity, error, or spontaneous, intentional deviations, and form part of longer-term, shared ‘vision’ for the group. At an individual level, mental representations can therefore reflect the intentions and expectations of a performer; and at a group level, they represent a key part of the shared concept of sound and performance plans.

#### 2.1.3.2 Rehearsal strategies and methods

Rehearsal strategies have been studied in both solo and group settings. In a series of case studies of performers with different expertise, Chaffin and Imreh (2002) developed a framework for study of expert piano memorisation, including basic, interpretive, performance, and structural dimensions. Whilst based on solo performers, this framework has been adapted for use in research on ensemble rehearsal, including by Ginsborg and King (2012) as the basis of a coding system to compare rehearsal activities of singer-piano duos preparing previously unknown material. King (2004) proposed a framework for the study of rehearsal, which included the dimensions of structure, collaboration, and technique. Structure was further suggested to be considered at three levels – the overall plan, session, and individual piece. Collaboration comprised discourse, and social and musical collaboration. Within technique, aspects of general, piece-specific, and group-specific methods were proposed (see Table 2.1).

Table 2.1 Levels of structure, and areas of consideration identified in the study of collaboration and practice techniques in chamber ensemble rehearsals (reproduced from King, 2004, p.12)

Structure	Collaboration	Technique
<i>General plan</i>	<i>Discourse</i>	<i>General (examples)</i>
Overall schedule of rehearsals (e.g. time, frequency etc.)	Verbal/non-verbal (e.g. balance between talking/playing)	Intonation-building techniques
Goals (e.g. performances, exams, competitions, auditions)	Analysis of ‘task-related’ utterances and ‘socio-emotional’ utterances	Tuning-up/warming-up techniques
Plan of repertoire to be learned/rehearsed		Preparing scores/editions/programs
		Balancing ‘runs’ and ‘work’
<i>Session plan</i>	<i>Social collaboration</i>	<i>Piece-specific (examples)</i>
Structure of rehearsal (including objectives/outcomes)	Observation of socio-emotional & socio-cultural factors	Segmentation/chunking
Length of rehearsal & pace of activity	Analysis of group dynamics (within & across rehearsals)	Slow practice (with/without metronome)
Timing & distribution of activities (e.g. warm-up, work on old/new pieces)	Identification of ‘team roles’ within group	Trial-and-error
		Analysis of score/form (e.g. to isolate key lines)
		Hearing select parts together
		Tuning specific chords & progressions (from bass upwards)
<i>Approach to individual piece</i>	<i>Musical collaboration</i>	<i>Group-specific (examples)</i>
Stages of practice over time (first ‘run’ to ‘polishing’)	Coordination of content and process	Metronome exercises to improve group’s timekeeping
Function of run-throughs and close-up work in each session	Types of negotiation using verbal discourse (for exchanging technical/expressive ideas)	Intonation-building techniques
Agenda according to segmentation: sequential/non-sequential		Techniques to support weaker players (if necessary)
		Techniques to improve blending of sounds/timbres

### 2.1.3.3 Individual strategies

One of the reasons that group rehearsal strategies vary widely is that each group is a sum of the individual experiences, knowledge, and skills of its members. Practice methods have been researched in a wide range of instruments and voices, including studies of pianists (Chaffin & Imreh, 2002; Gruson, 1988; Miklaszewski, 1989, 1995; Williamon & Davidson, 2000; Williamon & Valentine, 2002), a jazz pianist (Noice, Jeffrey, Noice, & Chaffin, 2008), violinists (Hallam, 2001) cellists (Chaffin, Lisboa, Logan, & Begosh, 2010) brass players (Miksza, Prichard, & Sorbo, 2012), wind players (Miksza, 2007) organists (Nielsen, 1999), and singers (Ginsborg, 2002; Ginsborg & Chaffin, 2011).

In her study of individual practice strategies of beginners and experts, Gruson (1988) found variation in rehearsal strategy with levels of expertise, in which beginners tackled smaller fragments than more experienced players. This was attributed to a greater awareness of musical structure by more experienced musicians. Musical and technical aspects aside, there may be some transfer of metacognitive processes from individual to group practice, such as time allocation, prioritisation, and planning. For example, musicians may have a preference to pursue a ‘holistic’ strategy (working through a whole piece) or a ‘serial’ strategy (breaking it down into sections) (Hallam, 1995). Individual practice may use musical landmarks to guide the ‘unfolding’ of the musical performance (Chaffin & Imreh, 2002; Chaffin et al. 2010; Noice et al., 2008; Ginsborg & Chaffin, 2011), and may use a range of strategies, including planning, mental practice, and attention to detail. These individual competencies and behaviours may inform the collective approach in any given group situation, depending on the preferences and past experiences of its members.

#### 2.1.3.4 Group strategies

Strategies for ensemble practice were summarised by Davidson and King (2004) in which they ascribed the stable ‘base’ of practice to permanent knowledge around historical, social, and cultural factors such as scale systems, etiquette, and performance practice. Within this, however, they recognised the role for shared knowledge that arises from moment-by-moment interactions.

There is wide consensus that, in working towards performance, ensembles will engage in a range of actions, including: establishing shared goals (Davidson & King, 2004; Gilboa & Tal-Shmotkin, 2012); combining run-through and intensive work on small sections (Gilboa & Tal-Shmotkin, 2012; Goodman, 2000); trying different interpretations (Davidson, 1997; Goodman, 2000; McCaleb, 2014); and listening and responding to each other by monitoring their own and others’ playing (Keller, 2008). The structure of rehearsal between groups is highly varied, but with some aspects common across a range of groups: a rough plan may exist, with room for extra rehearsals if needed to respond to the unfolding needs of the performance (Goodman, 2000). Drawing on research on small as well as larger group rehearsals, Davidson and King (2004) proposed that ingredients for effective single rehearsals included warm ups, a balanced pace or intensity of work, and the engagement of all.

Rehearsal strategy may also be influenced by the structure of the musical material being worked on. Attendance to musical structural features is more likely to arise in expert musicians, although it can be highly individual, and even idiosyncratic (Williamon & Davidson, 2002; Williamon & Valentine, 2002).

## 2.2 Social interactions and roles in rehearsal

Rehearsal involves the engagement of ensemble members in interdependent musical and social coordination, which may emerge and develop both within and across a series of rehearsals. Key processes in rehearsal are the development of collective, or ‘social’ action, and shared leadership arising from the self-organised nature of small ensembles.

### 2.2.1 *Collective action*

Shared ‘social’ action may be influenced by familiarity, empathy, and shared purpose (Moran, 2013). Rehearsal provides the opportunity for group members to develop the necessary familiarity with each other, and their own and others’ parts (King, 2016; Ragert et al., 2013). Furthermore, it fosters the creation of informal or formal roles within the group which may relate to leadership, or to specific roles such as concert planning or rehearsal organisation (Lim, 2013; Murnighan & Conlon, 1991). They may also be characterised as socio-behavioural ‘team’ roles (Ginsborg & King, 2012; King, 2006). Cross (2014) argues that music can be provide the setting for “communicative interaction” (p. 814). In this he attributes musical communication partly to entrainment effects through reciprocal leading and following, and partly to what he terms “floating intentionality” (p. 814), in which individual and shared meanings coexist during music-making. He differentiates between communication in speech and language as being on the one hand “transactional” and on the other “relational” (p. 815). Whilst Cross makes the case that these relational, socially mediated attitudes and intentions form part of musical communication in unscripted music, Chew (2014) also argues for their existence in formal, scripted music. These theoretical perspectives strengthen the case for research that explores social aspects of musical communication.



### *2.2.2 Shared leadership in ensembles*

Small musical ensembles have been characterised as examples of ‘self-managed teams’, in which a lack of hierarchy requires consensus for goal achievement (Gilboa & Tal-Shmotkin, 2012). In this setting, leadership is a shared activity. Leadership in musical contexts has been the focus of a number of studies, relating to both the social dimension (in terms of decision making, direction, and motivation) and leader-follower relations expressed as timing asynchronies (Timmers, Endo, Bradbury, & Wing, 2014; Wing, Endo, Bradbury, & Vorberg, 2014) or in relation to body movements (e.g. Glowinski, Dardard, Gnecco, Piana, & Camurri, 2015). Many well-established groups purport to be ‘leaderless’, or, as the Guarneri String Quartet describe themselves, ‘an ensemble of leaders’ (Blum, 1987). In such groups the role of leader is not assigned to any one individual, but rather moves around the group as musical needs dictate, or is distributed between members as they respond to each other.

Beyond the musical domain, traditional hierarchical models of leadership in teams have been challenged by a paradigm of distributed, or ‘shared’, leadership, in which leadership is viewed as a set of activities, shared between team members (Pearce & Conger, 2002). Certain preconditions are needed for shared leadership to work in a team; a shared purpose, a socially supportive environment, and for members to feel they have a voice in how the team works towards its goals (Carson, Tesluk, & Marrone, 2007). Whilst providing a mechanism for creating a unified direction, such a leadership approach may also create contradictory demands and require team members to raise issues and confront differences in order to reach consensus (Fletcher & Kaufer, 2003).

This model of shared leadership has been explored in musical groups (Bathurst & Ladkin, 2012), who found that leadership tasks included understanding the technical demands of instruments, creating a setting whereby ensemble members could see and hear each other effectively, establishing tempo, for example by using preparatory breaths, addressing problems as they arise, and establishing a blended sound. Together, these aspects resulted in a collective form of leadership, in which all players contributed. In their study of a professional string quartet Tovstiga et al. (2005) found that players adopted the role of leader on an ‘as needed’ basis, whilst in a professional eight-piece vocal ensemble, Lim (2013) described a ‘horizontal’

model of leadership, in which the group chose not to appoint an artistic director, but rather to share management roles around the group. Lim argued that these organisational choices were also reflected in the way the group performed;

It is apparent that, at various levels, what can be said about their performances can equally apply to how they manage themselves. The non-hierarchical nature of their repertoire reflects both the nature of their interpersonal relationships and their chosen leadership model. (Lim, 2013, p. 320)

### 2.3 Communication and interactions in ensembles

The nature of musical communication has been a focus of study for half a century or more. As the psychological underpinnings are better understood and modelled, and research methods have become more sophisticated, there has been a greater focus on coordination, especially in relation to timing and synchronisation. The complex, dynamic setting of the ensemble lends itself to a number of approaches and theoretical frameworks.

#### *2.3.1 Verbal and nonverbal communication*

It is widely accepted that ensembles use both verbal and nonverbal communication to support collaboration and organisation. In their case study of a string quartet and jazz sextet, Seddon and Biasutti (2009) assigned six modes of communication, categorising verbal and nonverbal communication to instruction, cooperation, and collaboration. Social as well as musical interactions were recognised as part of this. Davidson and Good (2002) identified modes of communication as social conversation, nonverbal social interaction, musical conversations, nonverbal musical conversations, and musical interactions. They also noted that experience is likely to influence the range and nuance of gestures employed and observed greater similarity of gestures over time. Verbal communication was found to vary in frequency and type depending on social familiarity (King, 2016). Blank and Davidson (2007) found that conversation in rehearsals of well-established piano duos was primarily music-related, with some social talk to sustain relationships within the duo.

One goal of performance is to achieve what has been termed a ‘qualitative transformation’ in live performance (Dogantan-Dack, 2012; Sicca, 2000). Building on this concept, King and Gritten (2017) suggest that, to achieve transformative

performance experiences, ensembles require good verbal communication (Davidson, 1997), empathy with co-performers (Waddington, 2013), and attendance to individual contribution and identities, including leadership (Lehmann, Sloboda, & Woody, 2007). King and Gritten (2017) go further, to propose a conceptual model in which they distinguish between more explicit ‘communication’ in rehearsal, which evolves to prepare for ‘interaction’ in performance, with greater emphasis on nonverbal communication and on embodied cognition. In this conceptualisation, ‘communication’ is mainly based on verbal exchanges and more explicit preparation, whilst ‘interaction’ comprises more nonverbal exchanges and a mix of both prepared and more spontaneous ‘in-the-moment’ processes. This model connects to recent research in (non-musical) teams, in which the emergence of implicit modes of coordination has been shown to play a vital role in establishing effective coordination (Rico, Sanchez-Manzanares, Gil, & Gibson, 2008). Furthermore, in doubles tennis, Blickensderfer, Reynolds, Salas, and Cannon-Bowers (2010) found that shared knowledge was a predictor in a regression model of relative positioning on court, which was negotiated nonverbally and interpreted as an outcome of implicit coordination.

The role of implicit communication in ensembles is also supported by others. Davidson and King (2004) highlight the way that long-standing ‘background’ knowledge, derived from previous experience and training, is integrated with situational or team familiarity and moment-to-moment decisions, and Ginsborg (2017) argues that the key to progression is effective communication in rehearsal, creating convincingly conveyed performances, in which musicians use more implicit than explicit communication:

Creativity in performance that is communicated convincingly to listeners depends, arguably, on creativity in rehearsal, which in turn arises from effective communication within the group. (Ginsborg, 2017, p. 182)

Part of the purpose of rehearsal is, then, to provide the time and space for these elements to be negotiated, tried, and established so that they are in place for performance.

### *2.3.2 Verbal communication*

Researching verbal discourse in an established professional string quartet, Bayley (2011) found that 58% of the time was spent discussing, and 42% playing or ‘musicking’ (using instruments to express a specific point). In contrast, Williamon and Davidson (2002) found that, in their study of an expert piano duo, over 90% of the rehearsal time was spent playing. Indeed, they concluded that playing provided the primary medium for exchange of ideas. They also note that nonverbal communication increased during rehearsal, especially at key landmarks:

... an emergent set of coordinated, nonverbal gestures and eye-contact developed, with these actions increasing significantly over the rehearsal process at locations in the music identified by the pianists as “important for coordinating performance and communicating musical ideas” (Williamon & Davidson, 2002, p. 53)

A high proportion of playing to talk may in part be an effect of the expert nature of the groups. Ginsborg and King (2012) used content analysis methods to study rehearsal talk in both professional and student duo partnerships and found that students talked significantly more than professionals in these rehearsals. Murnighan and Conlon (1991) studied professional string quartets as examples of intense work groups and found that successful groups, with a strong sense of shared goals, tended to play more than talk.

### *2.3.3 Nonverbal communication*

Implicit coordination is a touchstone of performance practice. A key goal of performance in the Western classical traditions is that it should be achieved without recourse to verbal communication, and that performers can synchronise and communicate their expressive intentions to each other, and to the audience (Ragert et al., 2013). To achieve this requires effective implicit coordination to be established between performers. However, this in turn generally requires a process of bringing to the surface and negotiating expressive intentions to have taken place through discussion and testing of ideas during rehearsal. It can therefore be argued that a core purpose of rehearsal is to enable these processes of explicit and implicit coordination to emerge and develop. Musicians and singers in rehearsal need to negotiate the artistic and performance challenges of the musical material, which requires them to

reach an agreed interpretation. In doing so they also address team processes, and ways to negotiate emotional demands, multiple identities, histories, and experiences, in order to achieve coordination. The task is often highly complex, and ensemble members may bring to it a range of skills, abilities, and goals. Rehearsal provides the space, time, and opportunity for group members to develop the necessary familiarity with each other, and their own and others' parts, and to develop expressive interpretations. In a string quartet case study, Tovstiga et al. (2005) postulated that these explicit and implicit processes are exchanged in what they term the 'field of interaction' (see Figure 2.1), in which shared mental models, sense-making and communication play a part. They further describe the evolutionary development of the group as its 'learning and development trajectory'. Tovstiga et al. (2005) highlight a number of explicit and implicit processes that come together within this model. Implicit processes include listening, responding, personality/traits, experiential knowledge and shared mental models; explicit processes include dialogue, social interactions, musical communication, and ground rules.

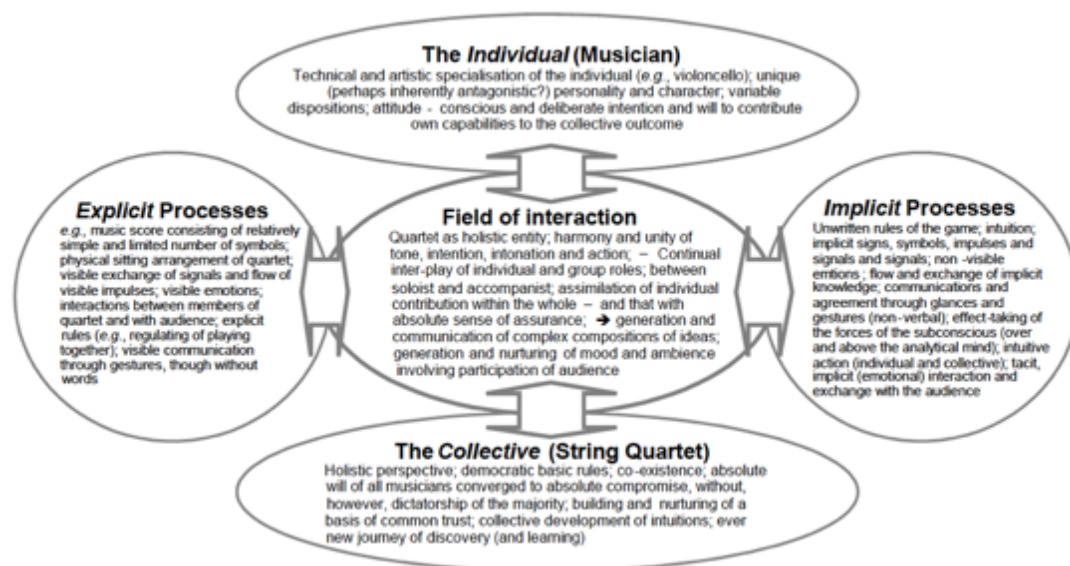


Figure 2.1 The 'field of interaction': Examples of explicit and implicit, and individual and collective processes in a string quartet (reproduced from Tovstiga et al., 2005, p. 224)

In musicians, a number of functions have been ascribed to gestures, including those needed for ensuring sound production, facilitating musical expression, and supporting interpersonal communication (Godøy & Leman, 2010). For example, Ekman and Friesen (1969) identified eye contact between ensemble members as a

type of *regulator* used to mark key moments, such as entrances of different parts, which they define as:

acts which maintain and regulate the back-and-forth nature of speaking and listening between two or more interactants (...) The regulators (...) are related to the conversational flow, the pacing of the exchange (p. 82).

Regulators can be particularly key in performance where verbal communication is not possible, and therefore increased incidence of regulator behaviours might be expected in later stages of rehearsal (Davidson & Salgado Correia, 2001; Seddon & Biasutti, 2009).

#### *2.3.4 Summary: Communication and interaction in ensembles*

A number of strands of research provide insights to the study of communication in ensembles. Both verbal and nonverbal communication modes of communication have been extensively explored in ensembles. What is less well understood is how they relate to implicit and explicit forms of coordination and knowledge, and how they may develop and change over time. These aspects will be considered in the following section.

### **2.4 Development over time in ensemble rehearsal**

The behaviour of ensembles preparing for performance can be viewed as a set of musical and social processes, organised over time. Whilst some scholars have adopted an emergent perspective in the study of ensembles (Badino et al., 2014; Glowinski et al., 2013), to date there is no unified view of how rehearsal processes relate to each other over time. Practical considerations such as a pre-arranged performance date, time available, the need to synchronise schedules to arrange rehearsals, and personal practice all represent time constraints within which many ensembles operate, and which may shape behaviours and outcomes. During a series of rehearsals, as ensembles progress towards a performance, time becomes an increasingly scarce resource, which may also affect rehearsal behaviours, including the mix of verbal and nonverbal communication in rehearsals (Davidson, 1997; Kokotsaki, 2007; Williamon & Davidson, 2002). Kokotsaki (2007) found that time availability was a point of difference between short-term and long-term ensembles, whereby established groups used prior experience to balance personal preparation

and ensemble rehearsal time, taking into account the particular demands of a forthcoming performance. She found that, where sufficient time was available, performer knowledge could be applied more effectively to create ‘depth’, whereas when time was short the production was more reliant on performer skills. Achieving integration was described as the state where musicians performed “as a unified whole” leading to the emergence of “a group kind of self” (p. 658). This was described as a type of ‘flow’ experience (Csikszentmihalyi, 1997). In the course of reaching a consensus for an interpretation, members of an ensemble may alternate between divergent and convergent thinking to reach a negotiated view (Héroux, 2016).

Variation in interactions may be evident in both shorter and longer time-frames, as found within a rehearsal, or across a series of rehearsals.

#### *2.4.1 Within a rehearsal*

Many of the decisions and interactions that occur in rehearsal happen continuously and incrementally. In the context of Western classical chamber music, Davidson (1997) observed that moment-by-moment coordination and feedback contributed to the shaping of the “processes and behaviours” of ensemble performance (p. 209); and in a case study of a group of students in rehearsal and performance, Davidson and Good (2002) identified moment-by-moment coordination of both ‘content’ (relating to the musical outcomes) and ‘process’ (relating to the actions required to achieve them). The authors suggest that, to develop a deeper theoretical understanding, it is helpful to view performance as being “mutually constituted between score and the players’ culturally-situated knowledge and abilities” (Davidson & Good, 2002, p. 200). In Gamelan ensembles, Brinner (1995) proposed a model in which interaction is achieved through both prediction of, and reaction to, musical or interpersonal cues, and in which leadership is shared. This resonates with McCaleb’s model of interaction and ‘inter-reaction’ in ensembles (McCaleb, 2014). It has also been proposed that a contribution of nonverbal interactive behaviour such as cue-giving is to maintain relationships and develop social rapport (Moran, 2014).

From observation of a single (two-hour) rehearsal of a string quartet, Bayley (2011) proposed a rehearsal model of the path from notation to performance, in

which she observed both use of rich descriptive language in sharing ideas, and detailed work on technical aspects. Over the time-frame of the rehearsal, she observed a clustering of topics of discussion. Most talk about notation happened in the first hour, after which there was more focus on interpretation. The most intense period of discussion and activity was in the ‘middle 100 minutes’ of the rehearsal, with more socially focused chat at the start and end. Ideas were generated throughout the rehearsal, but were not evenly distributed, with most being generated during the intense middle period. She also observed that, throughout, humour played an important role in maintaining social bonds but also in defusing tension during more intense interactions, and the issue viewed as most important changed continuously, in response to moment-by-moment events. In the light of this, Bayley (2011) called for future research to consider how characteristics of verbal and nonverbal interaction vary in different contexts.

In a study of social and task-related interactions of duo partnerships, King (2016) analysed the transactional style of exchanges developed by Sameroff (2009) to evaluate the quality and ‘family feel’ of relationships. Early in the rehearsal there were short bursts of activity and lots of verbal exchanges, referred to as the ‘hesitancy’ transactional frame, which occupied up to 65% of the rehearsal time. This was followed by a ‘flowing’ frame with longer exchanges and more sustained focus on a musical passage or piece. Newly formed groups changed from ‘hesitancy’ to ‘flowing’ from a point around the middle of the rehearsal, suggesting a change in relationship quality. New duos also talked more than established duos at the start of rehearsal (Ginsborg & King, 2012), highlighting the role of establishing social familiarity in rehearsal.

#### *2.4.2 Across a series of rehearsals*

Case studies of string quartets have provided rich descriptions of roles, strategies, success factors, and decision processes adopted by professional ensembles in preparing for performance (Butterworth, 1990; Poulson & Abraham, 1996; Tovstiga et al., 2005). However, these cases do not include explicit description of how they vary by stage. Williamon and Davidson (2002) investigated four rehearsals and a performance of two pianists preparing duo and duet repertoire. In later-stage rehearsals (i.e. just before performance) they found an increase in synchronisation of



gestures (body sway, eye contact), particularly at key landmarks. In seeking an explanatory theory, the authors suggested that their findings relating to the mutual identification of key points of musical structure were explained, at least in part, by the acquisition of knowledge structures, including the long-term working memory theory of Ericsson and Kintsch (1995). However, whilst this theory has been used to explain ways that experts can hold and process large amounts of technical information, it relates to individual, rather than group, processes.

In a survey of piano duos, Blank and Davidson (2007) found that the frequency and duration of rehearsals increased as performance approached. Furthermore, in a study of a series of 13 rehearsals of a duo partnership, differences were found in the types of tasks employed (Ginsborg et al., 2006). During a four-week period, the discussion focus progressed from basic and structural elements to more interpretive and expressive aspects, suggested by the authors to indicate increased creativity as the rehearsals progressed. These categories of verbal utterances were based on those defined by previous studies of Chaffin and collaborators (e.g. Chaffin & Imreh, 2002). The focus on rehearsal tasks also changed, with performers using musical sections and subsections as markers to focus on key passages and to vary from work on short sections to part or whole run-throughs in later rehearsals. A rehearsal diary study of one established and two newly formed student ensembles over two terms of conservatoire study revealed a wide range of strategies, goals, and amount of time allocated to rehearsal (reported in Ginsborg, 2017). The success of the ensembles when measured by assessed performance could be partly attributed to the effectiveness of their rehearsal strategies – the more successful groups recorded more ensemble rather than individual practice, and clearer, more actionable goals.

In their detailed analysis of collaboration on a new piece, Clarke, Doffman, and Timmers (2016) combined an exploration of musical timing, verbal interaction, and the evolving relationship between a composer and performer. They describe a shift in understanding from performers coming together to ‘realise’ a relatively pre-determined performance, to a paradigm of collaboration as a primary creative process. In this they build on Sawyer (2006), who, in his work on creative collaboration, argues that group creativity is an emergent, moment-by-moment process, but in which each moment is a product of existing knowledge and

experience. Analysing time allocations over a series of three workshops over two days, the proportion of rehearsal time spent playing changed over time, starting at 31% in the first workshop, reducing to 24% in the second, and was at its highest in the final session (47%).

### *2.4.3 Summary: Time and ensemble interactions*

Taken together, these studies indicate that time-based interactions in rehearsal can reveal insights into rehearsal processes. Researchers have highlighted the need for longitudinal studies to investigate these further. In his study of improvising jazz ensembles, Seddon (2005) described the communicative processes required to achieve unanimity of approach, calling for longitudinal research to explore the progressive acquisition of ‘attunement’ over time, and King (2016) called for further work in the form of longitudinal studies to explore what she termed the ‘growth’ of chamber ensembles across rehearsals. In the embodied view of ensemble advanced by McCaleb (2014), he argues that the term ‘communication’ is problematic, and that ‘interaction’ is more meaningfully regarded as (‘reaction’ and) ‘inter-reaction’, in which a cycle of transmission, inference, and attunement drives the socio-musical actions of the group. This model is particularly relevant to the study of rehearsal, in which exchanges are multidirectional, complex, and multi-modal, and where musicians place a high level of emphasis on sharing ideas through playing. It describes a number of ‘modes of representation’: linguistic, vocalised, performed, and integrated. However, McCaleb’s primary focus is on performance (rather than rehearsal) and he does not explore the way these processes of inter-reaction develop over time.

Furthermore, whilst it is recognised that developments over time in rehearsal may be impacted by small group development processes (Creech & Hallam, 2017; King, 2016), the adoption of conceptual models relating to groups for music education and research tends to be limited to Tuckman’s model of ‘form, storm, norm, and perform’ phases (Tuckman, 1965; Tuckman & Jensen, 1977). This and other frameworks of group development are considered further in the next section. Given the range of perspectives and active research in this area, there are further opportunities to explore the underlying mechanisms driving rehearsal behaviours in relation to the interpersonal or team-level processes involved.

## 2.5 Small group interactions and coordination

Rehearsal in chamber ensembles has parallels with other highly dynamic and complex workplace settings, in which shared goals and collaborative processes contribute to the alignment of actions and knowledge of interdependent members (Arrow, McGrath, & Berdahl, 2000; Glowinski, Bracco, Chiorri, & Grandjean, 2016). It is also recognised that the interactive processes involved extend beyond music and are shaped by context and social processes (Wöllner & Keller, 2017) and have generalisable features; indeed, interaction in music ensembles has been proposed as an ecologically valid setting in which to model social cognition (D'Ausilio, Novembre, Fadiga, & Keller, 2015).

The active and growing literature on coordination in teams therefore provides an important and hitherto underutilised resource for researchers seeking to understand the complex coordinative challenges of ensemble performance. By drawing out the parallels of context, purpose, and function, research on group interactions and coordination in a range of settings can both inform current research and provide a departure point for future studies in music ensembles. This view has been put forward by a number of scholars (Glowinski et al., 2016; Sawyer, 2006; Sicca, 2000; Tovstiga et al., 2005; Volpe, D'Ausilio, Badino, Camurri, & Fadiga, 2016) who identified further opportunities to examine these connections. They argue that such research not only advances the research agenda for organisational behaviour by providing rich case study material with the potential to support or refine existing theory, but also informs the musical context. However, music ensembles have highly idiosyncratic, unique characteristics that set them apart. For example, Young and Colman (1979) describe the mode of interaction of ensembles as having “a degree of intimacy and subtlety possibly not equalled by any other kind of group” (p. 12). In building the case for interdisciplinary research, therefore, careful selection of theories and models appropriate to the setting is an important consideration.

As has been mentioned previously, music ensembles may be viewed as a type of ‘expert’ team, in which members have specific technical contributions and defined roles (Fiore & Salas, 2006; Muethel & Hoegl, 2013). They may be similar to newly formed or ‘swift-starting’ teams, which come together for a specific purpose and have to get up and running quickly (Lei et al., 2016; Zijlstra et al., 2012); or

which exist in creative settings with loose agendas and some built-in ambiguity about processes or outcomes (Hargadon & Bechky, 2006; Harrison & Rouse, 2014). There are also parallels with research on coordination in sports teams, with their focus on ‘performance’ outcomes and teamwork (Bourbousson, Seve, & McGarry, 2010a, 2010b; Camerino, Chaverri, Anguera, & Jonsson, 2012; Chelladurai, 1990) and in dance, which shares with music the element of shared artistic endeavour (Harrison & Rouse, 2014; Himberg, Laroche, Bige, Buchkowski, & Bachrach, 2018; Merritt, 2015). What these contexts also have in common, however, is the need to function in a fast-moving, dynamic environment and to manage the tension between stability and change. Rather than static organisations, ensembles can be viewed as emergent, dynamic entities, which can adapt and evolve. Viewing an ensemble as a distributed, dynamic ‘ecosystem’ Clarke, Doffman, & Lim (2013) shine a light on the micro-dynamics of otherwise hidden creative processes, such as how musicians resolve tensions around fixed and improvised elements.

### *2.5.1 Coordination in groups and teams*

Research on team coordination provides a rich source of theories, concepts, and methods to further our understanding of specific workplace contexts. Many recent studies of coordination build on concepts of emergence and temporality. There is an expanding lexicon of definitions of ‘coordination’. Okhuysen and Bechky (2009) gave a range of definitions from 1945 to 2006 but, for this research, the definition of coordination used by Faraj and Xiao (2006) seems appropriate, and their work with fast-moving organisations, where there is a need for verbal interaction and timely action, offers parallels with music ensembles;

... a temporally unfolding and contextualised process of input regulation and interaction articulation to realize a collective performance (Faraj & Xiao, 2006, p. 1157).

Okhuysen and Bechky (2009) reviewed several decades of research on coordination and proposed a framework for coordinating mechanisms and integrating conditions. Their coordinating mechanisms included plans and rules, objectives and responsibilities, roles, routines and proximity, and their integrating conditions were proposed as accountability, predictability, and common understanding. In a recent attempt to incorporate explicit and implicit coordination, Chang, Lin, Chen, and Ho

(2017) developed a framework (p. 919) in which they propose five dimensions – *explicit accountability*, *implicit accountability*, *explicit predictability*, *implicit predictability*, and *common understanding*.

In the musical setting, implicit coordination mechanisms may be especially important in synchronising activities. *Implicit accountability* occurs when team members voluntarily assume roles or tasks in committing themselves to joint action; in *implicit predictability*, members anticipate and adjust to others, and *implicit common understanding* constitutes professional knowledge that relates to the shared task (Rico et al., 2008). Together, these elements address a key integrative purpose of team coordination and help to enable a team to get started quickly in the absence of prior shared experience (Chang et al., 2017; Rico et al., 2008). The Chang et al. (2017) dimensions provide a useful frame for identifying work areas in groups seeking to coordinate. However, they do not address the temporal aspect of coordination.

Other scholars have sought to incorporate time as a factor in coordination. Also building on the Okhuysen and Bechky (2009) framework, an alternative view was offered by Jarzabkowski, Le, and Feldman (2012). Taking a practice-led perspective, they propose that coordinating<sup>2</sup> mechanisms are viewed as a set of dynamic processes, enacted in a given setting. In this they also draw parallels with organisational routines, which have both an ostensive (intended) and performative (enacted) dimension and which are socially constituted (M. S. Feldman & Pentland, 2003). Based on a detailed case study of a large organisation undergoing major restructuring, they identified five ways in which teams interact to create coordinating mechanisms: (1) enacting disruption of coordinating, (2) orienting to absences in coordinating, (3) creating elements of coordinating, (4) forming patterns of coordinating, and (5) stabilising patterns of coordinating. Working with teams in a large industrial services organisation, Jarzabkowski et al. (2012) found that ‘enacting disruption’ was part of a series of ‘ostensive-performative’ cycles (Feldman & Pentland, 2003) in which the intended and actual sequences of events unfolded. They

---

<sup>2</sup> Jarzabkowski et al. (2012) distinguish dynamic ‘coordinating’ from the more static ‘coordination’.

argued that it is in this way that the coordinating mechanisms form, and suggest that disruption of processes is an essential part of establishing and stabilising effective patterns of coordination. They also highlighted ways in which absences (gaps or missing processes) in coordinating can be a catalyst for dynamic change:

Orienting to absences is a critical building block in a process theory of coordinating because these areas of absence become the focus of activity to create or recreate elements of a coordinating mechanism in order to undertake interdependent organizational tasks (Jarzabkowski et al., 2012, p. 918).

Collective processes of cognition and creativity are inherently social in nature, arising from pooled resources, from which group products and outcomes emerge (Hargadon & Bechky, 2006). In creative organisations, therefore, emergent approaches provide useful frameworks for understanding the fluid, often ambiguous, processes involved. For example, in their study of rehearsal of contemporary dancers, Harrison and Rouse (2014) explored coordination through study of interaction patterns between dancers in a small ensemble, which revealed a paradoxical, dynamic tension between the constraints and freedoms inherent in the creative process. This model of ‘elastic coordination’ is an example of an emergent process that relates closely to the context of musical ensemble practice. Harrison and Rouse (2014) found cycles of both divergent and convergent behaviours, as dancers worked through a series of rehearsals in which the group moved through periods of ‘integration’, as ideas came together, and of ‘de-integration’ as they moved apart. These tensions in the creative process provided a source of energy and impetus to the process and were regarded as integral to the dynamics of the group. This process also supports observations by Marks, Mathieu, and Zaccaro (2001) of recurring phases in group interactions, where the outputs of one episode feed into the next.

#### 2.5.1.1 Coordination and interactions in newly formed groups

Coordination has been studied in temporary organisations that come together for a specific project or purpose. Newly formed groups may face particular challenges, especially in high-pressure environments. An example is that of so-called ‘swift-starting’ teams, which have to mobilise quickly with team members who may not have worked together before (Zijlstra et al., 2012). Such groups may be particularly interdependent and time-constrained, so the establishment of effective

relationships and communications is key (Peters & Pressey, 2016). Temporary groups can form for many different reasons, in many different ways. A useful framework for understanding group formation is that advanced by Arrow et al. (2000), in which they describe groups in terms of being either internally or externally initiated, and whether membership is ‘emergent’ (spontaneously or pragmatically instigated for a given purpose) or pre-planned. As an example, they describe how a student *a cappella* singing group formed as a ‘self-organised’ group (internally instigated by a singer wanting to form a group) and emergent (members selected themselves).

In a new or inexperienced team, members lack the advantage of experience and shared ways of thinking and operating. In swift-starting teams, a temporary team of specialists comes together for a specific purpose to perform complex, coordinated work: examples include teams of journalists, healthcare professionals, and flight crews. In such cases, it is not well understood to what extent the ‘classic’ linear group formation models apply (e.g. Tuckman, 1965; Tuckman and Jensen, 1977). It has been argued that other mechanisms come into play, and that patterns of interaction established in early encounters are likely to persist and to shape consequent behaviour (Gersick & Hackman, 1990). One mechanism advanced for this is that these early, implicit patterns play a key role in facilitating progress whilst social relationships develop (Zijlstra et al., 2012). Changes in team task situations have been shown to influence patterned team interactions. In their study with 12 flight crews, Lei et al. (2016) found that complexity of interaction patterns was related to the complexity of the task, whereby in more ‘routine’ tasks, teams with more complex patterns were more effective, whilst in ‘non-routine’ tasks teams with simpler patterns performed better. In their study of action patterns in small teams in a firefighting simulation task, Uitdewilligen, Rico, and Waller (2018) found that the relationship between patterned behaviours and team effectiveness was affected by task, and that the amount and complexity of patterned behaviour increased over a series of scenarios over three days. The authors related their findings to the team compilation model of Kozlowski, Gully, Nason, and Smith (1999) and the role of shared knowledge in implicit coordination (Rico et al., 2008).

There is a gap in research to further understand how early interactions support interactions and coordination in small groups, specifically the early

appearance and persistence of patterns (Gersick & Hackman, 1990) and their role in early progress (Zijlstra et al., 2012). There is an opportunity to carry out this type of investigation within a more ecological setting of a creative work team, over a longer period. Together, and alongside the existing research on ensemble coordination, these theoretical frameworks provide a departure point for this research. They provide the basis for exploring explicit and implicit coordination mechanisms in music ensembles, and the consideration of how they emerge and develop over time.

#### 2.5.1.2 Emergence of group coordination and interactions over time

The input-process-output model is a well-established model of team performance (Kozlowski & Ilgen, 2006). It provides a departure point from which a growing body of research is based on a conceptualisation of key processes as ‘emergent’ phenomena (Arrow et al., 2000; Corning, 2002; David, Petia, Robert, Geoff, & Safwat, 2015; Fulmer & Ostroff, 2016; Goldstein, 1999; Kozlowski & Chao, 2012; Kozlowski & Klein, 2000). A number of recent studies of coordination build on concepts of emergence and temporality. An emergent phenomenon in teams is one that “originates in the cognition, affect, behaviours or other characteristics of individuals, and is amplified by their interactions” (Kozlowski & Klein, 2000, p. 55). This property of emergence can be explained by characterising groups as complex adaptive systems along with nonlinearity, self-organisation and adaptation.

#### *Groups as complex adaptive systems*

In their landmark volume, Arrow et al., (2000) set out ways in which teams and groups behave as complex adaptive systems (CAS). They argued that it is the interaction and dynamic nature of teams which is fundamental to their evolution, and that disregarding this dimension severely limits team research. Since then, many more studies have adopted approaches which consider teams as CAS. For a comprehensive review of work since 2000, see Ramos-Villagrasa, Marques-Quinteiro, Navarro, and Rico (2018). In this perspective, members of teams are viewed as ‘agents ‘which conform to nonlinear system dynamic theory (Eidelson, 1997), and, as with many other natural phenomena, exhibit chaotic behaviour which through their interactions become an organised whole, through processes of adaptation (J. Campbell, Flynn, & Hay, 2011; Lewin, 1993). Examples of CAS cited in the natural world include murmurations of starlings, ant colonies, or even climate.



A core feature is the interplay between the micro and macro patterns of these systems. Through this interplay, agents are able to respond to each other and adapt, and ultimately self-organise. The resulting feedback between integration required to sustain the macro-level system and the differentiation represented by its constituent parts is what drives the complexity in the system (Ramos-Villagrasa et al., 2018). Adopting a temporal perspective on team performance allows monitoring from first moments, and changes in trajectories indicative of group interactions.

The music literature also offers examples where groups are explicitly viewed as complex systems. Tovstiga et al (2005) explored complexity and sense making in a professional string quartet and proposed that their ‘field of interaction’ model (see Figure 2.1) reflected the complex system in which the quartet operated. They acknowledged that was a first step, and that more work was needed to explore issues of complexity in ensembles. Jazz musician and researcher David Borgo describes jazz performance as a system with “neither too much, nor too little order” (Borgo, 2006, p.4.). He argued for a systems-based understanding of improvised music performance, taking into account its real-time nature, reliance on audience reception for full realisation, the social or cultural context, and its inseparability from other networks. His studies with jazz musicians were largely ethnographical and focussed on the flow of ideas in an improvising group. Müller, Delius, and Lindenberger (2018) investigated a large choir as an interconnected system, from which complex networks emerged. Respiratory, cardiac, vocalisations, and motor measures were recorded and analysed for coupling and synchronisation. The researchers found that temporal coordination operated at multiple levels - that of the whole choir and those between individual members. As they described it, “the network dynamics of each individual singer are likely to be influenced by a complex coordination or the function of the choir as a whole.” (p. 16).

#### *Leadership as an emergent process*

Leadership may also be regarded as complex phenomenon. Within the paradigm of emergence, the concept of leadership in teams has undergone a major shift in understanding. From being regarded as singular role, it is generally understood as a set of formal and informal processes of influence (Wang, Waldman, & Zhang, 2014; White, Currie, & Lockett, 2016). Indeed, shared, distributed or ‘system’ leadership may be regarded as a natural consequence of emergence, and

that leadership emergence from leaderless groups has been well-documented over a number of decades (e.g. Bass, 1949). More recently, Guastello (1998, 2007) proposed a theory for leadership emergence based on nonlinear dynamics, in which a ‘catastrophe’ model for discontinuous events provides a trigger for leadership. Evolving complex patterns of conversational interaction, such as asking for information or offering ideas, resulted in asymmetries of contribution, which in turn gave rise to self-organised roles, including leadership. In coordination-intensive groups (of the type represented by musical ensembles) asymmetry arose through levels of contribution in conversation, whilst the extent of the change was governed by a shift from verbal to nonverbal behaviour. Underlying this model were conflicting forces of stability and instability (Guastello & Bond, 2007).

In this conceptualisation, shared forms of leadership are an emergent team property of mutual influence and social capital (Carson et al., 2007; Day, Gronn, & Salas, 2004). Informal leadership has been shown to emerge (and disappear) amongst individual team members over time (Emery, Calvard, & Pierce, 2013) and through a range of social and functional behaviours (Fransen et al., 2015). For example, a longitudinal study of social networks in virtual software development teams found that interaction patterns evolved from a central hub model to a more decentralised structure (Long & Siau, 2007). The decision making and communication was found to become more distributed over a group of key members rather than concentrated in the central hub, as a shared understanding of (and demand for) key skills became better understood by the network. Examples of shared leadership in music ensemble contexts are reviewed in 2.2.2.

### *Studying emergent phenomena in groups*

Investigation of emergent aspects of small group performance has also given rise to studies that apply dynamic or longitudinal approaches, in which researchers make observations and measurements over time, or explore team performance under different conditions. Adaptation is a core, dynamic element of CAS, and has been extensively studied. Building on the multiphase model of Marks et al. (2000), Barth, Schraagen, and Schmettow (2015) explored adaptation in surgical teams as a nonlinear process. They found that for noncomplex tasks communication became more centralized, whilst for complex tasks, communication was more decentralized. They also observed reduced frequency of communication in more complex tasks

(similar to that found by Rico et al. (2008) as evidence of implicit coordination) and that reciprocity was higher during phase transitions than during team action phases. A study of 23 professional basketball teams over a twelve year period showed that effective teams shared characteristics relating to a certain degree of chaotic dynamics, a healthy variability in organisational behaviour, and stability of the squad. These dimensions enabled fluctuations in performance to be explained through a CAS perspective, in which new characteristics were developed by interactions at a lower level to give rise to the emergence of new properties (Ramos-Villagrasa, Navarro, & García-Izquierdo, 2012)

Research into time as a factor in group organisation has led to the development of frameworks within which to understand team performance (Ancona, Okhuysen, & Perlow, 2001; Gersick, 1988, 1989; Lei et al., 2016; Li & Roe, 2012; Marks et al., 2001; Mathieu, Tannenbaum, Donsbach, & Alliger, 2014). There are some key assumptions associated with this view of emergence in the evolution of group working: that changes arise from the transformation of individual skills and knowledge into collective team-level manifestations; that they are shaped by the team context; and that they are variable in process and form (Kozlowski & Bell, 2008). In the absence of experience, and in creative settings, processes of emergence and integration can support group working (Chang et al., 2017; Harrison & Rouse, 2014; Rico et al., 2008). The team compilation model of Kozlowski et al. (1999) recognises that a combination of episodic cycles, temporal development, and transitions all contribute to the emergent team. As part of this process towards ‘team compilation’, they propose that individuals move through task compilation and role formation, which involves transition via dyads to multiple-member exchanges, towards a fully compiled team network (see Figure 2.2).

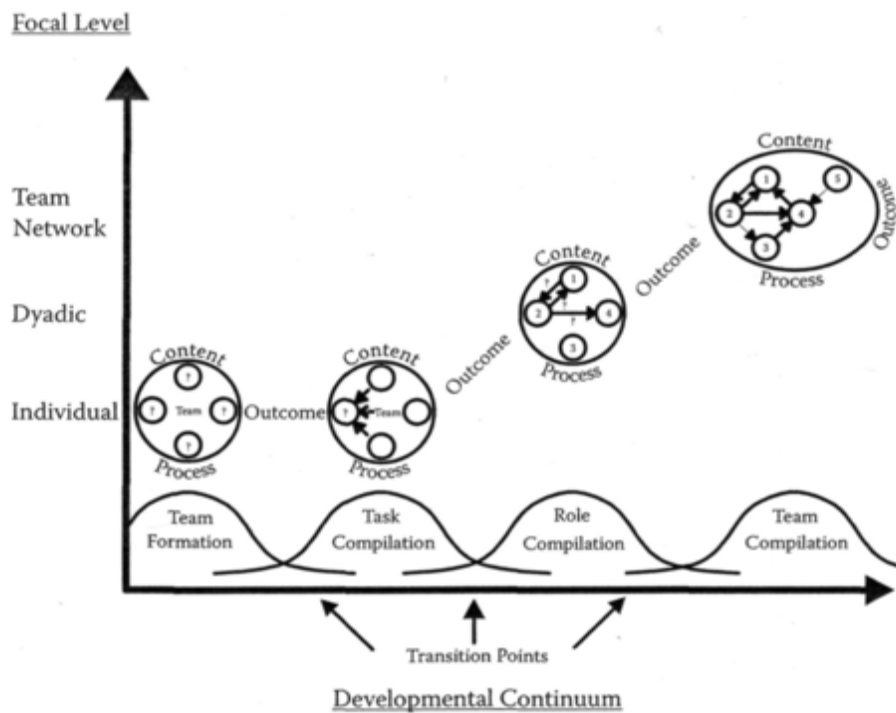


Figure 2.2 A process model of team compilation (reproduced from Kozlowski et al., 1999, p. 280)

### 2.5.2 Time as an organising factor

In recent years there has been a turn in organisation studies towards more dynamic, time-based research. In his review article on the merits of time-based, or ‘temporalist’, research in applied psychology, Roe (2008) called for more research into time-based parameters in groups, in order to foster theoretical innovation and to deepen understanding. He described this as a need for a shift in perspective from ‘what is’ to ‘what happens’. Other researchers also have offered their perspectives on the importance of study of time in groups, in which methodological challenges are acknowledged, but in which new theoretical perspectives support and explain organisational behaviour (Arrow et al., 2000; Ballard, Tschan, & Waller, 2008; McGrath, 1990, 1991). The call for more research of this type remains current. In the 2018 special issue of the *Journal of Organizational Behavior*, the editors exhort scholars to adopt a temporal and process-oriented perspective:

... the time has come to move from a differential to a temporal and process-oriented perspective, allowing us to understand what happens, how things happen, and why things happen at the workplace (Vantilborgh, Hofmans & Judge, 2018, p. 1045)

In summary, a number of theories and frameworks have been advanced to explain group progress over time. For this research, two distinct but related paradigms are key – those that advance an incremental, adaptive approach to change, and those in which revolutionary changes gives rise to sudden shifts in behaviour.

#### 2.5.2.1 Phased group development models

According to a number of development models, newly formed groups may experience phases of development. Three such models are considered here. The most well-established is that proposed by Tuckman (1965) and later refined by Tuckman and Jensen (1977). This widely cited model of ‘forming’, ‘storming’, ‘norming’, and ‘performing’ has become well known and widely accepted; indeed, for many practitioners it represents a *de facto* model of group development. Each phase is viewed as distinct, and progress from one to the next is assumed to be linear. In the ‘forming’ stage there is exploration of interdependencies and orientation to the task. In the ‘storming’ phase there is internal conflict and discord, whilst ‘norming’ is associated with increased cohesion and multi-way interactions. The final phase, ‘performing’, is where breakthrough and goal attainment occurs. Later versions also add ‘adjourning’ to acknowledge that teams often disperse (Tuckman & Jensen, 1977).

Perceived deficiencies in the Tuckman model regarding the group as a social system were discussed by Hare (1973). Based on what Hare describes as the functional needs of groups, his model defines phases as ‘Latent pattern maintenance’ (L), ‘Adaptation’ (A), ‘Integration’ (I), and ‘Goal attainment’ (G). In the L- phase the group defines its purpose, whilst in the A- phase, new skills and resources are established. In the I- phase, the group develops roles, and in the G-phase, members focus on the core task. Hare’s model is circular, each G- phase is followed by a new L- phase.

Another four-phase model was advanced by McGrath (1984) as part of a theoretical review of group interactive processes. His ‘integrated task circumplex’ model proposes the four phases as being: ‘values and goals’, ‘abilities and resources’, ‘norms and cohesiveness’, and ‘group task processes’. In the first phase, values and aims are established, and plans and ideas are created. In the second phase, these are reviewed and selected. In the third phase, behavioural norms are

established, roles and resources assigned, and conflicts of interest and approach are resolved. In the fourth and final phase, cohesion is achieved, and the task is performed.

Whilst there is some similarity between the four phases in each of these models, McGrath (1984) highlighted the fact that the ‘Storming’ phase described by Tuckman (1965) does not align well with the Hare (1973) ‘Adaptation’ phase or McGrath’s own ‘Abilities and resources’ phase. The three models are summarised in Table 2.2.

Table 2.2 Three four-phased development models of teams

Phase	Tuckman (1965)	Hare (1973)	McGrath (1984)
I	Forming	Latent pattern maintenance	Values and goals
II	Storming	Adaptation	Abilities and resources
III	Norming	Integration	Norms and cohesiveness
IV	Performing	Goal attainment	Group task performance

Whilst these and other development models retain currency in management practice, later research suggests a more nuanced, dynamic process.

#### 2.5.2.2 Dynamic models of group behaviour

According to McGrath (1991) groups may face three generic problems in relation to time: ambiguity (of duration and onset), conflicting temporal demands, and scarcity of temporal resources (lack of time). Music ensembles generally have a fourth – the need to synchronise timing. Researchers have taken different perspectives to investigating how groups deal with these generic problems. Two approaches of particular note include ways in which teams undergo transitional changes around the midpoint (Gersick, 1988, 1989), or in which they proceed over time in a series of episodic cycles (Marks et al., 2001).

Exploring this further, the punctuated equilibrium model of team development (Gersick, 1988, 1989) acknowledges environmental factors affecting group progress, in particular the timeline of delivery. Drawing on theoretical constructs from a range of disciplines, it takes a revolutionary, rather than

evolutionary, approach to group development, in which new states arise through ‘punctuations’ in progress. As well as its application in evolutionary biology, the theory has been applied in a range of organisational contexts (Sabherwal, Hirschheim, & Goles, 2001; Tushman & Romanelli, 1985), and particularly in relation to self-organisation (Sundarasaradula, Hasan, Walker, & Tobias, 2005). The theory predicts that change happens at first incrementally, but then more rapidly as discontinuities surface, leading to a period of reorientation. This new organisational orientation then persists until such time further change is triggered (see Figure 2.3). Theories that share these constructs therefore have three commonalities: a deep structure, or set of rules, which in organisational settings manifests as a tenacity of early choices (Gersick, 1988); periods of equilibrium in which basic organisation and activities remain static; and revolutionary periods in which there is a dismantling and rebuilding of the deep structure. (For a full exposition of the theory, see Gersick, 1991).

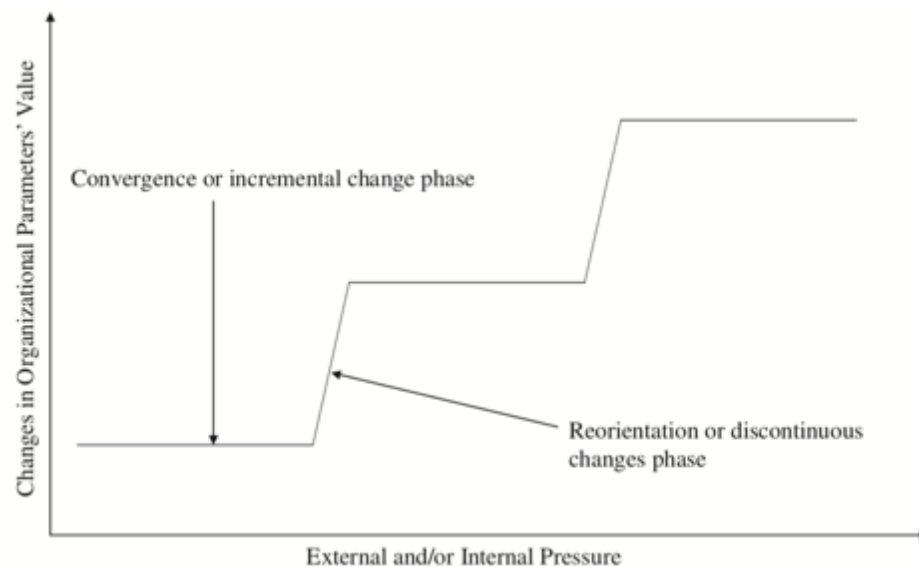


Figure 2.3 Pattern of changes that typify the punctuated equilibrium model (reproduced from Sundarasaradula et al., 2005, p. 371)

In a group context, critical points are the first meeting, and the chronological halfway point on a planned timeline. The framework of behavioural patterns that is established in the first meeting persists for the first half of the group’s life. A transitional point at the calendar midpoint, when the group’s internal pacing responds to increasing urgency, gives rise to a “paradigmatic shift” in behaviour (Gersick, 1988, p. 32) into a new phase of work towards the deadline, directed by plans formulated during the transition period.

Marks et al. (2001) proposed a conceptual model of team processes in which multitasking teams move through recurring episodes of action and transition, which the authors describe as the “rhythm of team task accomplishment” (p. 361). They propose a taxonomy of team processes (p. 363), whereby transition phase processes include ‘mission analysis’, ‘goal specification’, and ‘strategy formulation’, whilst action phase processes include ‘monitoring progress towards goals’, ‘systems monitoring’, ‘team monitoring and backup’, and ‘coordination’. Spanning both action and transition phases are ‘conflict management’, ‘motivation’, and ‘affect management’. Episodes may run sequentially, simultaneously, and even recursively, over time. In a recent review, Bush, Lepine, and Newton (2017) extended the Marks et al. (2001) model by categorising transitions into four types: those that are lengthy and between similar tasks, lengthy between dissimilar tasks, brief between similar tasks, or brief between dissimilar tasks (see Figure 2.4). They also highlight the need for further research in this area.

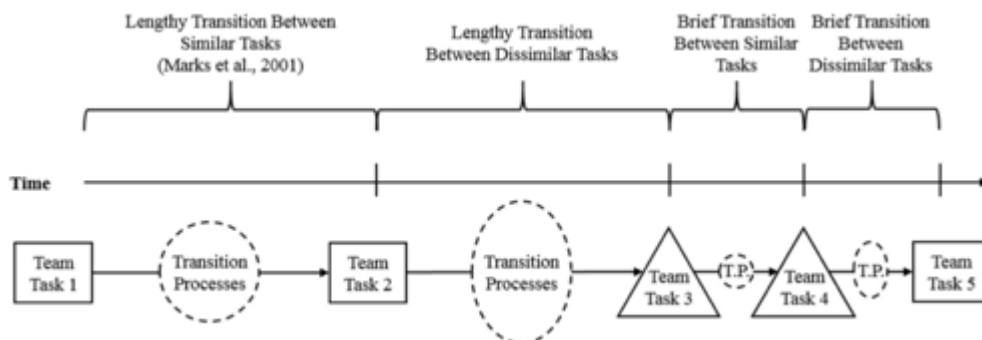


Figure 2.4 The temporal nature of team task transitions (reproduced from Bush et al., 2017, p. 425)

Relating these ideas to ensemble performance, in which a series of rehearsal ‘episodes’ are linked by periods of transition, may help to further understand temporal aspects of ensemble interaction and performance.

Group interactions over time may be subject to temporal pacing (Gersick, 1994; Okhuysen & Waller, 2002). These perspectives on the way groups pace and organise their activities represent an important departure from the phased models that predict progressive stages in groups of all types. However, consistent validation of this midpoint transition has been elusive. Rather, it has formed the basis of



research that explored wider implications of temporal pacing and transitions in teams. In seeking to replicate Gersick's findings, Seers and Woodruff (1997) found that the midpoint effect was not consistently apparent in all groups studied, proposing that it should be re-conceptualised as a 'group task progress model' rather than a 'group development model'. They also highlighted the need for more work on group model development. To build on Gersick's midpoint transition model, they highlighted the need for greater flexibility of models, especially those which can reflect "complex processes which integrate social structure with task activity, especially task pacing" (p. 186), and to address their concerns for a lack of pace-related specificity for Tuckman's (1965) model. Gersick's model has also been described as a 'tipping point' in which there is a shift from inertia to change, for example in organisational routines (Zellmer-Bruhn, Waller, & Ancona, 2003).

In a lab-based study with groups of four members, Okhuysen and Waller (2002) found evidence to support the existence of the midpoint, although they found it to be a subtle effect. They proposed that temporal pacing can provide groups with a framework for working on complex or ambiguous tasks. This framework has been suggested to give rise to shifts in behaviour around emergent 'semistrukures', which may promote transitions such as those found at the calendar midpoint or other milestones. Given the subtle nature of the midpoint transition, Okhuysen and Waller (2002) also highlighted the need for further research to clarify the conditions in which the midpoint emerges, and, more generally, a need for more research on group transitions, specifically the tasks undertaken by groups at key junctures and milestones.

Such transitions have been proposed as critical in contributing to group performance (Marks et al., 2001). There has been a call for research which addresses "qualitative changes" (p. 515) in phase transitions by using methods which detect the quantity and informational content of communication patterns (Gorman, Cooke, Amazeen, & Fouse, 2012). Recent work by Wiltshire, Butner, and Fiore (2018) adopted this approach, using group interaction patterns as a way of identifying phase transitions in problem-solving groups. Pacing of activities over time has been proposed as a way of monitoring progress when the task is complex or ambiguous (Weingart, 1992). In other words, deadlines or milestones can provide groups with a way of evaluating advancement, where there may be more than one way to approach

the task. In music (and many other creative endeavours), the paths chosen are seldom planned in advance as a clear set of steps. Rather, task interruptions, which may arise for a number of reasons, provide opportunities to re-evaluate progress. As well as temporal milestones such as the midpoint, interruptions can be triggered by formal instruction and familiarity (Okhuysen & Waller, 2002)

### *2.5.3 Summary: Small group interactions and coordination*

Research into small group interactions and coordination has much to offer the field of ensemble research. In particular, the related concepts of emergence and temporality, coordination and interactions each have a contribution to make. This research takes the perspective of the ensemble as an emergent, rather than predetermined, system, which originates in individual characteristics and manifests as collective phenomena. Alternative views of development over time are considered, especially evolutionary, moment-by-moment changes and revolutionary, transitional shifts. Implicit and explicit forms of coordination and their underlying mechanisms are of particular interest to those researching communication modes in ensembles. Related to this, there is an opportunity to better understand ways that interpersonal interactions influence group processes, how newly formed groups become established, and how groups resolve creative tensions and make decisions ‘in the moment’.

Musical ensembles have many unique features relating to their context and culture: fundamentally, however, they involve people working together and are therefore subject to the same social dynamics as other groups. Therefore, the body of empirical research and methods that has been used to investigate small groups in these areas of research can be harnessed to accelerate and illuminate research on ensemble working. Other researchers in the field of musicology have recognised this – in that sense, what this research offers is not new. However, by focusing on the way that small group rehearsal processes evolve over time, this thesis takes a novel approach, in which the opportunity for theory building is primarily through selected concepts from organisational research. Drawing on prior research in implicit and explicit coordination, interaction pattern research, and temporal pacing and patterning, and building on existing work in ensemble rehearsal and development, this thesis offers a new contribution in this area.

## 2.6 Literature gaps and implications for this research

Research on ensemble performance preparation is active and diverse, whilst in small group research in coordination, scholars are interested in real-life contexts for theory development and testing. This research provides an opportunity to harness research on group coordination, using novel methods applied in the study of social interactions in teams, to provide a new perspective on the music ensemble in rehearsal. It aims to contribute new insights into the emergence of coordination in small ensembles. Taking the viewpoint of the ensemble as small team, it takes its departure points from the current understanding of chamber ensemble rehearsal, whilst drawing on the insights of researchers who have investigated small group interactions and processes. Exploring ensembles working together over time is a central focus of this research, in order to address the following gaps identified in the literature:

### **Gap 1: Methods and structure of rehearsals in self-organised ensembles**

The first gap identified relates to understanding of how self-organised ensembles employ rehearsal strategies and methods in different group types and at different rehearsal stages. This will be addressed in Chapters 4 and 5.

Small, self-organised ensembles are an extremely common form of music-making in Western classical music. However, the way that such groups organise and structure their activities in a rehearsal is not well understood, particularly in relation to how a series of ensemble rehearsals is shaped. Changes in rehearsal strategies have been observed in ensembles over time (Blank & Davidson, 2007; Ginsborg et al., 2006; Seddon, 2005; Williamon & Davidson, 2000). However, there remain major gaps in knowledge, particularly how group member interactions and rehearsal activities change as performance approaches, and the extent to which there are distinctive stages. In addition, there has been no large-scale study of rehearsal structure and methods in self-organised ensembles, although common features have been proposed (King, 2004), and it is recognised that there is wide variability across groups (Ginsborg, 2017; Goodman, 2000).

## **Gap 2: Explicit and implicit communication and coordination over time**

Secondly, there is a gap in knowledge relating to how explicit and implicit modes of communication appear and change over time in rehearsal, including the amount of verbal (versus nonverbal) behaviour. These aspects are explored in Chapters 4, 5, and 6.

There is a well-established body of work on social and musical communication in the ensemble. However, few studies have explored how or whether communication changes, how verbal interactions develop in the ensemble, or how the relative balance of talking and music-making changes as performance approaches. Based on previous research, King and Gritten (2017) argue that there is a shift from ‘communication’ (based on explicit, often verbal exchanges) in rehearsal to ‘interaction’ (nonverbal cues and gestures) in performance. This has not so far been tested empirically. Tovstiga et al. (2005) also highlight the role of implicit and explicit communication modes in their case study of a small ensemble as a complex system. Whilst there is an extensive literature on coordination in music ensembles, this has mainly focused on interpersonal synchrony of sounds and rhythms. Research on social and organisational coordination of music ensembles has not been systematically related to models of small group coordination and its development over time. Coordination is an emergent process, which integrates interdependent group members’ actions and knowledge towards a common goal (Malone & Crowston, 1994). Widely studied in teams, it has been defined in terms of implicit and explicit processes (Rico et al., 2008). However, few studies have considered the ways that both implicit and explicit coordination manifest in specific contexts, nor the ways they evolve over time. In creative settings (although not so far in music), cyclical processes of integration and de-integration have been shown to contribute to a form of ‘elastic’ coordination as performance takes shape (Harrison & Rouse, 2014).

## **Gap 3: The formation and development of interaction patterns in ensembles**

The third gap identified is in the way that patterns of verbal interaction develop over time from first rehearsal in newly formed ensembles, and how they relate to processes of collaboration and coordination. This is explored in Chapters 5 and 6.

Ensembles encounter uncertainty, ambiguity, and time pressure in preparing for performance. Previous research in music ensembles in rehearsal suggests that ensemble members respond to moment-to-moment interactions triggered by musical features and landmarks, which has been described as the creative ‘flow’ (Sawyer, 2006, 2012; Sawyer & Dezutter, 2009). Interaction flows have also been identified in work groups (van Oortmerssen, van Woerkum, & Aarts, 2015). In order to deal with uncertainty, effective groups are able to adapt to their situation and maintain coordination (Entin & Serfaty, 1999). Few studies have explored how early interactions relate to coordination behaviours in small groups, although research suggests that early patterns tend to persist (Gersick & Hackman, 1990) and facilitate early progress (Zijlstra et al., 2012) enabling groups to ‘get started’ whilst affective bonds are established. Approaching this topic through the lens of interaction patterns in groups, Uitdewilligen et al. (2018) found that (action) pattern emergence increased over time, and linked this trajectory to the phased team compilation model of Kozlowski et al. (1999), and to how shared knowledge supports the development of implicit coordination (Rico et al., 2008). Exploring simple and complex patterns in groups therefore provides a method to investigate group interactions and their role in coordination.

#### **Gap 4: Temporal pacing and milestones in newly-formed groups**

The fourth gap concerns the way that ensembles use temporal frameworks, pacing, and transitions in preparing for performance. These aspects will be addressed in Chapters 5, 6 and 7.

Time constraints have been shown to affect behaviour during rehearsal in ensembles (Kokotsaki, 2007). In relation to time-based milestones, the punctuated equilibrium model of team development (Gersick, 1988, 1989) acknowledges environmental factors, including the timeline of delivery. It predicts a change in behaviour at the calendar midpoint, in which the team’s internal pacing responds to increasing urgency, although replication of the midpoint transition has been shown to be elusive (Seers & Woodruff, 1997). Investigating temporal pacing and transitions in lab-based teams, Okhuysen and Waller (2002) supported the existence of the midpoint, and proposed temporal pacing as a type of flexible ‘semistructure’ which, along with familiarity and formal instructions, provides groups with a

framework for working on complex or ambiguous tasks. They emphasised the subtle nature of the midpoint transition and call for research that clarifies the conditions in which it emerges. They also call for more research on group transitions, specifically the tasks undertaken by groups at these junctures, as a way of understanding group flexibility and adaptation. In the musical context, the role of time in pacing of activities in a rehearsal series has not been investigated.

This chapter reviewed the literature on rehearsal communication and interactions in ensembles, and the way these elements relate to developments over time. It also considered selected literature from organisation studies on small group interactions. Four major gaps were identified as areas for focus for this thesis. The ways in which these gaps in research are addressed are explored in the following chapter.

## 3 CHAPTER THREE

### Methodology

*But when we perceive a distinct before and after, then we speak of time; for this is just what time is, the calculable measure or dimension of motion with respect to before-and-afterness. (Aristotle (384-322 BC) in Aristotle, 1993, pp. 217b-218a)*

The previous chapter laid out the background and previous work in musicological and organisational research in small groups, which together provide the basis for this study of ensemble coordination. Given the diversity of the field, and the range of sub-disciplines represented, there are a wide variety of methods and tools which have been previously used. This chapter outlines the methodological framework used in this thesis, which is drawn from a number of sources. The philosophical assumptions and viewpoint are outlined, and selected methodologies used in the study of ensemble function and small group interactions are reviewed. The chosen methods are described, along with a summary of data sources, collection, analysis, limitations, and ethical considerations. The methodology is summarised in relation to the literature gaps identified, and in relation to the research questions addressed in each of the component studies. Further details of the methods employed in each study are given in the respective chapters.

#### 3.1 Research scope

The population studied comprises members of small, self-directed ensembles preparing for performance of music in the Western classical tradition. Whilst rooted in musical performance, this research also draws on theories, methods, and concepts from group and organisation science, particularly the study of small groups. The large body of literature on organisation of small groups represents many decades of research on human interaction, team working, and organisational behaviour. To narrow the scope, this thesis sets out a number of assumptions and framing principles, in which ensembles are viewed as small groups that are self-organising, adaptive, and engaged in processes in which constituent behaviours evolve over time.

### *3.1.1 Researching ensembles as small groups*

As established in Chapter 2, the context of music ensemble rehearsal is highly social. Studies of social interactions of small musical groups, including string quartets (Tovstiga et al., 2005), vocal ensembles (Lim, 2013) and, especially, jazz ensembles (Barrett, 1998; Gibson, 2010; Humphreys, Ucbasaran, & Lockett, 2012) have contributed to research on teams and small group performance. There are also examples of research in which the behaviour of small musical groups has been systematically investigated from a broader team performance perspective (Gilboa & Tal-Shmotkin, 2012; Glowinski et al., 2016; Murnighan & Conlon, 1991; Tovstiga et al., 2005).

A key theoretical perspective from the small group research literature relates to coordinating in small groups, in which the ensemble is viewed as a dynamic, self-managed collective. For example, Müller et al. (2018) undertook a study of choral singing in which they viewed the choir as a system from which complex networks emerged. Respiratory, cardiac, vocal, and motor measures were recorded and analysed for coupling (between pairs) and synchronisation (of multiple members). The researchers found that temporal coordination operated at multiple levels – of the whole choir and between individual members. As they describe it, “the network dynamics of each individual singer are likely to be influenced by a complex coordination or the function of the choir as a whole” (p. 85). This perspective is shared by researchers who explore emergent phenomena – for example, those who characterise small groups as complex adaptive systems. In this paradigm, groups with identical starting points will be subject to different influences and forces as their interactions emerge. A methodological approach for study of emergent phenomena in small groups was proposed by Arrow et al. (2000), who recommended comparative case studies, acknowledging the challenge of access to multiple sets of comparable groups. In their research they tracked key variables over time for comparison across groups, and exhort researchers to shift the type of questions asked from a deductive to a more inductive approach:

... future research on small groups needs to shift the form of its fundamental questions ... from ... ‘How can we can predict what groups of this ‘kind’ will do under such and such conditions?’ ... to asking questions such as ‘How can we assess what this group did do, and in what circumstances, so



that we can better understand what ‘kind’ of group it is or has become?’ (p. 296).

For the current research, the goal was therefore to ensure the experiences of participants were captured, as well as including ways of quantifying interactions amongst individuals. As such, the aim was to inductively develop theoretical understanding (Creswell, 2009). In order to understand changes over time, this research takes a process perspective to these questions, in which time is a key factor. For further background on the choice of methodologies, ways in which ensembles use time in rehearsal, and their approaches to studying changing processes in organisations, are considered.

### *3.1.2 Researching ensemble rehearsal*

The challenges of teasing out the underlying behavioural processes involved in the complex setting of a musical group remain significant. Rehearsal of chamber ensembles has been studied extensively using a range of methods. Most research is qualitative, often using case studies (Bayley, 2011; Bayley & Lizée, 2016; Butterworth, 1990; Davidson & Good, 2002; Ginsborg et al., 2006; Havrøy, 2015; King, 2006; Lim, 2013; McCaleb, 2014; Schiavio & Hoffding, 2015; Seddon & Biasutti, 2009, 2009a; Tovstiga et al., 2005; Williamon & Davidson, 2000, 2002). There are also a number of questionnaire studies (Blank & Davidson, 2007; Ford & Davidson, 2003; Gilboa & Tal-Shmotkin, 2012; Murnighan & Conlon, 1991). Others have used mixed methods and quasi-experimental designs (Ginsborg & King, 2012; Goodman, 2000). Several studies have adopted video-recording to support observation (Davidson & Good, 2002; Williamon & Davidson, 2000, 2002). There are also biographical (Blum, 1987; Rounds, 1999) and autobiographical texts (Dusinberre, 2016; Tomes, 2004), which describe the experiences of groups preparing for performance. Whilst not scholarly, they enrich available description of what can be a hard-to-access process for those outside it.

In relation to group type, there is an emphasis on string quartets (Bayley, 2011; Bayley & Lizée, 2016; Gilboa & Tal-Shmotkin, 2012; Tal-Shmotkin & Gilboa, 2013; Tovstiga et al., 2005; V. M. Young & Colman, 1979). Other types of group studied include wind quintets (Ford & Davidson, 2003), piano duos (Williamon & Davidson, 2000, 2002), cello-piano duos (Goodman, 2000), singer-

piano duos (Ginsborg & Chaffin, 2011; Ginsborg et al., 2006; Ginsborg & King, 2012), and a vocal consort (Havrøy, 2015).

Rehearsal time is generally a scarce resource for musicians, requiring effort to organise. It requires decisions to be made regarding how to allocate the time available and to allow the combined experience to adapt to different musical demands. A number of studies have explored the nature of task allocation during practice. In a series of case studies that were conducted with collaborators with expertise in a range of performing domains, Chaffin and colleagues developed a series of musical dimensions attended to by performers in their preparation. By analysing behavioural data, including starts, stops and repetitions, verbal commentaries, and comparison of score markings, they posit that, during rehearsal, performers learn to attend to specific musical features, about which decisions are made relating to the ‘unfolding’ of the musical performance (Chaffin & Imreh, 2002; Chaffin et al., 2010; Ginsborg & Chaffin, 2011; Noice et al., 2008). The resulting framework (see Table 3.1), was originally devised for the study of solo piano memorisation and has been adopted for use in later studies of ensemble rehearsal (e.g. Ginsborg & King, 2012).

Table 3.1 Dimensions that require attention when learning a new piece of music for performance (reproduced from Chaffin & Imreh, 2002, p. 344).

Dimension	Description
Basic	Fingering – e.g. non-standard choices about which fingers to use to play particular notes
	Technical difficulties – places requiring attention to motor skills (e.g., jumps)
	Familiar patterns of notes (e.g., scales, arpeggios, chords, rhythms)
Interpretive	Phrasing – grouping of notes to form musical units
	Dynamics – changes of loudness, or emphasis of a series of notes in order to form a phrase
	Tempo – variations in speed
Performance	Pedal – used mainly in phrasing by giving a note series the same colouring
	Basic cues – familiar patterns, fingering, and technical difficulties still requiring attention in performance
	Interpretive cues – phrasing, dynamics, tempo, and use of pedal still requiring attention in performance
	Expressive cues – emotion to be conveyed during performance (e.g., surprise, excitement)

Musical structure	Section boundaries – beginnings and ends of musical themes, dividing the piece into sections and subsections Switches – places where two (or more) repetitions of the same theme begin to diverge
-------------------	--

As well as structural elements, researchers have used quantitative methods to explore nonverbal communication in rehearsal. King and Ginsborg (2011) assessed gestures during singing/playing episodes. Nonverbal communication was categorised as either a *state* (an action with a duration, such as pulsing with a hand across several bars or gazing at a co-performer during a bar/phrase) or a *point* (an action with no specific duration, such as glancing at a playing partner or making a gesture to coincide with a downbeat). Categories were drawn from those used in previous research (Cassell, 1998; Ekman & Friesen, 1969). Using the software *Observer XT* (Noldus Information Technology) they created a log of rehearsal events, including type, who it was produced by, and duration. Recording both ‘state’ categories (duration and percentage of rehearsal time) and ‘point’ categories (as rate of occurrence per minute of rehearsal time) enabled comparisons of the proportion of time engaged in actions/gestures by individual performers in different rehearsals.

These examples illustrate some of the ways that researchers have sought to translate observed rehearsal behaviours into quantifiable measures for analysis. These methods provide a useful starting point for designing the studies relating to rehearsal behaviours in this thesis. In particular, opportunities are identified for investigating group types other than string quartets, the capture of time-stamped observation data, and the use of specialist software for analysis.

### 3.1.3 A ‘process’ perspective

In Chapter 2 it was highlighted that, in both musicological and organisation research, time as a factor is under-researched, despite its ubiquity in group working. Process thinking foregrounds temporality and therefore provides a framing assumption for this research. What is generally described as a ‘process’ perspective has no specific method, but rather embraces any that can help to understand how things work over time (Langley, 1999). It is not new – indeed its origins are ancient. Rescher (1996) traces the origins of process thinking to the philosopher Heraclitus,

living in the 6<sup>th</sup> century BC, who first distinguished “things” from “processes” in which “all things flow” (p. 10).

In a landmark article on process theory in organisation research, Langley (1999) highlights the value of process thinking as a practical tool suitable for the study of step-by-step activity and movement. It thus lends itself to applied or pedagogical contexts, with the capacity to capture short- and long-term ripples of effects from actions and behaviours rather than focusing on single organisational outcomes. Langley sets out methods from a range of disciplines that are appropriate for study over time and to address different modes of understanding. Rich longitudinal data that fits with the timespan of the phenomenon is a prerequisite, and the author further proposes a number of methods that can be mixed and matched according to the context. Among these are: quantitative methods for systematically deriving patterns or statistical differences (Van de Ven & Poole, 1990); inductive, qualitative (e.g. grounded theory) methods (Gioia, Corley, & Hamilton, 2013); longitudinal case studies (Eisenhardt, 1989); and visual mapping of processes (Denis, Dompierre, Langley, & Rouleau, 2011). Hence, a process perspective embraces mixed methods approaches. Langley, Smallman, Tsoukas, and Van de Ven (2013) describe how process research questions, which aim to understand changes over time, differ from approaches that adopt a deterministic or ‘variance’ view which aim to relate entities and their attributes to causality. A process approach assumes, therefore, that entities participate in events which unfold over time, and that their time ordering is critical (Poole, Hollingshead, McGrath, Moreland, & Rohrbaugh, 2004). Van de Ven and Poole (2005) articulate a framework for studying organisational change, in which they describe four approaches to time-based change in organisation (see Figure 3.1). The authors make a case for conducting both variance and process studies of the same organisational phenomenon, for example combining ‘Approach II’, which explores events or stages or change, with ‘Approach IV’ investigating processes through quantitative analysis, in which event attributes are coded to permit time series analysis and emergent structures and patterns.

As an example of this, in a study of information system design process, Sabherwal and Robey (1995) defined their variance strategy as the level of participation of actors in relation to system outcomes, and their process strategy as a

sequence of actions, expressed as a stage model of unfolding events. They call for researchers to combine variance and process strategies in this way. In their theory development, they reconcile the two approaches, and data from both variance and process strategies are combined and explained in process terms.

Whilst a process approach is flexible, and exploring process data can provide deep insights into organisations, it has limitations that relate to the large amount of data often generated in longitudinal studies, which in turn can limit the number of cases (and hence generalisability) for data collection (Van de Ven & Poole, 2005).

		Ontology	
		An organization is represented as being:	
		A noun, a social actor, a real entity ('thing')	A verb, a process of organizing, emergent flux
Epistemology (Method for studying change)	Variance method	<b>Approach I</b> Variance studies of change in organizational entities by causal analysis of independent variables that explain change in entity (dependent variable)?	<b>Approach IV</b> Variance studies of organizing by dynamic modeling of agent-based models or chaotic complex adaptive systems
	Process narratives	<b>Approach II</b> Process studies of change in organizational entities narrating sequence of events, stages or cycles of change in the development of an entity	<b>Approach III</b> Process studies of organizing by narrating emergent actions and activities by which collective endeavors unfold

Figure 3.1 A typology of approaches for studying organisational change (reproduced from Van de Ven and Poole, 2005, p. 1387)

A process perspective therefore has a number of features appropriate for the study of ensemble rehearsal. It is able to accommodate multiple data types and is appropriate for the study of social contexts. It requires the capture of longitudinal data and can combine both variance measures with sequences of events. This research aimed to approach and understand the ensemble as a holistic entity or system. However, when music ensembles are viewed as dynamic, social structures, engaged in a range of complex processes, their study cannot readily be reduced to a few specific variables. Therefore, the choice is to go deeper, by using case studies. Case study research often involves overlap between data analysis and data collection (Eisenhardt, 1989), and may rely more on analytical than statistical inference (Dubois & Gadde, 2002) in which relationships and patterns cannot be directly tested. Hence, the methodology that was devised for the current research was based on a pragmatic, mixed methods

approach, adopted longitudinal case studies and observational data, and used primarily a process perspective for interpretation.

### 3.2 Research design

The mixed methods strategy used in this research comprised a background quantitative study to provide context and to investigate a range of ensemble types, followed by two longitudinal case studies, each of which had a quantitative and a qualitative component (see Table 3.2). The case studies adopted a process strategy as advanced by Langley (1999), in which time-based phenomena are explored from multiple data sources, and quantitative and qualitative data were equally weighted. The two data sets were collected and analysed concurrently, then ‘merged’ in the final discussion to determine convergence and differences (Creswell, 2009).

Table 3.2 Mix of methods used in the thesis

Quantitative	Qualitative	Merged data analysis
Survey	Interviews and observation	Process analysis
Observation and coding of behaviour	Analysis using first and second order coding and themes	Temporal bracketing into ‘phases’
Pattern detection and analysis	Visual representations of timelines	

This strategy provided multiple perspectives on a complex environment and a novel approach to the study of the ensemble setting. It had the advantage of providing internal triangulation of the data, gathered from the same participants in the same timeframe. However, it had the disadvantage of requiring multiple analysis approaches, generating different forms of data which can be hard to compare. This was addressed through the interpretation, which considered areas of convergence or discrepancies. The way these elements were organised in the research design, and associated organisation by chapter, is shown in Figure 3.2.

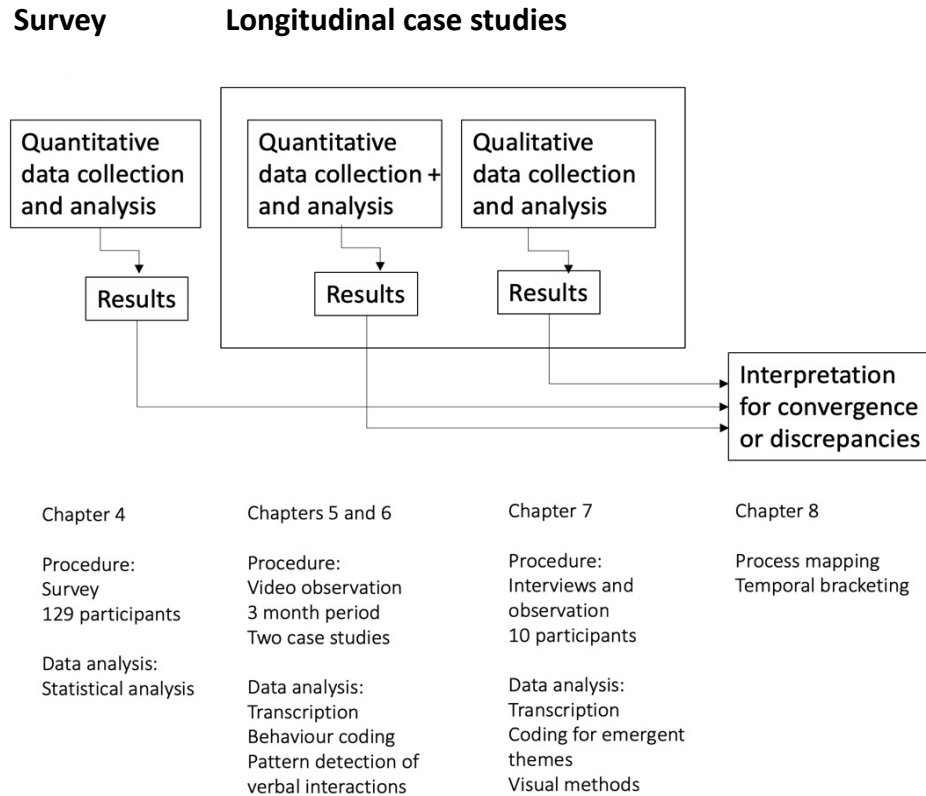


Figure 3.2 Mixed methods research design and chapter organisation

### 3.2.1 Survey

In reviewing previous research on ensembles, it was apparent that there was limited data on what small ensembles of different types actually do in rehearsal, in relation to their preparation for performance. To address this and provide further context for the detailed investigation of specific groups, a broad survey study of UK-based musicians and singers was conducted, which explored rehearsal strategies, methods, and organisation in relation to group type, size, and stage of rehearsal. The survey method was adopted as way to provide numeric descriptions of the experiences and views of chamber musicians and singers. Details of respondents' age, gender, and experience (both as musician and as members of ensembles) were captured, as well as details of their main ensemble: type, length of time in existence, size, purpose, gender mix, and location. Questions were mainly presented in a form that required respondents to select from a scale or list of options, with some open-ended questions to capture free text comments. Respondents were drawn from a sample of chamber musicians engaged in Western classical music sourced from

within the UK, comprising professional, student, and amateur players and singers, with experience of chamber ensembles of up to 15 members. The survey provided further contextual information to support the central questions of how groups progress over time, the nature of ensemble goals, and how groups use rehearsal to achieve them, planning, roles, verbal versus nonverbal communication, and rehearsal tasks.

### *3.2.2 Longitudinal case studies*

In order to investigate the emergence and development of coordination in ensembles, the approach taken in this research was to conduct longitudinal case studies of newly formed small ensembles, from first rehearsals to performance. Longitudinal case studies are appropriate for the study of the dynamics present in a given setting (Eisenhardt, 1989). Whilst laboratory methods for studying ensemble interactions continue to develop, and to generate important insights (Volpe et al., 2016), case study research continues to be an accessible and valuable approach, and as the range of examples and contexts expands it becomes more possible to identify commonalities across cases. Theory building from cases works best when multiple sources are used (Yin, 1994) and theory is built inductively and supported by an explanation drawn from the literature (Eisenhardt, 1989).

The first case study was conducted as a standalone study solely for the purpose of this research. For the second study, further data collection was also carried on the same cohort of singers. As part of the White Rose College of Arts and Humanities (WRoCAH) network on expressive ensemble performance, the opportunity arose to design the second study in such a way that it provided opportunities for data collection not only for this research, but also, separately, for fellow student Sara D'Amario and her work on ensemble synchronisation. These were distinct studies and the data was collected and analysed independently according to the respective goals of the research. However, there were findings of mutual interest. In this thesis, selected results from this separate research are reported in Chapter 6 where they offer additional evidence to support the main study; they are referred to as 'parallel studies'. It is clearly indicated where these results are included, and their source. Summaries are included in the text, and the full text



of a co-authored paper arising from this collaboration may be found in Appendix E (D'Amario, Howard, Daffern, & Pennill, 2018).

### 3.2.2.1 Case study participants

Two vocal quintets in advanced (pre-professional) level education at a UK university music department were selected as the cases for this study, which provided both the opportunity for close observation and in-depth investigation of each case, and for comparisons between groups.

Group 1 (Case Study, Chapter 5):

A, Soprano, Female

B, Mezzo-Soprano, Female

C, Alto, Female

D, Tenor, Male

E, Bass, Male

Group 2 (Case Study, Chapter 6):

V, Soprano, Female

W, Mezzo-Soprano 1, Female

X, Mezzo-Soprano 2, Female

Y, Tenor, Male

Z, Bass, Male

### 3.2.3 Case study methods

Following the broad framework proposed by Chang et al. (2017), the dimensions of explicit and implicit coordination, and common understanding were investigated, using a range of methods (see Table 3.3).

Table 3.3 Main methods of investigation of explicit and implicit coordination in case studies

Dimension	Investigated by (method)	Case Study 1	Case Study 2
Explicit coordination:			
Musical tasks	Observation	✓	✓
Roles and goals	Interview and observation	✓	✓
Implicit coordination:			
The emergence of (non-conscious) verbal interaction patterns	Coded verbal behaviours and pattern detection	✓	✓
Measures of ensemble synchronisation: timing, pitch	Laryngography and acoustic microphones		✓
Effect of musical structure	Repeated measures quasi-experimental design		✓
Perceptions and shared understanding of ensemble members	Interviews	✓	✓

Quantitative methods applied in these case studies included observation and coding of behaviours, in the form of musical tasks performed and verbal interactions.

### 3.2.3.1 Coding of musical tasks

Coding of rehearsal tasks was based on the coding system of musical dimensions originally proposed by Chaffin and Imreh (2002). These dimensions have been further adapted and applied by other researchers investigating ensemble interactions (Ginsborg et al., 2006; Ginsborg & King, 2012). The musical dimensions were categorised as basic, interpretative, expressive, or strategic. Examples of each are shown in Table 3.4. In summary, ‘basic’ features refer to those that can be discussed based on the notation found on the musical score, such as rhythm, dynamics, pronunciation of text, issues relating to notation, metre, entries, the structure of the song, and articulation. Some of these may also be classified as ‘interpretive’ features, when they relate to decisions made by members of the group about the composer’s intentions, which may not be evident from the score alone.

‘Expressive’ features relate to the way basic or interpretive elements are implemented in performance. ‘Strategic’ aspects relate to the approach employed – for example, singing the entire piece, repeating sections or sub-sections, or making general comments about how to develop further, or relating to future plans.

Table 3.4 Coding scheme for musical tasks in rehearsal (based on Chaffin et al., 2002; Ginsborg et al., 2006)

Type of feature	Specific feature	Code
Basic	Pitch	BP
	Tempo	BTem
	Technique	BTec
	Breath	BB
	Ensemble	BEns
	Harmony	BH
	Composition	BC
	Dynamics	BD
	Words	BW
	Notation	BN
	Metre	BM
	Entries	BEnt
	The instrument/voice	BI
	Structure	BSt
Articulation	BA	
Interpretive and expressive	Rubato	IR
	Dynamics	ID
	Words	IW
	Tempo	IT
	Phrasing	IP
	Articulation	IA
	Colour	ICol
	Harmony	IH
	Meter	IM
	Expressive	E
Strategic	Whole song	SW
	Repeat section, subsection, phrase	SRep
	General learning strategy	SL
	Rehearse phrase by phrase	SP
	Slow or speed tempo	ST
	Rehearse verse by verse	SV
	Rehearsal strategy/time	SReh
	Prepare for performance	SPerf
	Memory	SM

### 3.2.3.2 Coding of verbal interactions

A number of studies have explored interaction patterns in various settings, as a way of understanding group processes (Lei et al., 2016; Stachowski et al., 2009;

Uitdewilligen et al., 2018; Zijlstra et al., 2012). These patterns perform a stabilising function and reduce uncertainty, especially in new groups (Zellmer-Bruhn et al., 2003). Given their temporal nature, changes in patterns over the course of a group's progress can reveal process aspects and shifting interpersonal interactions.

To measure interactions, transcripts of rehearsal were coded with a time-stamp and a behaviour type, using one of four main categories of behaviour. Previous studies have used a range of coding schemes in their pattern analysis. There is no standard approach; rather the schemes have been chosen for the relevance to the focus of the research. For example, in a study of airline crews, Zijlstra et al. (2012) used a behaviour coding scale widely used in the aviation industry (the LINE/LOS behavioural marker checklist), whilst Lehmann-Willenbrock, Chiu, Lei, and Kauffeld (2017) used a subset of the 'act4teams' scheme (Kauffeld & Lehmann-Willenbrock, 2012) for their research on positivity in groups, where utterances were coded as problem, solution, or positivity behaviour. A number of studies have used Interaction Process Analysis (Bales, 1950), which provides a taxonomy for classifying verbal behaviours. It has been used in studies of ensemble behaviour (Ford & Davidson, 2003; Ginsborg & King, 2012; King, 2006; Young & Colman, 1979) and group development (Ballard et al., 2008; Gersick, 1988, 1989). However, more recent variants of this scheme have been developed to accommodate different group settings. This research adopted one such more recently established variant on the Bales scheme in the form of the Behaviour Analysis (BA) coding system (Farley, Evison, Rackham, Nicolson, & Dawson, 2018; Rackham & Morgan, 1977). This scheme, like that of Bales (1950), is designed to record verbal behaviour in small groups and teams, and has been applied and validated in a range of organisational settings. It has been validated in student groups (Farley et al., 2018), and shown to provide enhanced specificity over Bales (1950) in situations calling for tracking behaviours as interactive skills develop over time in the workplace (Rackham, Honey, & Colbert, 1971). Compared with the 44 categories of the act4teams scheme (Kauffeld & Lehmann-Willenbrock, 2012), the BA system comprises 15 categories (see Table 3.5), with the following four meta-categories: Initiating (related to ideas and suggestion creation), Clarifying (that create a common understanding), Reacting (that establish agreement and disagreement) and Participation behaviours (that balance people's contributions).

Table 3.5 Behaviour Analysis (BA) coding scheme (Farley, Evison, Rackham, Nicolson, & Dawson, 2018)

Meta-category code	Code	Abbreviation
Initiating	Proposing procedures	PP
	Proposing ideas	PI
	Building	B
Reacting	Supporting ideas	SI
	Supporting people	SP
	Disagreeing	D
	Defending/attacking	D
Clarifying	Checking understanding	CU
	Seeking task information	ST
	Giving task information	GT
	Seeking personal information	SP
	Giving personal information	GP
Participation	Shutting out	SO
	Bringing in	BI
	Lightening the mood	LM

### 3.2.3.3 Coding reliability and validity

Accuracy of coding has been highlighted by researchers as an important consideration for using pattern detection software methods (Ballard et al., 2008). In-depth training was undertaken by the researcher (Rater 1) to ensure familiarity and consistency in applying these codes. The training comprised two days of online preparatory training, and four days of intensive hands-on training on application and boundary conditions with lectures and simulations. The training was around 20 hours for each session, and was undertaken twice, each time shortly prior to the data collection period. This training was delivered by coding experts who included the researcher who had developed the coding scheme (Rackham & Morgan, 1977). Following the training, validation checks were carried out to confirm performance of a Kappa inter-rater agreement of at least 0.70 reliability with experts. Following this, a further eight days of practice coding were completed with student groups working on collaborative tasks, coding real time interactions, with further monitoring for coding consistency.

For the subsequent analysis process, it was important that only a single code was applied, which created slightly different boundary conditions in coding practice. To validate this, an additional test was conducted with a second trained coder. This validation test achieved an inter-rater score (Kappa) of 0.77. Discrepancies, where

they arose, were generally where more than one code was appropriate to the behaviour, but not mutually exclusive. For example, if a participant made a humorous remark whilst sharing a personal comment, both ‘Lightening the mood’ and ‘Giving personal information’ could be assigned. In such cases, the dominant or most appropriate behaviour was selected by considering the subsequent behaviours. So, if their comment was followed by general laughter and a change of topic it would be coded as ‘Lightening the mood’, whilst if followed by further sharing of personal information it would be coded as ‘Giving personal information’.

### *3.2.4 Group interaction analysis*

Group interaction research is a developing field of investigation, with new methods for capturing, coding, and analysing group data being developed and applied (Brauner, Boos, & Kolbe, 2018). Given the focus of the current research on social interaction patterns, and based on prior research, the Theme software algorithm (Patternvision Ltd) was chosen as the analysis tool for pattern detection. Theme was designed for the purpose of ‘T-pattern’ (time pattern) detection (Magnusson, 2000, 2018) and has been applied in a range of settings including group research (Ballard et al., 2008; Harrison & Rouse, 2014; Stachowski et al., 2009; Zijlstra et al., 2012), as well as sports, medicine, animal behaviour and at many levels of biological and interpersonal organisation (Casarrubea et al., 2015).

#### *3.2.4.1 T-pattern analysis*

T-pattern analysis identifies hidden repeated patterns. In complex behaviour, conventional statistical tools designed for analysing relationships between attributes do not always readily detect underlying data structures: T-pattern analysis can be effective even with shorter periods and smaller data sets (Magnusson, 2017). T-patterns are recurrent behaviour patterns occurring within a ‘critical interval’. The Theme algorithm identifies point-series data on a discrete scale within  $n \geq 1$  intervals, where the series represents the positions of the start or end of a given phenomenon, such as a specific type of behaviour. It first identifies simple temporal patterns of two events that occur in the time-coded data significantly more than chance. Secondly, it cycles through the data to identify further ‘patterns of patterns’, where combinations of these simple two-event patterns are repeated. Finally, it eliminates patterns that are incomplete versions of other patterns; newly detected

patterns are only included if they occur equally often and comprising the same event types as existing patterns. It is explained by Borrie, Jonsson, and Magnusson (2002) as follows:

... during the detection process, a pattern  $Q = (ABCDE)$  may be partially detected as, for example,  $(ACDE)$  or  $(BDE)$  or  $(ABCE)$ ; since elements of  $Q$  are missing, these three patterns constitute less complete descriptions of the underlying patterning. A newly detected pattern  $Q_x$  is thus considered equally or less complete than an already detected pattern  $Q_y$  if  $Q_x$  and  $Q_y$  occur equally often, and all events in  $Q_x$  also occur in  $Q_y$ . In this case,  $Q_x$  is eliminated. This completeness competition ensures that only the most complete patterns survive and constitute the result of the detection process (Borrie et al., 2002, p. 847).

An example of 25 hypothetical events, starting ADB, is shown on a timeline in Figure 3.3. Within this sequence there are two sub-series (or ‘T-patterns’): ABC and DEFG. Both sequences are embedded in the original series, but are hard to detect by eye (Casarrubea et al., 2015).

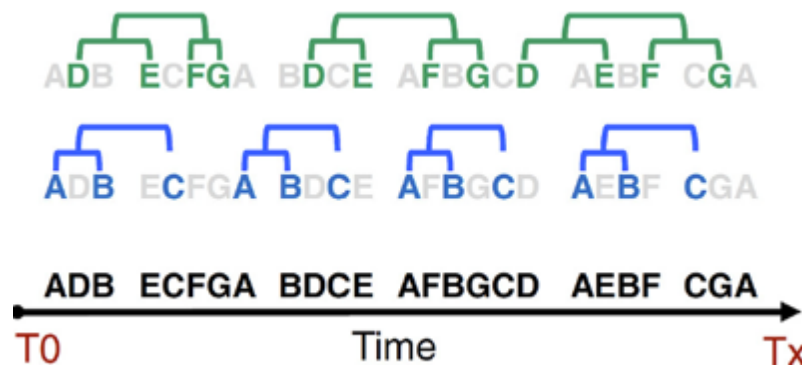


Figure 3.3 Example of T-patterns within a hypothetical series of events (Casarrubea et al., 2015, p. 34)

### 3.2.5 Use of Theme in the present study

Coded, time-stamped data was used for the analysis of temporal patterns in rehearsal interactions in Groups 1 and 2, (see definition of groups in 3.2.2.1) and reported in Chapters 5 and 6, respectively. Following other studies of team performance (Lei et al., 2016; Uitdewilligen et al., 2018; Zijlstra et al., 2012), further analysis of the data included comparison of the number of unique patterns, pattern length and levels, mono-actor patterns, and presence of dyadic interactions. These

measures were also obtained through Theme. Such patterns may be regarded as characteristic emergent phenomenon such as those found in complex dynamic systems (Tubbs, 2012).

#### 3.2.5.1 Finding the most meaningful patterns

Meaningful patterns were identified based on complexity (number of events and actors), and qualitative content. Previous research has shown that groups seek to adapt to tasks over time to reconcile the tension between the need for stability (to foster productive working interactions) and change (for innovation, renewal and creativity) (Tsoukas & Chia, 2002; Uitdewilligen et al., 2018). Complex patterns of interaction may arise as groups use their collective creativity to explore a task. Shorter, simpler patterns, often expressed as two-person interactions (dyads), help to create a stable group that can work together on tasks, and in which members can predict each other's responses.

#### 3.2.5.2 Adjusting settings in pattern searches

Following previous studies (Borrie et al., 2002; Lei et al., 2016; Zijlstra et al., 2012), the algorithm was configured to identify patterns that occurred three or more times in a given period, and assigned a  $<.005$  confidence interval for pattern occurrence (the probability that the pattern occurred above and beyond chance). These settings were tested and then validated on the Group 1 case study (Chapter 5) data, and the same settings used for Group 2 (Chapter 6). The results of these tests are shown in Appendix A.

#### *Identifying 'significant' patterns.*

To establish the chosen confidence value, using the data from Group 1, patterns were analysed at three confidence intervals using the settings within Theme: .001, .005, and .05. All three levels resulted in identifying 'significant' patterns – the probability of the patterns occurring at more than 99.9%, 99.5%, or 95% chance level. However, the lowest confidence level (.05) gave a large number of patterns of greater complexity (overfitted). The large number of patterns was hard to work with when identifying the main trends, as the patterns were intended to be subsequently related to the specific interactions identified in the transcript. The highest level of .001 effectively reduced the number of patterns and their complexity, however this



provided less discrimination between weeks of study (underfitted). The .005 confidence value was therefore selected. This confidence level provided sufficient discrimination between repeated weeks, with a manageable number of interactions to analyse further for content of discourse. Having established the optimal setting for Group 1, the same setting was used for Group 2.

#### *Minimum occurrences of patterns*

Maintaining the confidence interval at .005, Theme settings were varied from 2, 3 and 4 minimum occurrence of repeated patterns. The impact of changing this setting changed the number of patterns identified. For example, in Group 1 during the most highly patterned rehearsal (Week 5), the number of different patterns varied from 7659 at minimum occurrence 2, 668 at minimum occurrence 3, to 194 at minimum occurrence 4. Minimum occurrences were therefore set at 3, which enabled comparisons to be meaningfully made across weeks. Again, having established the optimal setting for Group 1, the same setting was used for Group 2.

#### *3.2.6 Measurement of other musical interactions*

Coordination of sounds between ensemble musicians is a basic ensemble goal. Its achievement is complex, and involves multiple, simultaneous, interpersonal mechanisms. It also operates at multiple levels, from short-term goals to longer-term goals relating to musical structure, which may be independent to some extent (Keller & Appel, 2010). Whilst these elements might be discussed explicitly as rehearsal goals, they are achieved through multi-modal and generally nonverbal mechanisms. In the current research, these aspects were explored in the two parallel studies that were conducted and published elsewhere. These studies measured evolving synchronisation (D'Amario, Daffern, & Bailes, 2018) and intonation (D'Amario, Howard, et al., 2018). The results were closely related as the data was collected from the same participants, under the same conditions (see 3.2.2) and are therefore referred to where relevant in Chapter 6, and in the discussion (Chapter 8).

#### *3.2.7 Qualitative research methods*

Building on the observation data collected during the longitudinal case studies, interviews and self-report data were also used in this study. The emphasis was on the perspectives of the participants and their 'lived experiences'. The

approach to qualitative analysis followed that advanced by Gioia et al. (2013), which assumes that the method for analysis needs to represent the experiences of participants whilst providing theoretical rigour, and that informants are ‘knowledgeable agents’. The role of the researcher was therefore to provide objective reporting without dependency on prior knowledge or theory (Gehman et al., 2018). Theory building from the data followed a systematic approach in which first-order codes (from informants) and second-order themes (researcher-derived) were used to create a data structure, from which theory rooted in the data emerged: According to Corley and Gioia (2011), theory is, “a statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs” (p. 12).

### *3.2.8 Interviews*

Experiences of the groups were explored from physical, cognitive, and emotional perspectives. In line with previous studies of social dynamics in music ensembles (Davidson & Good, 2002; McCaleb, 2014; Page-Shipp, Joseph, & van Niekerk, 2018) an interpretive approach was adopted as the analytical framework for exploring and analysing the interview data. This approach seeks to create meaning from individual accounts by means of the researcher’s immersion in, and interpretation of, the data, which may go beyond those articulated directly by the participants. It hence has a double hermeneutic – “the researcher is trying to understand the participant’s subjective experience as well as trying to scrutinise the underlying meaning” (Joseph, 2014, p. 150) – and uses open-ended questions in order to allow participants to give full and free responses. In analysis, responses were grouped by theme and, as is consistent with the convention of the method, interpretations are supported by the use of quotes.

#### *3.2.8.1 Visual maps of development*

Further data was gathered using a template on which participants were invited to draw and annotate a timeline of their group’s development (see basic template, Figure 3.4).

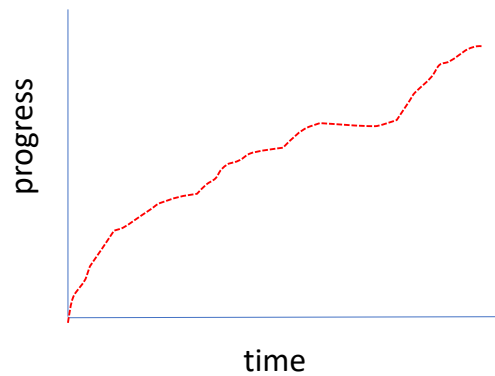


Figure 3.4 Basic template for trajectory drawings (dotted line shows example of participant's drawing)

Visual methods have been used in social sciences to augment other methods, and as a way of generating and sharing data. In their case study of sense-making in a string quartet, Tovstiga et al. (2005) used a learning and development trajectory approach to explore experiences of the quartet's members. Visualisation can facilitate the relationship between researcher and participant, enhance data quality and validity, map out patterns, and help to visualise models for theory building (Glegg, 2019). One limitation of qualitative interviews can be in the difficulty of eliciting tacit knowledge. Using visualisation can help to surface difficult-to-articulate ideas that can be hard to draw out in traditional interviews, as well as making it a more engaging experience for the participants. increasing visibility of central themes (Bischof, Comi, & Eppler, 2011). Using a timeline template, Bischof et al. (2011) asked participants to indicate how they perceived the evolution of a work domain. They noted that it prompted interviewees to carry on talking whilst filling in the template, as a type of 'thinking aloud', adding richness to the data and helping to surface tacit knowledge. Their purposes in using visual methods were to stimulate respondents, gather deeper information, and enhance their methodological approach. They advance a four-stage process: 1) preparing a visual template appropriate for the central theme; 2) completing the visual template; 3) wrapping up, using visualisation as a summary to check understanding; and 4) analysis of visual data by comparing and aggregating with that gathered on multiple templates.

### 3.2.8.2 Coding and analysis of interview and observation data

The data was analysed using a systematic approach to identify underlying structures in the data, and whereby progression from raw data to aggregated dimensions could be mapped (Corley & Gioia, 2004; Gioia et al., 2013). An ‘open coding’ approach was used to create first-order concepts, based on the voices of the participants (Strauss & Corbin, 1998). From these concepts, relationships and meanings were interpreted to create second-order emergent themes (see Figure 3.5). These were then aggregated to form the basis of conceptual themes, which were compared to the extant literature. These elements were the basis for building a data structure, described by Gioia et al. (2013) as the “pivotal step” in this qualitative research approach (p. 20), as it shows the connection between raw data and emergent themes and concepts.

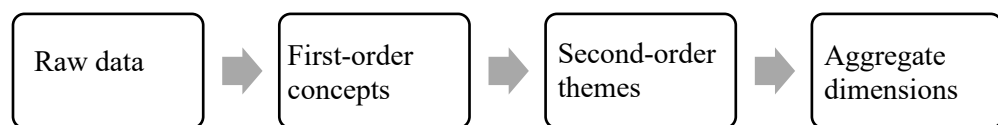


Figure 3.5 Approach to qualitative data analysis  
(based on Corley & Gioia, 2004; Gioia et al., 2013)

### 3.2.9 Ethics

The survey study was approved by the University of Sheffield ethics committee. It also gained Conservatoires UK Ethical Approval for distribution within Royal Northern College of Music. The introduction to the survey (entitled ‘Background to the Study’, see Appendix B) clarified the purpose of the study, that data would be treated as confidential and anonymous, and that participation was voluntary. It was also explained that respondents could withdraw at any time, and that by submitting a questionnaire they were giving informed consent to participate.

For the case studies, ethical approval was granted by the University of York research ethics committee. Detailed information was provided through an initial briefing, and by providing written information sheets. The participants gave their informed consent, which was verified in subsequent interviews.

### *3.2.10 Approach to interpretation - a process lens*

Drawing together the threads of research from the longitudinal case studies, comprising both quantitative and qualitative data, a process lens was applied in order to understand how the processes evolved over time, in both the short term (e.g. within a rehearsal episode) and longer term (across a series of rehearsals).

In a process ontology the use of theory is highly focused and selective (or ‘parsimonious’) (Eisenhardt, 1989) and derived through a process of ‘abductive reasoning’ (Langley, 1999). Based on the writings of nineteenth-century scholar Charles Peirce (Hartshorne, Weiss, & Burks, 1931) and described by Reichertz (2007), abduction is a method of reasoning gaining in usage in the social sciences (Aarikka-Stenroos & Jaakkola, 2012). Abductively generated process theorising has been proposed as a way flexibly interpret processes in the light of existing theory (Langley, 1999; Langley et al., 2013; Locke, Golden-Biddle, & Feldman, 2008), in which, “empirical observations and surprises are connected to extant theoretical ideas to generate novel conceptual insights and distinctions” (Langley et al., 2013, p. 11). In this thesis, an abductive approach is the means by which empirical findings were combined towards a theoretical contribution, which in turn advances understanding of the process of ensemble performance preparation. A specific method adopted to aid this process was ‘temporal bracketing’ (Denis et al., 2011). This approach simplifies time flows by decomposing them into phases, between which there may be discontinuities. Each phase may show distinct, recurrent process phenomena, and thereby enable detection of the mechanisms of temporal evolution (Langley, 1999). Using this approach with the merged data identified distinct phases as well as data flows in the process.

### **3.3 Philosophical viewpoint and assumptions**

As previously outlined, this research adopted a pragmatic, mixed methods approach, and made inferences across both quantitative and qualitative data.

Mixed methods research was first formalised as a research strategy in psychology by D. T. Campbell and Fiske (1959), whilst a pragmatic worldview (Cherryholmes, 1992) draws on both qualitative and quantitative assumptions. It is recognised as a distinct methodology (Creswell & Plano Clark, 2017), and in social research as a way of integrating the philosophical assumptions on which the

constituent methods are founded (Greene, 2007). The term ‘mixed methods’ became standardised with a major handbook first published in 2003 (Tashakkori & Teddlie, 2016) and is also referred to as an ‘integrating, synthesising or multimethod’ approach (Creswell, 2009). Among its tenets are the requirements for extensive data collection, requiring both quantitative and qualitative modes of analysis, rigorous data analysis appropriate for the data type, and the merging of qualitative and quantitative data for interpretation (Creswell & Zhang, 2009).

The research design therefore aimed to meet the needs of each study component in order to provide the best understanding of the problem, to enable triangulation of the different data sources, and to explore time-based phenomena in small groups. Well-established methods from the study of ensemble rehearsal were used (case study, interview/observation and questionnaire survey), in combination with more specialist approaches drawn from the study of small groups (pattern detection and process analysis). Given the already strong representation of string quartets in the ensemble rehearsal literature, a different ensemble type was favoured, and two vocal ensembles were selected for the case studies. In order to study changing phenomena over time, newly formed groups were identified that could be studied from formation to first performance.

The central research question reflects the mixed methods design, consistent with the integrative nature of the research (Tashakkori & Creswell, 2007).

How do behavioural interactions in a self-organised music ensembles emerge and change over time?

The sub-questions, and how they relate to the literature gaps identified and the methods used, are summarised in Table 3.6, below.

### **3.4 Summary**

The core question that this thesis aimed to address was how behaviours change over time. In order to investigate this question in the complex setting of a music ensemble, a mixed methods approach was used, combining quantitative data from a survey, with analysis of verbal interactions, and qualitative data from interviews and observation. Overall interpretation took a process perspective, appropriate to over-time studies. Theory building used an abductive approach,

combining existing theory with research findings contributing towards a process model of ensemble preparation.

The methods are summarised below in relation to the literature gaps and research questions for each of the component studies (Table 3.6). Further details of how the methods are applied in each study are given in the opening sections of the relevant chapters 4-7.

Table 3.6 Summary of literature gaps, research questions and methods

Gaps	Chapters	Research questions	Methods
Gap 1: Methods and structure of rehearsals of self-organised ensembles	4 & 5	How are rehearsal activities structured in self-organised Western art music ensembles of different types and at different stages of preparation for performance?	Survey Observation and coding of behaviours
Gap 2: Explicit and implicit communication and coordination over time	4, 5 & 6	How does verbal and nonverbal communication vary by stage of preparation?	Survey Observation and coding of behaviours
Gap 3: The formation and development of interaction patterns	5 & 6	How do interaction patterns form and impact changing group behaviours in a newly formed ensemble? How do interaction patterns relate to other aspects of the rehearsal context, including rehearsal methods, roles, and musical interactions as manifested in timing and intonation? In what ways do interaction patterns vary depending on the task at hand (e.g. does the musical organisation of performed repertoire have an influence)?	Observation and coding of behaviours Verbal interaction pattern detection and analysis
Gap 4: Temporal pacing and milestones in newly formed groups	7	How do members of newly formed ensembles experience the process of preparing for performance? How are stages of rehearsal perceived and managed over time?	Interviews and observation Analysis using first- and second- order coding and themes Visual representations of timelines Process analysis and temporal bracketing

Results of the empirical studies relating to these areas of investigation are presented in Chapters 4–7. Results from a survey of rehearsal practices of small chamber ensembles are reported in Chapter 4. In Chapter 5, the first of two longitudinal case studies of newly formed vocal quintets, observed in a field-based setting, investigated the emergence of patterns of verbal interactions, and their use of rehearsal strategies. Chapter 6 reports the results of a case study of a second newly formed quintet, this time in a lab setting, which investigated the relationships of emergent interaction patterns to ensemble development, timing and synchronisation. Evidence from interviews and observations from both participants in both case studies is reported in a qualitative study of rehearsal stages and processes in Chapter 7.



## 4 CHAPTER FOUR

### Time and self-organisation of chamber ensembles in rehearsal

*... to fully understand work teams, researchers must investigate how team dynamics develop and change over time (Gully, 2000, p. 35)*

In the Western classical tradition, membership of self-organised ensembles is a highly popular form of music participation, and involves both musical and social interaction (Klorman, 2016). It is highly diverse, with multiple instrumental or vocal configurations. As well as being part of many professional musicians' portfolios, the small-scale, self-organised nature of such groups, and the large available repertoire, have contributed to a long-established function of chamber music as a form of social participation. Accordingly, rehearsals take a variety of forms, from an intensive progression toward performance to a playing opportunity with like-minded musical friends. However, despite their ubiquity and diversity in professional, social, and pedagogical settings, few studies have explored the way that chamber ensembles structure and organise their rehearsal time.

Reviewing rehearsal processes in ensembles, Davidson (1997) identified group factors, including roles of individuals and their social dynamics, along with musical elements arising from performance etiquette and historical practice. She also observed that, in research terms, "the social communication aspects of rehearsal and performance have been largely ignored" (p. 211), highlighting a major gap in knowledge. Since then, however, as reviewed in Chapter 2, there have been significant contributions to the field. Existing research, mainly in the form of case studies, has explored aspects of social and musical coordination in rehearsal and performance, their development during isolated rehearsals, and in the transition from rehearsal to performance. These studies provide a valuable basis for understanding the key dimensions of, and influences on, rehearsal and its role in performance preparation. However, there remain few studies that have investigated these factors in relation to different stages of preparation. In order to address this gap, and to provide further context to the case studies reported in later studies in this thesis, the findings of a survey of chamber ensembles are reported in this chapter.

A key focus of the current study is on the choice and order of methods used in rehearsal, and the extent to which there is a common framework for chamber ensembles in the Western classical tradition. Existing research suggests both commonalities and variation within and across groups, and differences in verbal and nonverbal communication behaviours, which includes the balance of talking and playing. This research also explores the extent to which rehearsal organisation is a predetermined, carefully planned activity, or an emergent process in which events unfold and are not planned in detail. These aspects also contribute to an understanding of how coordination is established in the ensemble and has implications for the wider themes of small group working that this thesis aims to address.

#### **4.1 Aims of the current study**

To provide broader background and context for the planned case studies, a survey study was designed to provide a wide sample of groups of different types. The purpose of this study was to explore how aspects of the ensemble and its methods relate to coordination, the stage of performance preparation, and self-reports of verbal and nonverbal communication. It also explores rehearsal practices in different group types, and the way that members of ensembles describe their roles and task allocation. The study therefore had two main aims. The first was to investigate what activities are commonly used in rehearsals and how they are organised and ordered in Western classical chamber ensembles. Second, it aimed to explore in what ways the rehearsal organisation varies with time and in ensembles of different sizes and types. It addressed the following research questions:

In self-organised Western art music ensembles:

- How are rehearsal activities structured in self-organised Western art music ensembles of different types and at different stages of preparation for performance?
- How does verbal and nonverbal communication vary by stage of preparation?

#### **4.2 Methods**

As explained in Chapter 3, a survey method was adopted to investigate the practices of chamber musicians and singers in rehearsal. Details of respondents' age, gender, and experience (both as musicians and as members of ensembles) were also

captured, as well as their main ensemble; type, length of time in existence, size, purpose, gender mix, and location.

#### 4.2.1 Participants

From the online survey 229 responses were received. However, a number were either incomplete or did not fulfil the criteria of the population sample required (e.g. not Western classical, or the group size was too large) and were therefore removed from the sample. Data from 129 respondents were used in the subsequent analyses.

Of the 129 respondents, the age range was 18–84 years, mean age 49, S.D. 18.8. The gender mix was 38.0% female, 60.5% male, 2 were not specified (1.5%). Overall experience as ensemble musicians was high, with 82.9% having 10 or more years' experience with ensembles, 10.1% of 6–9 years, 5.4% 3–5 years, and 1.6% less than 3 years. Ensemble types were categorised as string, wind, voice, mixed, and other. Group size ranged from 2 to 15. Group categories are summarised by size in Table 4.1.

Table 4.1 Ensemble type and size ( $N=129$ )

Group size	2	3	4	5	6	7	8	9	10	12	15	Total
Wind only	3	1	15	14	0	0	5	3	0	1	1	43
String only	0	2	35	3	1	0	0	0	0	0	0	41
Voice only	0	1	3	1	2	1	1	2	0	0	0	11
Mixed	9	9	5	2	2	2	0	1	1	0	0	31
Other	0	0	1	0	1	0	0	0	1	0	0	3
Total	12	13	59	20	6	3	6	6	2	1	1	129

Respondents were asked to indicate the professional status of their ensembles, and the length of time that they had been together (Table 4.2). The largest proportion of respondents were members of groups who described themselves as 'non-professional' (87.6%) compared with 'professional' (12.4%). Professional groups were defined by whether performances by the group were paid. The length of time that groups had been in existence was generally high, with 46.6% having been established for 5 years or more, and 23.3% for more than 10 years.

Table 4.2 Frequencies: Professional status and duration of groups' existence ( $N=129$ )

	Duration of group existence (years)					Total
	<1	1–3	3–5	5–10	10+	
Non-professional (n)	17	24	16	28	28	113 (87.6%)
Professional (n)	4	7	0	3	2	16 (12.4%)
Total %	16.3%	24.0%	22.4%	33.3%	23.3%	100%

#### 4.2.2 Materials

An online questionnaire was created using the specialist survey software design tool SoSci ([www.sosci.de](http://www.sosci.de)), which enabled flexible question design, good data security, and had a customisable online interface. The survey included questions related to respondents' background, chamber group membership, organisation of group rehearsals and activities, and their opinions on the structure and purpose of a recent rehearsal. It also included questions on group roles and organisation, communication, and managing conflict (see Table 4.3).

The survey questions were drawn from themes identified in the literature, in order to address gaps and to explore specific aspects of rehearsal over time. Much of the existing research is based on case studies, so a wider purpose was to explore some case study findings with a larger sample. It is widely accepted that there is significant variability in rehearsal practices between groups (Davidson & King, 2004; Ginsborg, 2017). Background questions were therefore designed to establish the experience of the respondent and their main group, as well as other basic information about the size and type of group. Variation has been shown to exist in rehearsal strategies over time (Blank & Davidson, 2007; Kokotsaki, 2007). Previous research also shows that rehearsal goals may be influenced by time available for performance preparation (Kokotsaki, 2007). The survey was a snapshot rather than longitudinal in design, so did not provide data on group progression over time. However, it captured information on the stage of development that the groups were at, based on whether they were in early or later stages of preparation for performance, or whether no performance was currently planned.

To explore rehearsal activities and structure, a starting point was the framework proposed by King (2004) for further research on ensemble rehearsal, which includes structure, collaboration, and technical dimensions, and how they relate to an overall plan, session plan, and work on individual pieces. Respondents

were asked which activities they employed, how important they considered them to be, and their timing within a single rehearsal.

Organisation and communication questions included those relating to verbal and nonverbal modes of communication conflict, and formal/informal roles. It also explored whether the self-organised groups in the sample considered themselves 'leaderless' (Bathurst & Ladkin, 2012) and whether this varied according to group size (Rasch, 1988). Verbal and nonverbal communication are known to be a feature of ensemble rehearsal and to vary with time (Williamon & Davidson, 2002), group type (Seddon, 2005), and the familiarity and expertise of co-performers (King & Ginsborg, 2011). The amount of talk in rehearsal has also been shown to vary with expertise (Williamon & Davidson, 2002). Murnighan and Conlon (1991) found that the amount of talk and how professional string quartets dealt with conflict were factors in long-term success. Questions on conflict, therefore, related to both its causes and resolution. There were 40 questions in the survey. For the full questionnaire, see Appendix B. Table 4.3 shows the overall survey structure and question groupings.

Table 4.3 Survey structure (see Appendix B for full survey)

Section	Topic	Question
I	Background – respondent	1. Gender 2. Age 3. Instrument 4. Time played (years) 5. Amount of practice 6. Years of formal training 7. Years of ensemble experience
II	Background – chamber group	8. Type of group (main group) 9. Instrument/voice in main group 10. Other groups 11. Size of main group 12. Length of time main group has existed 13. Location of main group 14. Professional status of main group 15. Main purpose of group
III	About group rehearsals	16. Frequency of group rehearsals 17. Length of rehearsals 18. Number of rehearsals to performance
IV	Recent rehearsal	19. Order of activities 20. Deciding order of activities 21. Time of day 22. Effect of time of day 23. Warm ups 24. How recent was last rehearsal 25. Content and importance of activities 26. Focus of last rehearsal 27. How satisfied with last rehearsal
V	Group roles and organisation	28. Who takes the lead 29. Informal or formal roles 30. Personal informal or formal roles
VI	Communication	31. Amount of time talking 32. Topics of rehearsal talk 33. Verbal and nonverbal communication
VII	Differences and conflict	34. Causes of tensions or differences 35. Resolution of tensions or differences 36. Frequency and severity of conflict 37. Personal view of conflict
VIII	Final remarks	38. Friendship in the group 39. Any other comments 40. Contact details (optional)

### 4.2.3 Procedure

The survey was piloted at the University of Sheffield during February 2016 and distributed to musicians and singers of a wide range of age and type during March–June 2016. To reach students, it was shared through the Universities of Sheffield, York, Leeds and Nottingham, and at the Royal Northern College of Music

(RNCM); with amateur musicians primarily through Benslow Music Trust<sup>3</sup>, and professional musicians through personal networks and societies. Accessed online, the survey was active for three months. The study was approved by the University of Sheffield ethics committee. It also gained Conservatoires UK Ethical Approval for distribution within RNCM.

#### *4.2.4 Analysis*

Frequencies, cross tabulations, and chi-square analyses were used to describe the population and general findings. Principal component analysis was used to identify related items in the rehearsal activities and define groupings. Parametric and non-parametric statistical methods were used to compare groups. Analyses of variance with post-hoc comparisons (with Bonferroni correction for multiple testing) were used where appropriate to identify subgroup differences.

In order to prepare the data to compare by rehearsal stage, some preliminary analyses were conducted. Respondents could answer in more than one category for Question 26, which established the purpose of their most recent rehearsal – for example, they could indicate they were ‘refining known repertoire’ and also be at a ‘final rehearsal before performance’. As these categories of responses to these statements were not mutually exclusive, the data relating to stage of rehearsal were extracted and three groups identified as shown in Table 4.4. The three groups comprised those with no immediate performance goal (Group 0, n=39), those in early stages of preparation (Group 1, n=32), and those where the rehearsal was the last before a performance (Group 2, n=37).

---

<sup>3</sup> Benslow Music Trust runs courses for amateur musicians and singers in the UK, for a wide range of instruments, voices and combinations ([www.benslow.org](http://www.benslow.org)).

Table 4.4 Stage of rehearsal – assigned groups

Group	Stage of rehearsal	n	%
Group 0	No performance planned	37	34.3
Group 1	Early stage of preparation	32	29.6
Group 2	Final rehearsal before concert	39	36.1
Total		108	100.0

Group constitution was checked for group size and found to be well matched. However, there was an uneven distribution of professional, amateur, and student groups across the three groups. Chi-square test for independence (with Yates Continuity Correction) indicated a significant association between stage of rehearsal and professional status ( $\chi^2(2, n=108) = 38.502, p < .001$ , Cramer's  $V=0.349$ ), and stage of rehearsal and amateur status ( $\chi^2(2, n=108) = 32.883, p < .001$ , Cramer's  $V=0.422$ ). Professional status may therefore be a confounding variable when comparing groups by rehearsal stage (see Table 4.5).

Table 4.5 Professional status and stage of group preparation

Status	Group 0	Group 1	Group 2
Professional	0	2	8
Semi-professional	5	6	16
Amateur	33	18	7
Student	1	6	6
Total	39	32	37

### 4.3 Results

Results are reported in two main sections. First, rehearsal structure and activities are analysed for all respondents, to explore the main components of rehearsal and how rehearsal activities are structured and planned, and what goals were identified. Second, analysis of rehearsal communication is reported in relation to stage of performance preparation, including verbal and nonverbal communication, management of rehearsal conflict, and the allocation and perception of roles.



### 4.3.1 *Rehearsal activities, structure and goals*

Rehearsal activities were rated for importance. Using principal component analysis, the large number of variables was reduced to reveal four main factors or groups of activities reported within rehearsal and between groups at different stages of rehearsal. The extent to which ensembles plan and order these tasks, the ways in which they do so, and the range of rehearsal goals reported, suggest an idiosyncratic, flexible approach. Rehearsal structure and activities are also influenced by stage of rehearsal.

#### 4.3.1.1 Rehearsal activities

To explore the structure and content of rehearsal activities, data from the combined sample were analysed to establish which aspects of ensemble were considered most important. Rehearsal tasks were rated according to importance in relation to their group's preparation for performance, where 1=not at all important and 5=extremely important. Results are summarised in Figure 4.1. Work on expressive aspects and on balance and clarity were seen as most important – least important were listening to own recordings, coaching of weaker players, and warmup exercises. In addition to the list provided in the survey, respondents had the opportunity to report additional rehearsal tasks. There were relatively few of these. These included *social time* (9 mentions) and *talk time/discussion* (5 mentions). Further rehearsal strategies reported included running whole work(s), use of metronome, articulation, changing parts, improvisation, interpretation, and staging/choreography. Other comments referred to the continuous nature of the tasks making them difficult to categorise (4 mentions), or the fact the rehearsal tasks varied very widely (4 mentions).

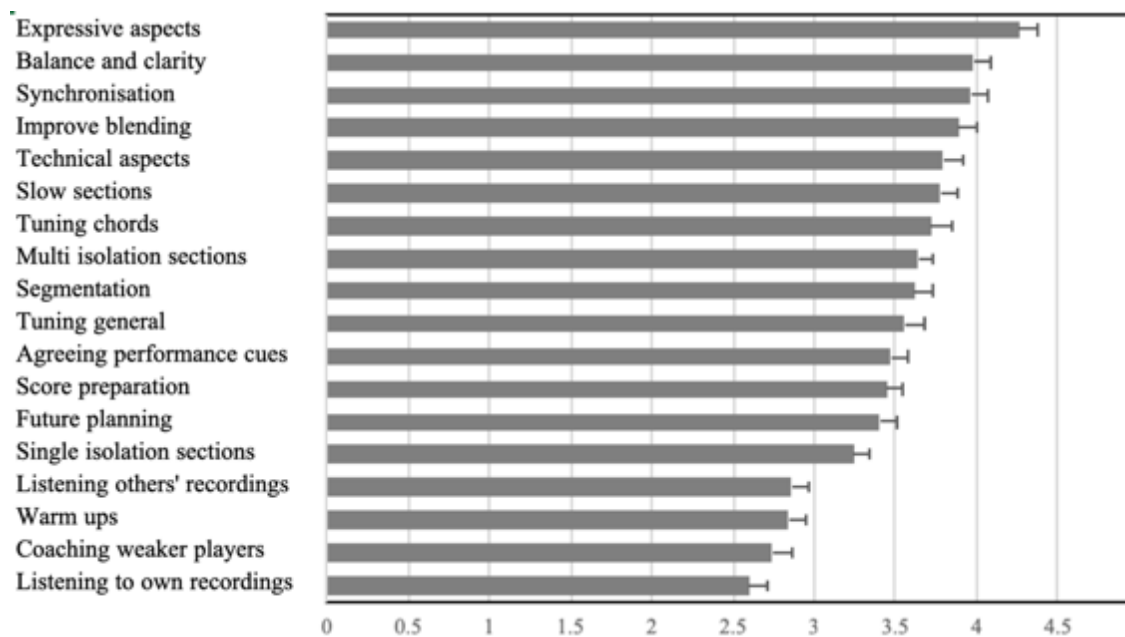


Figure 4.1 Mean rating (+S.E.) of importance of rehearsal elements to group preparation for performance

Principal component analysis was used to explore underlying structure in the data, based on correlations between importance ratings and enabled exploration of the interrelationships between the variables, from which groupings of the components ('factors') could be determined (Field, 2009).

Missing data (ensemble type), from three respondents meant these were removed from the sample for this analysis (n=126). Principal component analysis was conducted on the 18 variables, for 126 respondents, with oblique rotation (oblimin). The Kaiser-Meyer-Olkin measure was used to verify the sampling adequacy for the analysis, 0.88, which is well above the minimum score required (Field, 2009). Bartlett's test of sphericity,  $\chi^2(153) = 1165.90, p < 0.01$ , indicated that correlations between items were sufficiently large for factor analysis. An initial analysis was run to obtain eigenvalues for each component in the data. Four components had eigenvalues over Kaiser's criterion of 1, and in combination explained 64.9% of the variance. The scree plot was slightly ambiguous as it continued to tail off gradually before stabilising to a plateau; however, using Kaiser's criterion four factors were retained in the final analysis. Table 4.6 shows the results from the pattern matrix used to produce factor loadings after rotation. These factor loadings were further checked using results from the structure matrix, which

reinforces the interpretation of the four factors and their components. The following colours are used to indicate the four factors:

Factor 1	Factor 2	Factor 3	Factor 4
----------	----------	----------	----------

Table 4.6 Summary of principal component analysis results for the importance of rehearsal elements; pattern matrix (n=126)

Rehearsal element:	Factor 1	Factor 2	Factor 3	Factor 4
Expressive aspects	.89	.01	.07	-.01
Synchronisation	.77	.03	.00	-.01
Balance and clarity	.76	-.07	-.15	.15
Improve blending	.74	.07	-.09	0.10
Technical aspects	.63	.21	-.19	-0.28
Performance cues	.54	-.04	.04	0.46
Score preparation	.33	.24	-.12	0.14
Work on segments	.10	.83	.04	-0.14
Isolation of single lines	-.01	.81	.28	0.23
Slow sections	.08	.69	-.28	-0.23
Coaching fellow players	-.15	.67	-.15	0.23
Isolation of several lines	.27	.66	-.04	-0.05
Warm ups	-.01	.01	-.79	0.12
Work on tuning	.25	-.01	-.68	0.20
Tuning specific chords	.39	.19	-.53	-0.06
Listening to others' recordings	-.01	.02	-.25	0.72
Listening to own recordings	.10	.16	-.18	0.67
Future planning	.37	.11	.28	0.54
Eigenvalues	7.48	1.67	1.4	1.13
% of variance	41.55	9.29	7.79	6.28
Cronbach's alpha	0.88	0.83	0.76	0.71

Extraction Method:

Values >.4 are highlighted in colour

Principal Component Analysis.

Rotation Method:

Oblimin with Kaiser Normalisation.

Reliability analysis of the subscales relating to the four factors were carried out. All principal component (PC) factors had good reliabilities, as assessed by Cronbach's  $\alpha$ ; PC Factor 1  $\alpha = 0.88$ , PC Factor 2  $\alpha = 0.83$ , PC Factor 3  $\alpha = 0.76$ , and PC Factor 4  $\alpha = 0.71$ . Factors 3 and 4 had slightly lower reliability ratings, as they had fewer items in the subscales. However, they were still in an acceptable range. As a further check, reliability ratings were also assessed for the individual scales for their impact on each factor rating for Cronbach's  $\alpha$  if they were deleted. However, as all  $\alpha$  values of individual components were less than the standardised

value for the subscale, it was concluded that no individual scale, if removed, would increase reliability.

Based on these groupings, four themes were identified. These were interpreted as follows: factors relating to work on overall ensemble (PC Factor 1), specific problem-solving or troubleshooting activities (PC Factor 2), warm ups and tuning (PC Factor 3), and tasks relating to reflection and future focus (PC Factor 4). The four PC Factors were used to explore whether there were consistent patterns in the timing of commonly used rehearsal tasks, and whether they occurred at the start, middle or end of the rehearsal or outside it (see Table 4.7).

Respondents indicated which activities formed part of their most recent rehearsal, with approximate timing within the rehearsal period (start, middle or end), and their importance. PC Factor 1 tasks, which related to work on matters relating to the ensemble as a whole, were generally carried out in the main ('middle') part of the rehearsal, with the exception of work on technical demands, which also happened outside the rehearsal itself. This is consistent with the generally accepted practice of ensemble members preparing their own parts prior to group rehearsals. PC Factor 2, which focused on problem-solving activities, were also most frequently reported as part of the middle section, as group members respond to issues arising during rehearsal. PC Factor 3 related to warm up and work on tuning, most often reported at the start of rehearsal, although tuning work on specific chords extended into the main body of the rehearsal. PC Factor 4 tasks most frequently occurred outside or between rehearsals, although planning of future performances was also something that happened at the end of a session.

Table 4.7 Summary of inclusion and general timing of rehearsal tasks

Factor	Rehearsal activities	Included	Timing within rehearsal			
			Start	Middle	End	Outside
1	Working on expressive aspects	89.9	3.9	65.1	18.6	2.3
1	Work to improve synchronisation	83.2	6.2	69.8	6.2	0.0
1	Working on technical demands	81.4	7.8	33.3	2.3	38.0
2	Slow practice of passages	81.4	8.5	61.2	2.3	9.3
4	Planning future performances	81.4	7.0	3.1	33.3	38.0
1	Work to improve blending of sounds	80.6	3.1	67.4	9.3	0.8
2	Isolation of several instruments or voices	79.1	2.3	73.6	2.3	0.8
1	Work on balance and clarity of voices	78.3	3.9	63.6	10.1	0.8
2	Segmentation: breaking music into sections	78.3	8.5	64.3	3.1	2.3
3	Tuning specific chords or progressions	73.9	5.4	58.1	7.8	1.6
1	Establishing cues for performance	67.4	7.0	43.4	10.9	6.2
2	Isolation of single instruments or voices	67.4	1.6	58.9	1.6	5.4
-	Preparing or revising scores or parts	65.9	11.6	10.9	-	43.4
3	Exercises to check intonation	59.7	31.8	18.6	1.6	7.8
4	Listening to recordings of others	56.8	2.3	3.1	3.9	46.5
3	Warm ups	47.3	29.5	0.0	0.0	17.8
2	Coaching or supporting weaker players	37.4	2.3	24.8	3.9	5.4
4	Listening to recordings of own groups	35.9	2.3	2.3	7.0	23.3

Factors 1-4 indicated by coloured cells, as defined in Table 4.6

Overall, these factors and their relative timing create a picture of what might be considered a ‘typical’ rehearsal, drawn from this mixed sample of groups of different sizes and types. The basic template can be summarised as shown in Figure 4.2.

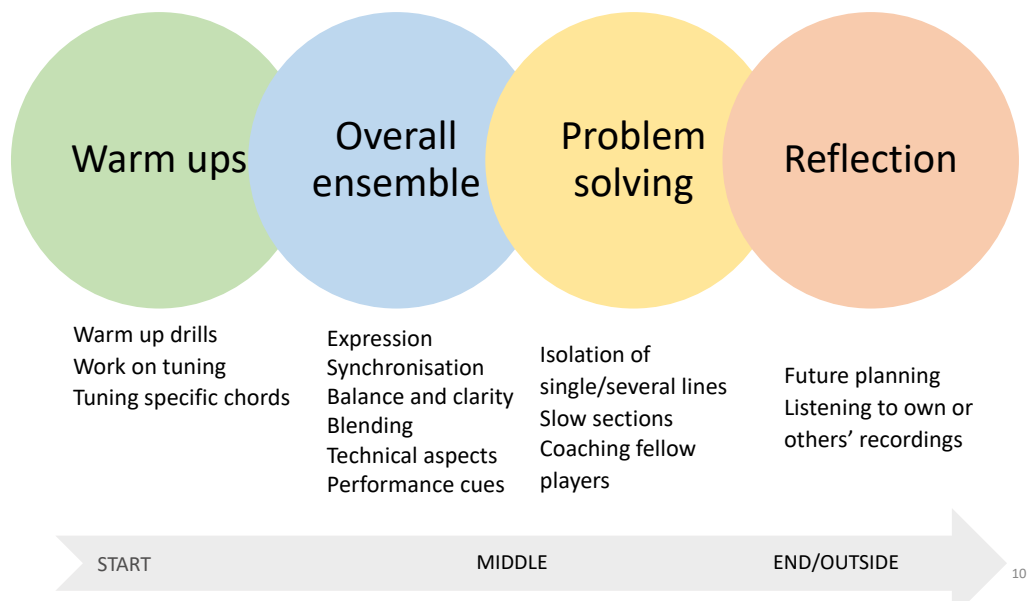


Figure 4.2 Summary of basic groupings of rehearsal task, based on factors identified using principal component analysis

#### 4.3.1.2 Planning and ordering of tasks

In order to establish to what extent rehearsal structure is predetermined or planned in advance, respondents were asked which statements best described their group practices. Most respondents (48.1%) indicated that there is no set pattern to rehearsal, or that it is dependent on how close to a performance the rehearsal is (39.5%) (see Table 4.8).

Table 4.8 Frequency of planning behaviour: Predetermined nature of rehearsal structure (N=129)

How the order of rehearsal activities is decided	Frequency	%
It varies, there's no set pattern	62	48.1
It depends on how close to a performance	51	39.5
We always do same things but in a different order	8	6.2
Other	6	4.6
We always do things in the same order	2	1.6
Total	129	100.0

Of the six respondents answering 'other', all gave further details, which were variations on 'it varies, there's no set pattern'. Respondents were also asked how rehearsals are planned (see Table 4.9). Most indicated that there is a collective

planning process at the start of rehearsal (33.3%) or that ‘it just evolves’ (32.6%). Consistent with responses in Table 4.8, relatively few respondents (5.4%) said that the same structure applies every time.

Table 4.9 Frequency of planning behaviour: Decision making and rehearsal structure (N=129)

Who decides order of rehearsal activities?	Frequency	%
Plan collectively at start of rehearsal	43	33.3
No plan, it just evolves	42	32.6
In advance by one person	16	12.4
In advance by several people	13	10.1
Other	8	6.2
Same every time	7	5.4
Total	129	100.0

Choice and order of rehearsal tasks were found to be most frequently decided collectively at the start of rehearsals. A large majority of respondents (48.1%) indicated that there is no set pattern to rehearsal, or that it is dependent on how close a rehearsal is to a performance (39.5%). Respondents were also asked how rehearsals are planned, the majority reporting a collective planning process at the start of rehearsal (33.3%) or that ‘it just evolves’ during the rehearsal period (32.6%). Different types of group described different strategies to planning. Some selected examples are included for illustration:

A member of a professional group described a wide variation:

There is considerable variation in our rehearsal process, partly because our repertoire has quite different demands in different pieces. Therefore, what is described for one rehearsal is not always true for all.

A member of a semi-professional saxophone ensemble had a routine, which was flexible:

We always start with warm up exercises, which vary slightly each time, then move on to rehearsing music for our next concert or exploring new repertoire.

A member of an amateur string quartet described spontaneous planning:

We don’t rehearse for performance, so we agree on something we’d all like to do. Sometimes we work on one piece over several sessions, other times we just play through.

#### 4.3.1.3 Goals

Group goals were evaluated according to whether the groups reported a primary focus of ‘performance’, ‘repertoire’, or ‘social’ goals for rehearsal. Respondents were asked to indicate which ranked as most, moderately and least important.

Table 4.10 summarises frequency and percentages in each primary goal focus. More than half (51.2%) of respondents rated performance goals as most important. Most (58.9%) rated repertoire focus as moderately important. There was a fairly even split of responses for social focus across least, moderate and most important. These goals suggest a wide range of reasons for participation in chamber ensembles and are likely to reflect the range and mix of ensemble members participating in the survey, and the mix of professional and non-professional groups.

Table 4.10 Rating of performance, repertoire or social as primary goal focus ( $N=129$ )

Primary goal	Importance	<i>N</i>	%
Performance	Least	36	27.9
	Moderate	27	20.9
	Most	66	51.2
		129	100.0
Repertoire	Least	7	5.4
	Moderate	76	58.9
	Most	46	35.7
		129	100.0
Social	Least	39	30.2
	Moderate	47	36.4
	Most	43	33.4
		129	100.0

#### 4.3.1.4 Activities and structure at different preparation stages

Next, these factors and other elements of the rehearsal process were explored further by the stage of rehearsal which groups were at. As explained earlier, the responses were assigned to one of three groups – those with no particular focus (Group 0), those at the early stages of rehearsal (Group 1), and those in the final stages before a performance (Group 2). Comparison of groups at different stages included rehearsal tasks and their order.

There was an increase in frequency of tasks reported as performance approached, suggesting more structured rehearsals. However, this picture is nuanced by the purpose of the groups represented (amateur, professional). The factors



identified through principal component analysis were used to group rehearsal tasks. Comparisons by rehearsal stage were made using chi-square analysis (see

Table 4.11). Comparisons of rehearsal tasks showed consistent differences between groups at the three stages of preparation. Group 2 reported inclusion of more tasks related to work on expression, performance cues, blending, and isolation of several voices. Group 0 reported less use of score study, isolation of single voice or instrument, work on tuning, and reflection and planning tasks (Pennill & Timmers, 2017).

Table 4.11 Results of chi-square analysis of percentage of respondents reporting inclusion of tasks by rehearsal stage

Factor	Rehearsal task	Rehearsal stage			$\chi^2$	<i>p</i> value	Cramer's <i>V</i>
		Group 0	Group 1	Group 2			
1	Balance	18.5	26.9	32.4	24.95	.000	.481
	Technical	25.0	25.0	30.6	5.252	NS	.221
	Expression	27.8	28.7	33.3	11.09	.004	.320
	Performance cues	18.5	21.3	27.8	8.08	.018	.273
	Synchronisation	24.1	25.9	32.4	11.03	.004	.320
	Blending	21.3	26.9	31.5	10.07	.000	.386
2	Segmentation	25.0	24.1	28.7	2.64	NS	.156
	Slow sections	27.8	25.0	25.9	0.89	NS	.091
	Single line	18.5	25.0	25.0	9.44	.009	.296
	Multi line	23.1	26.9	29.6	9.25	.010	.293
	Coach weaker	10.2	13.9	14.8	3.03	NS	.167
3	Warm up	13.9	13.0	19.4	2.68	NS	.157
	Tuning	14.8	20.4	24.1	8.43	.015	.279
	Tune chords	20.4	25.9	26.9	9.43	.009	.296
4	Listen own	6.5	10.2	18.5	10.87	.004	.317
	Listen others	17.6	14.8	22.2	2.39	NS	.149
	Plan future	25.0	26.9	31.5	8.76	.013	.285

Comparing the stages of rehearsal within each of the four factors suggested most variation by stage in Factor 1, characterised as 'overall ensemble'. Differences in reported inclusion of all tasks were apparent in the final stages of rehearsal, which were higher than other stages. Significant differences between stages were found in reported work on balance, expression, performance cues, synchronisation, and blending. Overall, these suggested an increased focus on ensemble-related tasks as performance approaches.

With the problem-solving aspects identified in Factor 2, the differences are less consistent between stages of rehearsal. Differences in reported inclusion of isolation of several lines were apparent in the final stages of rehearsal, which were higher than other stages. Single line isolation was greater in later stages. A commonly reported approach to rehearsal is to break down material into segments. However, there was no significant difference between rehearsal stages. Likewise, no differences were found between stages in the use of slow sections.

For Factor 3, no significant differences were found in reported use of warm ups between stages. Inclusion of warm ups was relatively low. Later stages of rehearsal were associated with higher levels of reported focus on intonation in terms of both general tuning and work on tuning specific chords.

In Factor 4, no significant differences were found in reported use of recordings of others between stages. Few groups reported using their own recordings in rehearsal; however, it was more prevalent in later stages of rehearsal. There was a small but significant difference by rehearsal stage in inclusion of future planning activities.

Ways of ordering tasks and planning were compared by stage. A chi-square test for independence (with Yates Continuity Correction) indicated a significant association between stage of rehearsal and presence of a plan ( $\chi^2(2, n=108) = 10.386, p < .01, \text{Cramer's } V = 0.310$ ). Respondents with no imminent performance were more likely to report the presence of plan than those in early or final stages of preparation (see Figure 4.3). Group 0 were more likely to have a rehearsal plan in place than other groups. Group 1 were least planned. Comparing groups with performance or social goals revealed no significant differences.

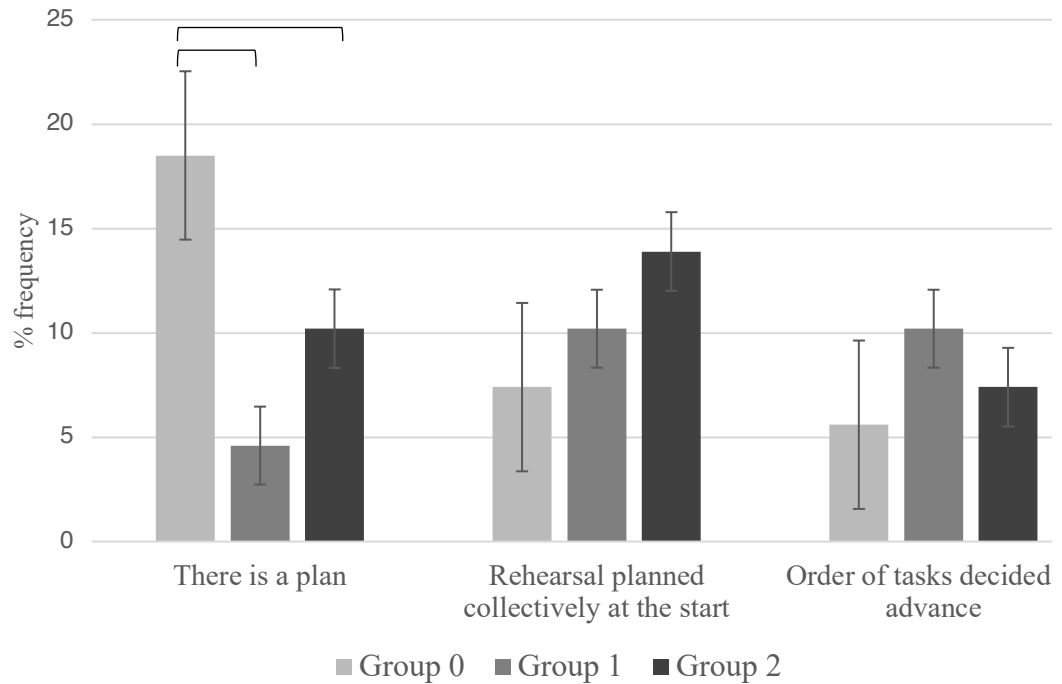


Figure 4.3 Type of planning behaviour by groups at different rehearsal stages (error bars indicate standard error of mean). Significant differences ( $p < .01$ ) indicated by brackets.

#### 4.3.1.5 Summary - rehearsal activities, structure and goals

The results of this study provide evidence of a framework for commonly-used methods of rehearsal, comprising a set of activities which are common both across and within groups. The list of possible tasks provided for respondents to choose from was not comprehensive (see full survey, Appendix B). However, the fact that relatively few additional tasks were identified suggests the existence of common practices for groups represented in the sample. Analysis of rehearsal tasks and ordering suggests a set of activities that are consistently reported across and within groups. Whilst they varied in perceived importance, factor analysis suggested four sub-goals forming the basis of many rehearsals. These activities were ordered consistently, with the start of rehearsal providing the opportunity for warming up, tuning, and deciding on short-term goals ('tuning in'); the main body of rehearsal working between longer term ensemble goals and short-term problem-solving activities; and the later part of the rehearsal for reflection or future-focused planning. Between rehearsals there were further tasks identified: score study, listening to recordings, and working on technical aspects through personal practice. This is

consistent with, and builds on, previous work on rehearsal structure. It supports King's theoretical framework for ensemble structure, which proposes a working model comprising an overall plan, a session plan, and plans for individual pieces (King, 2004). Whilst it is well established that rehearsal provides the opportunity for groups to surface, agree, and prepare the elements required for performance, the findings from this research suggest they achieve this through a combination of structured tasks, shared knowledge, and interpersonal interactions, in a series of dynamic processes that evolve over time (Figure 4.4).

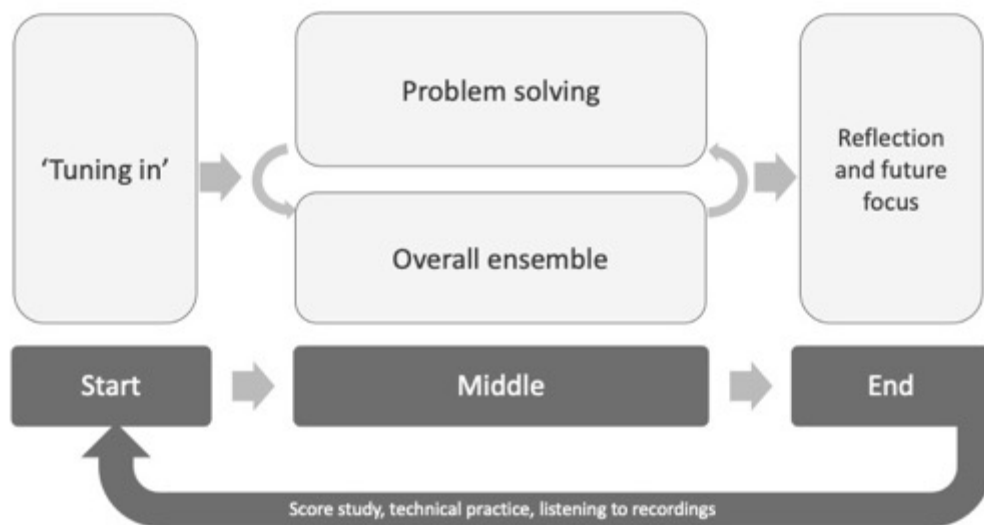


Figure 4.4 A framework for ensemble rehearsal

### 4.3.2 Rehearsal communication and roles

Communication in rehearsal was investigated in relation to the reported use, amount, and type of verbal and nonverbal modes. A key aspect of the investigation was to explore whether and how the balance of explicit (e.g. talk) and implicit (e.g. nonverbal) modes of communication was different in groups at different preparation stages. Ensemble members reported how much, and what type, of verbal and nonverbal communication were used in rehearsals. Results were compared by rehearsal stage. Sources and resolution of rehearsal conflict were also reported, giving a further insight into the ways that interpersonal dynamics are manifested and managed. Finally, the way that formal or informal roles are allocated, and ways that ensembles interpret the function of leadership, were explored.

#### 4.3.2.1 Talk in rehearsal

Respondents were asked how much time was generally spent talking in rehearsal. There was a wide variation in talk time as a percentage of total rehearsal time reported during rehearsals, summarised in Figure 4.5. The mean was 35.04%, SD=17.90, and mode 30%. The maximum was 80%, and two respondents reported no talk during rehearsal.

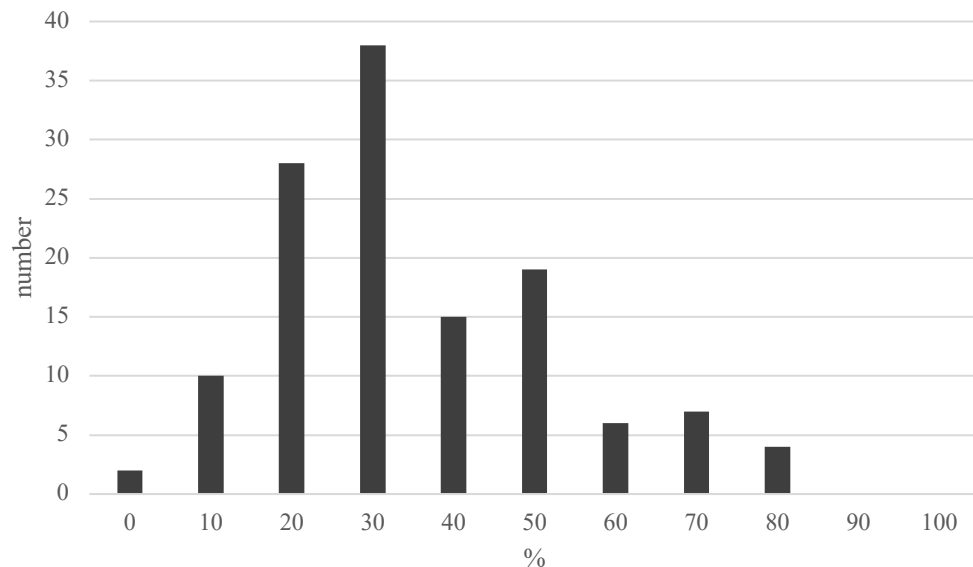


Figure 4.5 Frequency distribution of amount of rehearsal talk (% of total rehearsal time)  
N=129

Respondents rated types of rehearsal talk according to amount and importance. A plot of importance versus amount of each of five main types of talk (social, ensemble, technical, interpretation and administration) shows that the mean responses fall into three quadrants, with talk about ensemble and interpretation in high-high (both amount and importance are rated high), technical and administration talk in high-low (importance high but amount low), and social in low-low (see Figure 4.6). This suggests that most talk is about musical interpretation and ensemble matters, which are also viewed as the most important topics.

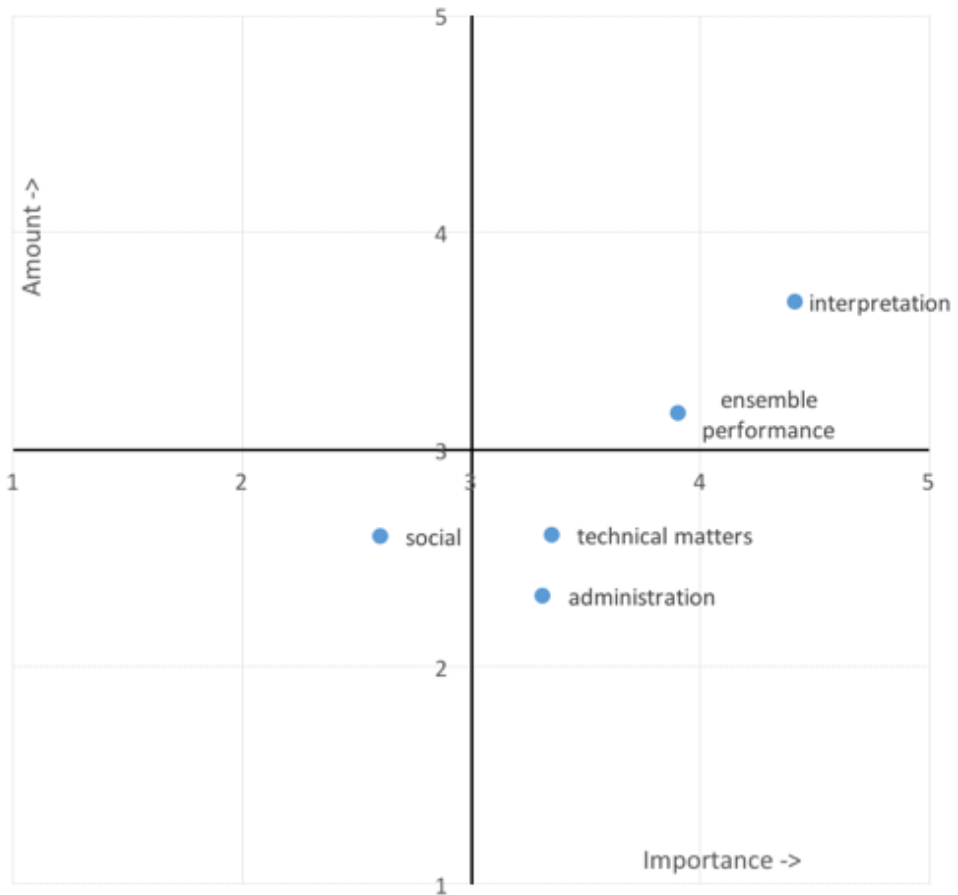


Figure 4.6 Rehearsal talk amount and importance by type, relative to mid-point (hypothetical mean) of 3.0

One sample *t*-tests were used to compare ratings with a hypothetical mean score of 3.0, assuming all questions were answered at the mid-point. Results are summarised in Table 4.10. All except amount of ensemble performance talk differed from the hypothetical mean at the  $p < .01$  confidence level, with alpha adjustment for multiple testing. Of those significantly different from the mean, the amount of technical and administration talk, and importance and amount of social talk were rated lower than the hypothetical mean. Amount and importance of musical interpretation, and importance of technical, ensemble performance and administration talk, were rated higher than the mean.

Table 4.10 Amount and importance of rehearsal talk type in the ensemble. Mean ratings (on a scale of 1–5) and standard deviations ( $N=129$ ) vs test value of 3.0

Rehearsal talk type	Measure type	Mean	S.D.	<i>t</i>	df	<i>p</i> value
Social	Amount	2.60	1.05	-4.36	128	.000
Musical interpretation	Amount	3.68	1.17	6.61	128	.000
Technical	Amount	2.61	1.11	-3.98	128	.000
Ensemble performance	Amount	3.71	1.23	1.57	128	.118
Administration	Amount	2.33	1.00	-7.65	128	.000
Social	Importance	2.60	1.27	-3.62	128	.000
Musical interpretation	Importance	4.41	0.90	17.84	128	.000
Technical	Importance	3.35	1.14	3.47	128	.000
Ensemble performance	Importance	3.90	1.09	9.38	128	.000
Administration	Importance	3.31	1.21	2.91	128	.004

Amount and type of verbal behaviour were compared by rehearsal stage. Comparison of amount of talk by groups showed less social talk, more interpretation, and more focus on performance in later stages of rehearsal. There was no difference in amount of technical talk or talk related to administration. One-way ANOVA was used to compare amount of rehearsal talk in each category by rehearsal stage, using Bonferroni adjusted alpha levels of .01 per test. Significant differences were found in social, interpretation, and performance talk types. Post-hoc tests (Tukey) showed that these differences were between Group 2 and Group 0 in each of these three talk types, and also between in Group 1 and Group 0 in the category of interpretation. Social talk decreased across rehearsal stage, whilst there was more talk on interpretation, performance, technical matters, and administration as the stage of rehearsal approached performance (see Figure 4.7).

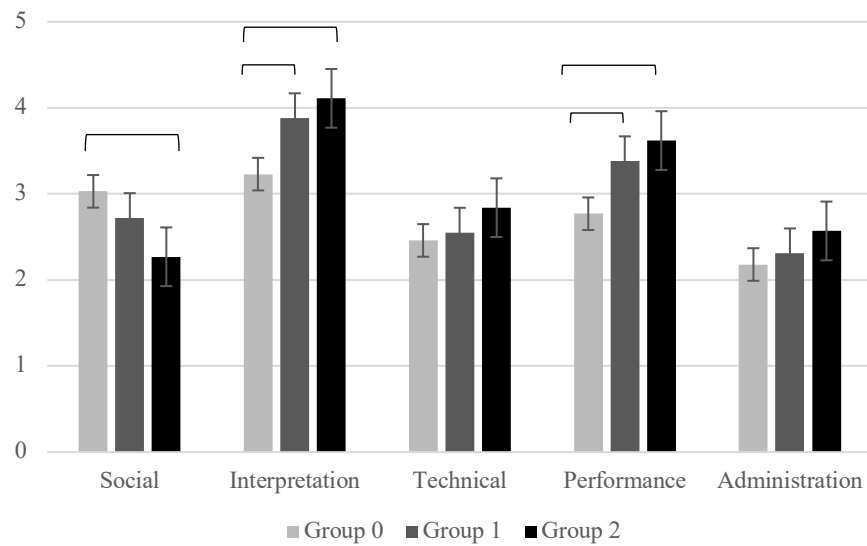


Figure 4.7 Amount of talk type by topic, mean score by rehearsal stage. Error bars indicate standard error of mean. (Group 0=no performance, Group 1=early, Group 2=late stage). Significant differences ( $p < .01$ ) indicated by brackets

Overall, the findings suggest a wide variation of talk time, with a mean of 35% of rehearsal time. There were no overall differences by stage, although when talk topics were compared, a decrease in social topics and increase in interpretation and performance topics were apparent.

#### 4.3.2.2 Nonverbal communication

Respondents were asked to identify which types of nonverbal communication were used in rehearsal, performance, both or neither. Types of nonverbal communication were reported according to use in rehearsal, performance, both rehearsal and performance, or neither (see Table 4.11).



Table 4.11 Nonverbal communication in rehearsal. Percentage of respondents reporting use in rehearsal and performance (N=129)

Type	Both rehearsal & performance %	Rehearsal only %	Performance only %	Neither %
Eye contact	80.6	13.2	0.8	5.4
Auditory cues	74.4	17.1	0.8	7.8
Positive facial expressions	68.2	17.1	3.9	10.9
Mutually agreed gestures	65.1	7.0	1.6	26.4
Instrument movements	64.3	14.7	0.8	20.2
Rhythmic body sway	53.5	13.2	1.6	31.8
Head nods	52.7	23.3	0.8	23.3
Negative facial expressions	11.6	33.3	1.6	53.5
Spoken cues	7.0	41.9	0.8	50.4
Foot tapping	4.7	26.4	0.0	69.0

A range of modes of nonverbal communication were reported. Most were used in both rehearsal and performance – especially important were eye contact, use of auditory cues, positive facial expressions, and other gestures and instrumental movements. More than 90% of respondents reported using spoken cues either not at all, or only in rehearsal, consistent with the conventions of Western classical music performance practice. Communication methods used only in rehearsal were negative facial expressions (33.3%), head nods (23.3%) and foot tapping (26.4%). Again, this may be because these gestures would be visible or audible to an audience and so be contrary to expected performance etiquette. There were very few reports of communication mechanisms that were used only in performance, suggesting that, by the time performance happens, gestures are embedded through rehearsal and additional cues are less likely to be introduced.

Reported use of different types of nonverbal communication were investigated by rehearsal stage and showed a range of different patterns of behaviour (see Table 4.12). Chi-square analysis showed significant differences in eye contact, negative facial expressions, use of mutually agreed gestures, and spoken cues between groups at different rehearsal stages. Eye contact was significantly lower in later stages, whilst use of mutually agreed gestures increased. Reported use of negative facial expressions was greatest in the final stages of rehearsal and was least

in the early stage of rehearsal. (The same pattern of behaviour was also noted in use of positive facial expressions, although these differences were not found to be significant.) Use of spoken cues was greatest in groups without an immediate performance, and again was lowest in early stage rehearsals.

It should be noted that, given the survey format, these data are reliant on respondents' recall and perception, and need to be verified in future studies through direct observation.

Table 4.12 Nonverbal communication type – percentage of respondents reporting use by rehearsal stage (n=108)

Nonverbal communication	Group 0	Group 1	Group 2	<i>p</i> value
Eye contact	16.7	2.8	0.9	.000
Positive facial expressions	30.6	26.9	33.3	NS
Negative facial expressions	13.0	10.2	24.1	.002
Auditory cues	32.4	29.6	30.6	NS
Mutually agreed gestures	20.4	22.2	30.6	.005
Spoken cues	25.9	8.3	17.6	.001
Head nods	31.5	20.4	25	NS
Instrument movements	31.5	21.3	26.9	NS
Rhythmic body sway	23.1	17.6	25.9	NS

The difference in eye contact between Group 0 and Groups 1 and 2 suggests that it is less important as performance approaches. This is consistent with the findings of King and Ginsborg (2011) who found “surprisingly little” eye contact (p. 197) in their study of rehearsal between performers of different familiarity and expertise. However, there is more use of mutually agreed gestures and negative and positive facial expressions in Group 2, suggesting the development of a wider vocabulary of gestures unique to the group. Auditory cues were consistently important across all groups. Use of structural landmarks as a way of learning for both solo performers (Gruson, 1988) and in ensemble settings (Williamon & Davidson, 2002) may be a further way in which auditory cues are used to support implicit coordination throughout rehearsal. Indeed, a recent study of nonverbal regulators in a rehearsal and performance of two string quartets (Biasutti, Concina, Wasley, & Williamon, 2016) found that eye contact was highly idiosyncratic and

subject to the context, whilst body gestures, often aligned to articulation of attack, were more standardised and related to structural landmarks in the score.

#### 4.3.2.3 Managing conflict

Conflict was considered as special category of rehearsal communication. Respondents were asked which topics give rise to tensions or differences of opinion. Multiple selections could be made by each respondent. Figure 4.8 shows the results for all respondents. Of those reporting issues, musical interpretation (73.6%) and repertoire (57.4%) were most frequently cited reasons. Punctuality, lack of personal responsibility, insensitivity to balance, disagreements over tempi, and whether to play repeats could also be sources of tension. The remainder took the opportunity to say that conflict was rare or non-existent in their group.

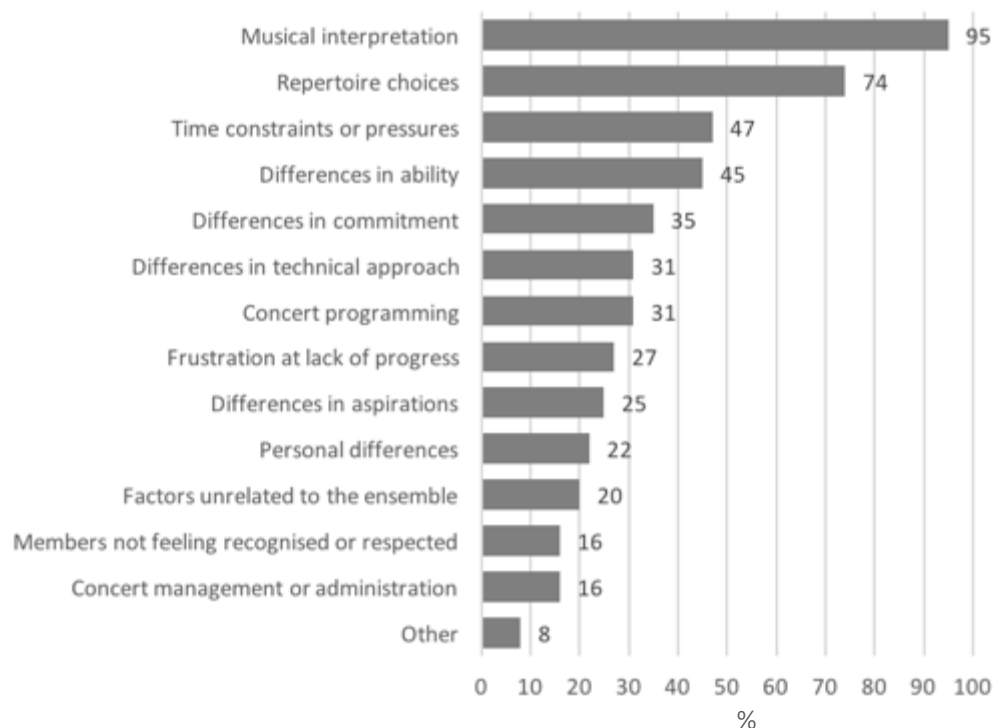


Figure 4.8 Reported reasons for conflict – frequency shown as % (all respondents,  $N=129$ )

Respondents rated ways in which conflict was resolved on a scale where 1=never and 5=all the time. One-sample  $t$ -tests were used to compare ratings with a hypothetical mean score of 3.0, assuming all questions were answered at the mid-point. A Bonferroni adjustment was applied to correct for multiple testing, giving an alpha value of  $p<.01$ . Results are summarised in Table 4.13. All except ‘using jokes

or laughter' differed from the hypothetical mean at the  $p < .01$  confidence level. Resolution through playing and discussion were rated significantly higher than the mean, and changing topic, having a cooling-off period, and not resolving issues were rated significantly lower.

Table 4.13 Reported methods of conflict resolution: Mean ratings and standard deviation (on a scale 1-5) vs hypothetical mean

Resolution method	Mean	S.D.
Through playing	3.53	1.09
Through discussion	3.54	1.06
Don't resolve	1.72	0.97
Cooling-off period	1.71	1.03
Joking or laughter	3.07	1.15
Changing topic	2.38	1.23

Other methods and comments relating to conflict resolution were reported, including post-rehearsal private resolution, the desire to resolve things quickly in order to get playing, and hoping that the disagreement will be forgotten by next time. There was evidence of unresolved conflict, too. One respondent, a member of an amateur string quartet, gave some contradictory responses revealing underlying issues that had not been resolved. They ascribed the cause of an unsatisfactory recent rehearsal as being due to a resentment from previous conflict, saying, "There was a row between myself and the cellist a couple of months earlier and I'm finding it difficult to be upbeat and positive about the quartet as I'm still angry with him." However, asked about how the group resolved conflict he said, "We generally share decisions and find a compromise on things we don't agree on", but later, giving details on how performances are planned, the problem with the cellist resurfaced: "We generally agree what we will do in a performance but on occasion, on the day, the cellist or first violin will go back to doing what they originally wanted to do :-)."

More conflict (amount and severity) was reported in groups nearer performance: time constraints, concert programming, and concert management were most often reported as sources of conflict in groups near performance (Figure 4.9).

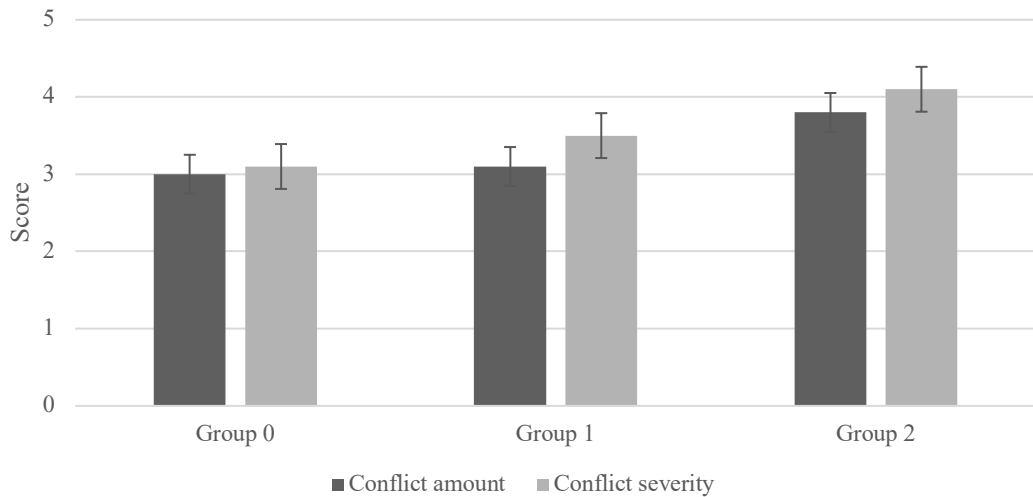


Figure 4.9 Rating of conflict (amount and severity) as performance approaches. Ratings on scale, error bars indicated standard error of mean). Group 0=no performance, Group 1=early, Group 2=late stage

One-way ANOVA was used to compare the percentage of respondents reporting reasons for conflict by rehearsal stage. Post-hoc tests (Tukey) showed significant differences between stage in reports of time constraints and concert preparation. These comparisons are shown in Table 4.14 and Figure 4.10.

Table 4.14 Reasons for conflict reported by members of groups at different rehearsal stages

Reasons for conflict	Group 0	Group 1	Group 2	<i>p</i> value
Time constraints	8.3	8.3	22.0	.000
Concert programming	3.7	9.3	13.0	.017
Concert management	1.9	2.8	8.3	.035
Interpretation	25.9	21.3	27.8	NS
Repertoire	20.4	17.6	20.4	NS
Lack of involvement	3.7	2.8	6.5	NS
Differences in approach	9.3	7.4	7.4	NS
Differences in ability	15.7	12	11.1	NS
Differences in commitment	11.1	8.3	9.3	NS
Differences in aspiration	9.3	5.6	6.5	NS
Personal differences	3.7	5.6	8.3	NS

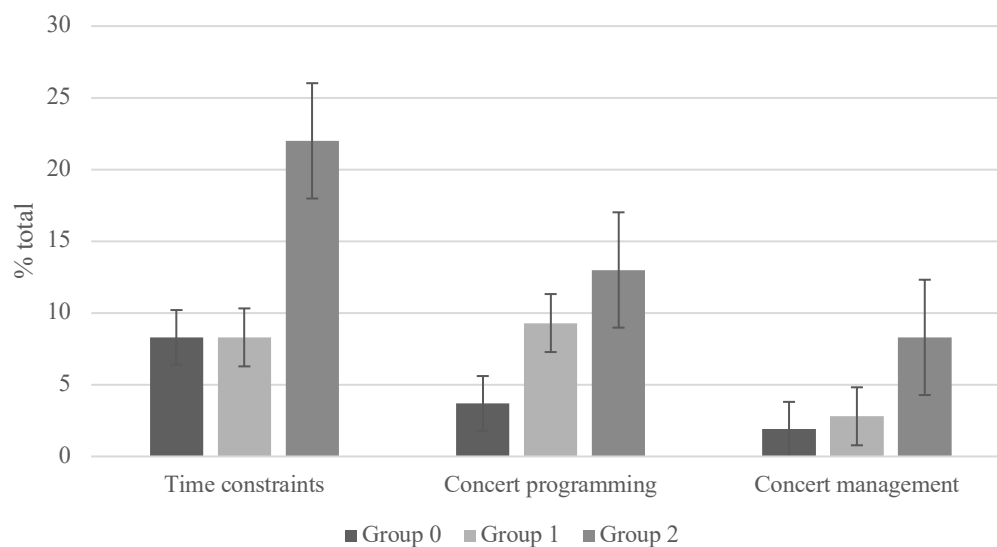


Figure 4.10 Most frequently reported reasons for conflict by groups at different stages of rehearsal. Error bars indicate standard error of mean. (Group 0=no performance, Group 1=early, Group 2=late stage)

Overall, levels and severity of conflict were generally low, mean score (0–100 scale) of 14.45 for amount and 16.5 for severity. Severity and amount were highly correlated. No effects of group type or size were found. The most common reasons for conflict were issues around interpretation and repertoire choices.

#### 4.3.2.4 Roles

Roles in ensembles have been shown to facilitate communication and stability (King, 2006). Respondents were asked to describe their own and others' roles in the ensemble. The results are summarised in Table 4.15 and Table 4.16. Most (74%) reported no defined roles, suggesting that organisation was informal.

Table 4.15 Frequency of reported roles ( $N=129$ )

Role type	n	%
Clearly defined roles (as specified)	26	20
No defined roles but things get done	82	63
No defined roles, don't get things done	14	11
Other way of organising	7	6
Total	129	100

For the relatively small number of ensembles where clearly defined roles were indicated, the following descriptions were reported (see Table 4.16). Overall, therefore, of the total sample, 10% had a director or leader. The role of ‘leader’ is further explored in the following section.

Table 4.16 Frequency of ‘clearly defined’ roles reported (n=26)

Role	Number of mentions	%
Director or leader	13	50
Music librarian	8	31
Rehearsal organiser	7	27
Publicity	5	19
Finances	4	15
Coach or conductor	4	15
Bookings	2	8
Programming	1	4
Wardrobe	1	4

Size of group has been reported to impact whether a conductor or single leader is needed, based on the ability of groups to synchronise to each other or to the focus of a leader (Rasch, 1988). To explore this in the current sample, reported leadership style was investigated in relation to group size. Analysis of leadership style revealed an effect of group size on reports of single or shared leadership (see Table 4.17). Whilst more than half of the respondents reported that leadership was equally shared, this varied by group size.

Preliminary analyses showed that the data violated assumptions of normality. The relationship between leadership style and group size was therefore investigated using Spearman’s rank order correlation. There was a moderate negative correlation between group size and shared leadership,  $\rho = -.269$ ,  $N=129$ ,  $p < .001$ , with larger group size associated with lower levels of shared leadership. To follow up the results from the correlation, ensembles were assigned to duo, small or medium-size groups, and chi-square tests for independence for shared and single leadership conducted. These indicated a significant association between size of group and single leader,  $\chi^2(2, N=129) = 15.96$ ,  $p < .01$ , Cramer’s  $V=0.352$ ; and between size of group and shared leadership,  $\chi^2(2, N=129) = 16.12$ ,  $p < .01$ , Cramer’s  $V=0.353$ . Using the standardised residuals (SR) from the chi-square test suggested that the effect (SR

values outside  $\pm 1.96$ ) related to groups of 6+ members, so that the larger group size (6–15) demonstrated a greater frequency of single person leadership (SR=3.0) and a lower frequency in shared leadership (SR=-2.4).

Table 4.17 Leadership style by group size (N=129)

Type of leadership style	n	% percentage by group size			
		2	3-5	6-15	Total %
Leadership shared equally	65	7.0	40.3	3.1	50.4
Same person always leads	36	2.3	14.7	10.8	27.8
Two people lead	13	0.0	8.5	1.6	10.1
One person (different) leads	7	0.8	3.9	0.8	5.4
Other	11	0.0	4.7	3.9	8.5

Leadership style was also explored by the type of group (wind, string, voice, mixed). A significantly higher proportion of vocal ensembles reported single rather than shared leadership (63% of all voice groups, compared with string (22.0%), wind (23.3%) and mixed (29.0%)). Size of voice groups ranged from 3–9, so this it is not likely to be an effect of group size. No significant association was found between type of group and other leadership modes. Chi-square tests for independence indicated a significant association between type of group and those indicating ‘same person always leads’,  $\chi^2(3, n=126) = 8.21, p < .05$ , Cramer’s  $V=0.255$ . Using the standardised residuals from the chi-square test suggests that the cells significantly contributing to the effect (values outside  $\pm 1.96$ ) related to vocal ensembles.

#### 4.3.2.5 Summary - rehearsal communication and roles

No differences were found in total amount of talking, or amount or severity of conflict. However, reasons for conflict varied according to rehearsal stage; notably, time constraints and issues around concert planning were most frequently reported as a source of conflict nearer performance (Group 2). In later stages there was less social talk, and more talk on interpretation, performance, technical matters, and administration. Previous studies have reported a wide variation in talk versus playing time, including reports of as much as 52% and as little as 10% of rehearsal devoted to talk time in professional groups working intensively. This study also found a wide variation, from 0–80% time spent playing, with a mean of 35.04%. The



most important topics (as indicated by amount and perceived importance) related to interpretation and ensemble performance. No differences were found overall in amount of talk by groups at different stages, or in groups of different types and sizes. Amateur groups, which had a more social than performance focus, talked less than professional groups. Although there were no differences in total talk, there were some differences in amount of ‘social’ talk – string players engaged in more social talk than other group types. It was also apparent that groups at later stages reported less social talk, and more talk about interpretation and performance, when compared with groups without immediate focus. Taken together, these findings on rehearsal talk suggest that contributions to the wide variation of talk time may include the group’s instrumentation and professional status.

As a type of verbal communication, conflict and its management has previously been found to be an important aspect of ensemble cohesion and even cited as an indicator of success, at least where there are effective strategies for its resolution (Murnighan & Conlon, 1991). Whilst reported levels of conflict were generally low in this study, artistic reasons (musical interpretation and repertoire choice) were most frequently cited reasons for conflict, resolved most often by playing, discussion, or through the use of humour. This resonates with the findings of Bayley (2011) who observed the consistent presence of humorous exchanges throughout an intensive rehearsal of a professional string quartet, including its use to alleviate tension, and as a transition from talking to playing. When compared by stage, the amount and severity of conflict were greater in groups at later stages, and most often attributed to time constraints, and practical issues around concert programming and management.

Roles in the ensemble were mainly informal, although there were some commonly occurring roles identified. Leadership was most frequently reported as ‘shared equally’ although a large minority reported a single leader. Larger groups (6+) and vocal ensembles were more likely to have a single leader. No differences were found in the incidence of shared or single leadership in the three groups by stage. More than 20% of respondents reported clearly defined functional roles, including the organisation of music library, rehearsals, concerts, and publicity.

#### 4.4 Discussion and conclusions

The self-organised groups in this study showed variation across a series of rehearsals, in which their tasks, communication, and organisation were influenced by stage of preparation. Groups in later stages of rehearsal reported inclusion of more tasks related to ‘overall ensemble’ – balance, expression, performance cues, synchronisation, and blending. They were also more likely to work on sections involving multiple parts, listen to their own recordings, and engage in future planning. The relative contribution of different elements of rehearsal at different stages provides further evidence for a ‘flexible framework’ for rehearsal, which is adaptable according to stage. The structure of a musical rehearsal – the tasks and their sequence – can be characterised as a type of organisational routine, or “repeated patterns of behaviour that are bound by rules and customs” (Feldman, 2000, p. 611). Such routines provide stores of knowledge and meaning, and support coordination by providing a predictable approach to tasks. From the current study, rehearsals were generally open-ended, rather than pre-planned, with an element of planning reported at the start of rehearsals to map out a general outline. This is consistent with prior research (Bayley, 2011; Davidson, 1997; Davidson & Good, 2002; Williamon & Davidson, 2000, 2002) which showed that moment-by-moment events in rehearsal and performance provide the impetus for decision making, often triggered by musical features and landmarks. It also suggests a high degree of implicit knowledge as many aspects of process and technique are assumed to be known by all. It supports a view of rehearsal as a flexible ‘space’ in which ensembles work towards shared goals using a varying combination of tasks and actions, which are well understood by the players through culture and training. The degree of advance planning was also found to be influenced by rehearsal stage, so that groups with no immediate performance were significantly more likely to have a plan in place before rehearsal, compared with groups at other stages. This also suggests that groups further advanced in their performance preparation tend to use the focus of performance and responding to emerging issues to structure their activities.

Differences in both verbal and nonverbal communication were also apparent. Type (although not amount) of talk varied by stage, with a shift away from ‘social’ and towards more ‘interpretation’ and ‘performance’ topics. There were also fewer spoken cues in later rehearsal stages; this is consistent with the findings of scholars

who suggest that verbal modes of communication are gradually replaced by nonverbal cues in performance (King & Gritten, 2017). Types of nonverbal communication also showed differences in groups at early versus later stages. The survey findings support recent research that found that, whilst more use of gesture is reported in later stages, there is less eye contact (Biasutti et al., 2016). Nonverbal gestures have been assigned different meanings (Ekman & Friesen, 1969). In musicians a number of functions have been identified, including ensuring sound production, facilitating musical expression, and supporting interpersonal communication (Davidson & Good, 2002; Davidson & Salgado Correia, 2001). Eye contact and use of gesture are classified as types of ‘regulators’, especially used to mark key moments such as entrances of different parts. According to Ekman and Friesen (1969):

[Regulators] are acts which maintain and regulate the back-and-forth nature of speaking and listening between two or more interactants (...) The regulators (...) are related to the conversational flow, the pacing of the exchange. (p. 82).

As such, they can be particularly key in performance where verbal communication is not possible, and therefore in later stages of rehearsal close to performance an increased incidence of regulator behaviours might be expected (Davidson & Salgado Correia, 2001; Seddon & Biasutti, 2009).

There is evidence from previous research that clear roles can positively influence effective coordination; for example that some groups allocate informal roles, which can support longer-term group success. In a case study of the organisation of a professional vocal ensemble, Lim (2013) found that one of the key tenets of the group in choosing to be self-managed was to assign organisational roles, for which members volunteered but for which they were held accountable by the rest of the group. These functional roles are distinct from the ‘team’ roles identified by King (2006), which related to Belbin’s team-behavioural model, and suggested that stability of roles was a factor in more successful student groups.

The adoption of a ‘shared’ leadership model was high, although larger groups were more likely have a single leader. This is consistent with the work of Rasch (1988), who reported that groups over six are more likely to have a leader. Anzieu and Martin (1968) defined group behaviour in relation to group size, citing four as a

critical number; at this point, the number of interactions exceeds the number of members. Groups of six or more create an environment for resolving ‘problems with multiple solutions’, such as score interpretation and expressive performance in a chamber ensemble. In this scenario, therefore, decisive leadership helps steer a course between multiple viewpoints.

This study was motivated by the question of how rehearsal activities are structured in chamber ensembles at different stages of preparation. It contributes to research in the field of ensemble performance practice, specifically how ensembles use rehearsal to work towards their goals. It showed that stage of preparation was associated with differences in rehearsal processes across a range of chamber ensemble types. It also provides a basis for further understanding of how self-organised groups order and structure rehearsals. The consistency of approach across a range of ensemble types suggests that group members rely on accepted cultural and social practices, consistent with the concept of a ‘community of practice’ (Wenger, 2000). It also contributes to understanding of the differences, and the variability between ensembles, in terms of goals, roles, and both nonverbal and verbal communication, and hence provides a basis for further study of rehearsal practices in specific ensemble types.

In conclusion, the findings suggest that chamber ensemble rehearsal is generally an unfolding process, organised around a broad framework of activity types, and facilitated by social interaction, including verbal and nonverbal behaviours. Other enabling features may include shared goals, and formal or informal roles. Progression towards shared goals also requires group members to negotiate differences, especially relating to artistic or other expressive ideas. Groups may resolve these differences through playing, or through discussion, in which humour often plays a part. Whilst this survey did not track groups over time, the comparison of data from groups at different stages suggests there is an evolution over a series of rehearsals. If viewed as phases of action in the overall performance preparation process, this supports the characterisation of music ensembles as adaptive teams engaged in interactive processes, which change with task demands (Marks et al., 2001).

This was a relatively small-scale study, limited to UK-based participants. It also relied on self-reports rather than observational data. Given that these results

were from a survey which reflected a mix of ensemble types and sizes, and which did not track ensembles over time, further corroboration using longitudinal investigations of specific ensembles is needed. Examples of such studies are offered in Chapters 5 and 6. Despite these limitations, it reveals certain commonalities and differences in practices in chamber ensembles. It also provides a departure point for further studies to investigate the question of how members of self-organised music ensembles evolve their distinctive practices individually and collectively. It will therefore help to frame subsequent studies, especially a longitudinal case study approach grounded in specific ensemble types and settings.



## 5 CHAPTER FIVE

### Verbal interactions in a newly formed vocal quintet

*Many, if not all, of music's essential processes can be found in the constitution of the human body and in patterns of interaction of human bodies in society.*  
(Blacking, 1974, p. xi)

Coming together with unfamiliar fellow performers in an ensemble setting is a part of normal working life for many musicians in the Western classical tradition. Investigating the process of organising within groups has the potential to reveal how interdependence and collaboration emerge over time, as social and task interactions develop. As groups prepare for a performance, their musical and social skills contribute to a shared working environment. By better understanding the ways that ensembles establish their early interactions and ways of working, there is therefore the potential to enhance groups' experiences and subsequent performance outcomes. Given the diversity of musical groups, and the often implicit nature of the coordination processes involved, the challenges of teasing out the underlying organisational mechanisms in music groups can be challenging. This chapter uses a mix of methods to investigate ways that verbal interactions and rehearsal methods co-evolve over time in a series of rehearsals, and, through the study of interaction pattern formation and development, how group behaviour changes as a newly formed ensemble works towards their first performance.

The amount, type, and purpose of verbal interactions – or 'rehearsal talk' – in ensembles varies by group and changes over time (Ginsborg & King, 2012; King & Ginsborg, 2011). Verbal utterances can provide clarification, instruction or even a diversion from the main task (King & Gritten, 2017), and they also play a key role in supporting the development of social relationships. Whilst nonverbal communication is increasingly recognised as the primary mode of conveying timing, and expressive meaning in musical coordination, a combination of both verbal and nonverbal communication modes have been shown to determine the quality of the musical output (Kokotsaki, 2007).

In their model for communication and interaction in rehearsal and performance, King and Gritten (2017) posit that a core purpose of rehearsal is to establish patterns of interactions, which can then be 'replayed' in the moment during

performance (p. 318). On this basis, there is direct connection between verbal interactions and performance outcomes, and the authors propose that the mechanisms for this include both verbal and nonverbal communication, which enable the patterns to be tried and tested in order to be fully assimilated and embodied. To achieve this, groups shift from dialogic conversational modes of communication in rehearsal, to embodied interaction in performance, in order to achieve what Gilboa and Tal-Shmotkin (2012) describe as,

... an implicit communication strategy to make time-critical decisions ... the performance phase combines anxiety and artistry; performance remains mysterious even to the musicians themselves (p. 34).

This model further suggests that, over time, a group working towards performance will be moving between these modes, and as performance approaches will be engaging in more music-making as the patterns become assimilated. Whilst there is evidence for this from previous studies, there have been few longitudinal studies with groups to explore the transition from ‘communication’ to ‘interaction’ modes.

Temporal patterning in group interactions includes the internal rhythms and pacing within which groups coordinate their activities (Gersick, 1988; McGrath, 1991). This chapter introduces measurement of interaction patterns using temporal pattern (‘T-pattern’) analysis, which has been used to reveal ways that sequences of verbal behaviours manifest over time in a range of group settings (Casarrubea et al., 2015). Detecting the presence, timing, and complexity of patterns based on verbal and social interactions has the potential to enhance understanding of ways that members of an ensemble work together, both within and across a series of rehearsals, and to identify changes or transitions over time.

In this study, verbal patterns of interaction were combined with investigation of rehearsal methods to track the emergence of group processes in a newly formed vocal ensemble. Taking a longitudinal case study approach, it combined investigation of the group’s musical activities during the first 30 minutes of four rehearsals over an eight week period. Building on prior studies of emergent team behaviour, the identification of temporal patterns of interaction highlighted underlying structures in the real-time behaviour of the ensemble.



## 5.1 Aims and research questions

The aims of this study were to investigate the changes over time in performance preparation in a small, newly formed ensemble. The ensemble comprised advanced level students on an international programme of study, working towards an interim assessment, in which they were both taught and assessed as a group. This research aimed to gain insight into ensemble dynamics and rehearsal practices from the early stages of an ensemble formation to just before their first performance. It aimed to look at how ensemble members contributed to the progression of the rehearsal process. Verbal behaviours and interaction patterns were investigated in relation to reported and observed rehearsal practices.

Keeping in mind the overarching question ‘How do behavioural interactions in a small work group emerge and change over time?’, the following research questions were also addressed:

- How do interaction patterns form and how do they impact changing group behaviours in a newly formed ensemble?
- How do interaction patterns relate to other aspects of the rehearsal context, including rehearsal methods, roles, and musical interactions?

## 5.2 Method

A longitudinal case study was conducted with a newly formed five-piece vocal consort (Group 1), who self-recorded rehearsals over a three-month period from early rehearsals to first performance. The focus of the data collection was on verbal exchanges, captured and transcribed from video recordings, and interviews. It was designed as an instrumental case study (Stake, 1995), in which a small group of subjects are used to examine patterns of behaviour.

### 5.2.1 Participants

The participants were five pre-professional level solo singers who were enrolled on an international advanced programme at a UK university. There were three females and two males, with an age range of 23–35 years. As outlined in Chapter 3, they were identified as Group 1, and allocated to vocal parts as follows:

Singer A, female – Soprano

Singer B, female – Mezzo-Soprano

Singer C, female – Alto

Singer D, male – Tenor

Singer E, male – Bass

### *5.2.2 Materials and apparatus*

Self-directed rehearsals were recorded by the group using a video camera supplied for the task (Sony MV1 Music Video recorder). These verbal exchanges were then transcribed and coded for interaction (behaviour) type and rehearsal tasks. The singers also completed rehearsal logs (see Table 5.1) to record overall ratings of the success of the rehearsal and any observations. In order to minimise disruption to their normal working, members of the group were shown how to use the camera and they set it up themselves at each session, and submitted the recordings post-rehearsal. They were asked to rehearse and interact as normal, and were encouraged to record all rehearsals and performances, so that the camera was a normal part of their rehearsal process.

### *5.2.3 Data selection*

The group was asked to record as many group rehearsals as they were able, and to include at least one every two weeks. Some of the recordings were not suitable, either because some group members were obscured by camera angles or because more than one member was missing from the session. Four sessions were selected for analysis, from Weeks 1, 3, 5, and 7, as they prepared for their first assessed performance in Week 9 (see Figure 5.1). Analysis concerned the first 30 minutes of each rehearsal. All five singers participated in the rehearsals of Week 1, 3 and 7, whilst four singers were present in Week 5, in which Singer B was absent due to illness.



Figure 5.1 Timeline of study showing weeks of data collection

#### 5.2.4 Data collection

Participants were asked to note the main goals of each of these sessions, and to log the main activities for the whole rehearsal by ticking from a predefined list of tasks (see Table 5.1).

Table 5.1 List of rehearsal activities from rehearsal log

Which of the following tasks or activities did you include in your rehearsal today?
<ul style="list-style-type: none"> <li>• Warm ups</li> <li>• Work on intonation</li> <li>• Work on expressive aspects</li> <li>• Work on synchronisation</li> <li>• Work on balance and clarity of voices</li> <li>• Work on blending of voices</li> <li>• Work on technical demands</li> <li>• Establishing cues for performance</li> <li>• Segmentation of music into sections</li> <li>• Isolation of single voice</li> <li>• Isolation of several voices</li> <li>• Slow practice of passages</li> <li>• Planning</li> <li>• Preparing or revising scores or parts</li> </ul>

The length and purpose of each rehearsal is shown in Table 5.2. As initial encounters were a key focus of study, the first 30 minutes of each rehearsal was transcribed verbatim to produce time-stamped, line-by-line utterances during the rehearsals. These utterances were coded using the Behaviour Analysis (BA) coding scheme, and the occurrence and duration of episodes of group singing were also noted. A single code was assigned to distinct speech units and the coding was checked for reliability. Time allocated to each of these speech units was recorded in the software package NVivo (QSR International) during the transcription process. (For further details of the coding scheme, procedure, and reliability checking of

coding see Chapter 3.) During this period the singers also participated in coached sessions, and in other self-directed rehearsals which were either not recorded, or not used in the analysis.

Table 5.2 Summary of recorded rehearsals

	Week 1	Week 3	Week 5	Week 7
Total length of rehearsal (mins)	60	120	120	75
Time of day	Morning	Afternoon	Afternoon	Morning
Main goal(s)	New repertoire, and establishing tempi	Familiarity with new music, and embed ideas discussed	Exploring polyphony, and an attempt to finalise recital programme	Preparing for coached session later that day; reinforcing dress rehearsal achievements

For subsequent analysis of T-patterns, further data preparation was required. Time-stamped data was converted to a text file in a format suitable for import to the software package Theme, including time (in seconds) and a combined code which specified which person ('actor') and type of behaviour occurred. The group prefix was removed from the participant identifier to simplify the coding, so they are allocated codes A-E as follows:

Ensemble member

A (Soprano)

B (Mezzo-Soprano)

C (Alto)

D (Tenor)

E (Bass)

SOME (more than one, but not all)

ALL (all)

Behaviours:

C (Clarifying)

I (Initiating)

P (Participating)

R (Reacting)

M (Music-making)

### 5.3 Analysis

Firstly, the main characteristics of rehearsals and behaviour were analysed examining frequencies of behaviours. Secondly, interaction patterns were analysed to provide more detail of the verbal interactions between group members.

#### 5.3.1 *Observation data*

Time allocated to main activities, including amount of talk and singing, and behaviour and musical task codes were summarised by week for the whole group. Based on this initial analysis, further detailed comparisons by week were made based on frequency and descriptive statistics. Frequencies of singer contributions by airtime and main behaviour types were also analysed to explore individual tendencies.

#### 5.3.2 *Pattern detection*

The Theme software was used to detect patterns in the behavioural events (see Chapter 3 for further details of use of Theme for pattern detection). Post-processing features of the Theme software program enabled further analyses of the patterns found in the data, including the number of ‘actors’ involved, the number of switches between actors, pattern length (duration), and occurrences of ‘mono-actor’ patterns, where the pattern involved a single actor (Stachowski et al., 2009). This measure was of interest as an indicator balance of contributions – more mono-actor patterns have been reported in less effective groups, which may suggest less ‘balanced’ interaction between group members (Zijlstra et al., 2012).

### 5.4 Results

Results are reported first for observational data from the behaviour coding and then for the pattern detection analysis.

#### 5.4.1 *Observation data*

Observation data are reported firstly as the overall duration and mix of talking and singing, rehearsal tasks and methods, and categories of behavioural interactions.

#### 5.4.1.1 Amount of talking and singing

Talking and playing (or singing) time in rehearsal has been explored in previous studies, which have found that more music-making happens in groups of greater expertise (Ginsborg & King, 2012), and around musical landmarks (Williamon & Davidson, 2002). It has also been found to be more prevalent in groups with greater overall success (Murnighan & Conlon, 1991). Based on previous research, King and Gritten (2017) suggest that verbal communication decreases over time as nonverbal communication becomes more established.

To understand the amount of verbal behaviour and music-making, the amount of time spent singing and talking in the first 30 minutes of each rehearsal was analysed. Time spent all singing together was greatest in Week 5. There were also fewest singing episodes in Week 5, where a singing episode involved the whole group singing together a passage, movement, or piece. The number of verbal utterances was highest in Week 3 (see Table 5.3). The total amount of time spent talking was high in Weeks 1 and 3, and considerably lower in Weeks 5 and 7, although the number of utterances remained high across all weeks, indicating brief, but numerous exchanges in later weeks.

Table 5.3 Duration (minutes/seconds) and total number of singing episodes in first 30 minutes of rehearsals by week (all singing together)

	Week 1	Week 3	Week 5	Week 7	Total
Singing: (minutes/seconds)	09:07	08:15	19:29	17:29	54:20
Talking: (minutes/seconds)	20:53	21:45	10:31	12:31	65:40
Singing: Number of singing episodes	13	11	6	8	38
Talking: Number of verbal utterances	179	260	250	196	885

The duration of singing episodes is summarised as a percentage of the recorded time each week in Figure 5.2 below. This shows the allocation of time and number of episodes of singing. Week 5 has both the fewest episodes, and greatest amount of time allocated to music-making, suggesting that the episodes are longer in the Week 5 rehearsal.

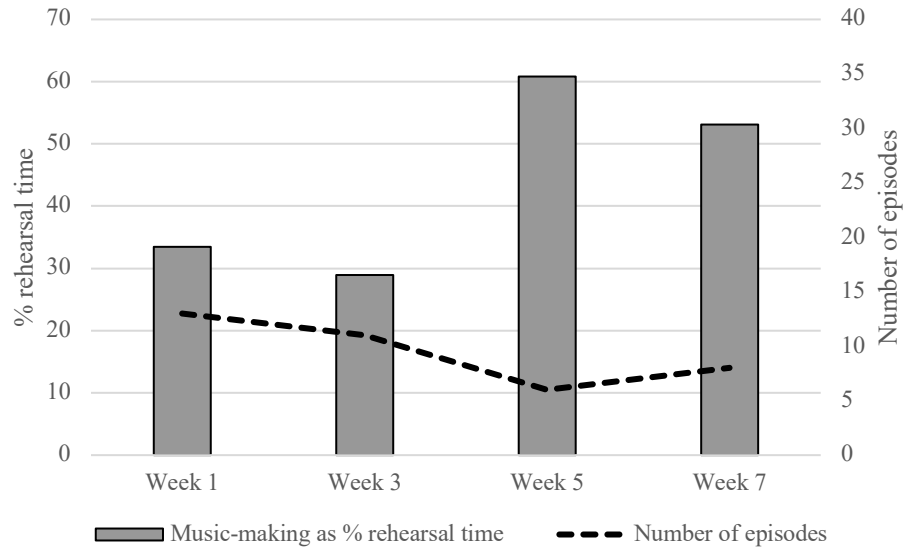


Figure 5.2 Music-making (all singing together) shown as % of total rehearsal time, and number of episodes

#### 5.4.1.2 Rehearsal tasks and methods by week

Rehearsal tasks were analysed identifying the focus of discussion by type, using an existing scheme (see Chapter 3, Section 3.2). Behaviours were coded and grouped into main categories of ‘basic’, ‘strategic’ and a combined category of ‘interpretive and expressive’. In brief, ‘basic’ features relate to rhythm, dynamics, pronunciation of text, issues relating to notation, metre, entries, structure (of the music), and articulation. When these dimensions related to decisions made by members of the group about the composer’s intentions, which may not be evident from the score alone, they were categorised as ‘interpretive’. Since ‘expressive’ features relate to the way basic or interpretive elements are implemented in performance, and the focus of this study was on the verbal discussion in rehearsal, the categories of interpretation and expression were combined for the analysis. ‘Strategic’ aspects relate to rehearsal strategy (for example, whether to tackle short or long passages, or in what order to proceed) or future planning. Figure 5.3 shows the summary of occurrences of discussions related to these categories, by rehearsal week, shown as a percentage of total number of utterances.

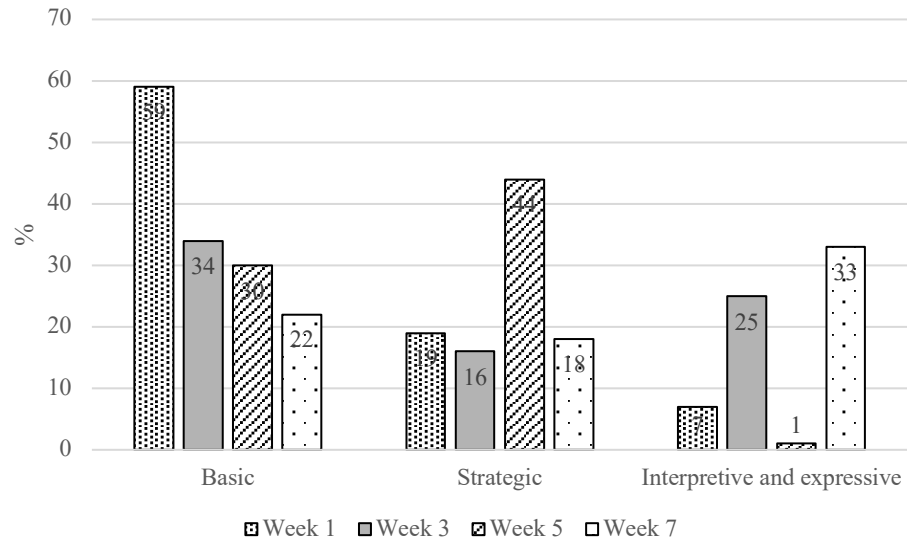


Figure 5.3 Percentage of total number of utterances by week: types of rehearsal task observed, categorised as basic, strategic, or interpretive/expressive

There were differences between rehearsal sessions in the adoption of rehearsal methods and tasks. Pearson's chi-square tests for goodness-of-fit indicated significant variation of frequency of rehearsal task type by rehearsal week;

Basic  $\chi^2(3, n=312) = 26.72, p < .01$

Strategic:  $\chi^2(3, n=312) = 75.60, p < .01$

Interpretive/expressive:  $\chi^2(3, n=312) = 95.52, p < .01$

There was less focus on basic rehearsal tasks as the weeks progressed. Strategic activities, in which the group spent time discussing and planning for future performances, were most frequent in Week 5. As will be seen in the content analysis of the verbal behaviours, discussion in this rehearsal involved planning and making decisions about the programme for the forthcoming recital. Interpretive and expressive tasks were most frequent in Weeks 3 and 7. In Week 3 the group were exploring lots of repertoire, but without the focus of an agreed programme, whilst in Week 7 they were working actively on agreeing an interpretation for their recital programme, which was by this stage agreed, and performance imminent. It is notable that in Week 5, with more strategic talk, there is very little interpretive/expressive discourse. These findings are consistent with those from previous studies, which showed that an initial emphasis on basic tasks decreased over time, and expressive and interpretative tasks increased (Ginsborg et al., 2006). Furthermore, they suggest



the relevance of certain pivotal moments in the rehearsal process when preparing for performance – for example, when performance repertoire needs to be decided.

Participants were asked to complete rehearsal logs, in which they reported which activities they engaged in during each rehearsal. This self-report data also shows week-by-week differences (see Table 5.4). Week 1 logs show a focus on technical demands, blending, work on shorter sections, and slow practice, which relate to the more basic rehearsal activities. In Week 3 there is more diversity of task types, adding interpretive and expressive aspects, such as work on intonation, synchronisation, and balance. Week 5 is highly focused, being concerned with planning, and work on intonation and expression. In Week 7 there is planning activity, establishing performance cues, expression, synchronisation, and balance.

Table 5.4 Self-reported rehearsal activities by week (from rehearsal logs)

Categories	Rehearsal tasks or activities	Week 1	Week 3	Week 5	Week 7
Basic	Work on intonation		✓	✓	
	Work on synchronisation		✓		✓
	Work on balance and clarity of voices		✓		✓
	Work on blending of voices	✓	✓		
	Segmentation of music into sections	✓	✓		✓
	Slow practice of passages	✓	✓		
	Work on technical demands	✓			
	Interpretive/expressive	Work on expressive aspects		✓	✓
Establishing cues for performance					✓
Strategic	Planning			✓	✓

Overall, when combining observation and self-report data, a progression of rehearsal focus emerges over time, in which time allocation, type of behaviour, and the main rehearsal tasks develop as follows:

- Week 1: Generally comprised basic tasks as the group were familiarising themselves with totally new repertoire and co-performers
- Week 3: Many ideas and techniques, more interpretation and expression, still lots of basic tasks

- Week 5: Fewer basic tasks, heavily focused on strategic tasks and the planning needed for forthcoming recital
- Week 7: Lots of interpretation and work on expression, fewest basic tasks

#### 5.4.1.3 Behaviours

The dominant behaviour category for each utterance was analysed at the higher-level categories of Clarifying, Initiating, Reacting, and Participating behaviours (see Chapter 3). Clarifying behaviours ensure a common understanding. Initiating behaviours create ideas and possibilities. Reacting behaviours ensure agreement and resolve disagreement, and Participating behaviours bring in or shut out others, or lighten the mood through humour.

Figure 5.4 shows the frequency of these behaviour types by week, for all participants. The start and end time of each utterance was recorded, and the duration noted.

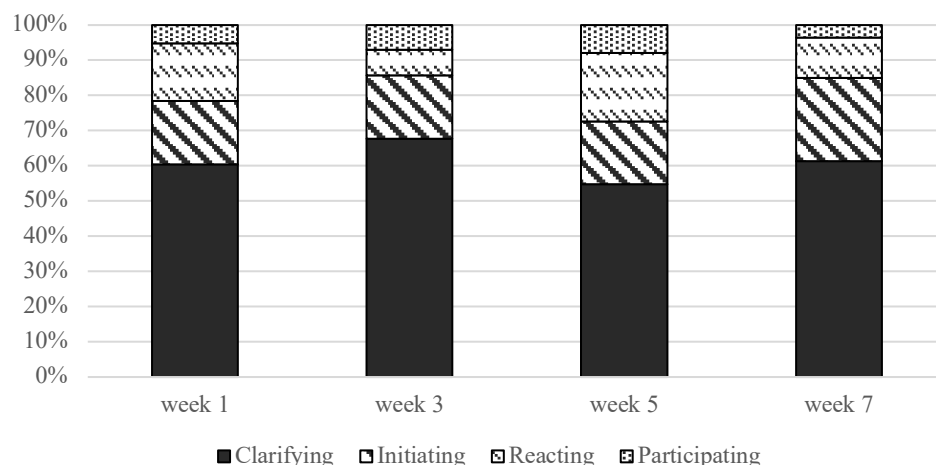


Figure 5.4 Frequency of behaviour type by week (% total)

#### *Analysis of behaviours by time allocation*

Figure 5.4 shows the greater focus on Clarifying behaviour, across all weeks, followed by Initiating behaviour. The proportion of Reacting behaviour was relatively large in Week 5. The amount of time allocated to each is shown in Table 5.5. There was a marked drop in time allocated to Clarifying behaviour in Weeks 5 and 7, which coincides with increased time spent singing.

Table 5.5 Duration of each behaviour type (minutes and seconds)

Category	Week 1	Week 3	Week 5	Week 7	Total
Clarifying	00:12:41	00:13:17	00:06:10	00:08:50	00:40:58
Initiating	00:01:30	00:03:38	00:02:41	00:03:27	00:11:16
Participating	00:01:13	00:01:44	00:01:23	00:00:30	00:04:50
Reacting	00:01:18	00:00:53	00:01:20	00:01:33	00:05:04
Other*	00:10:30	00:08:58	00:20:27	00:18:36	00:58:31
Total	00:27:12	00:28:30	00:32:01	00:32:56	02:00:39

\* 'Other' includes music-making

Clarifying behaviour was most frequently observed, and was highest in Week 3. Initiating behaviour was consistently low in proportion across weeks, although more frequent in Week 7. There was more variability in Reacting behaviour; in Week 3 very little Reacting behaviour was observed but it increased in Week 5. Participating behaviour constituted the smallest percentage, was more prevalent in Week 5, and was least evident in Week 7. Given the high proportion of Clarifying behaviour, the behavioural subtypes for the category were further analysed and revealed that Giving Task information (GT) was most frequently observed. Overall, GT accounted for a mean of 60.6% of the Clarifying behaviour. Figure 5.5 shows the sub-types of Clarifying behaviour by week, and the dominance of behaviour relating to GT. See also Appendix C (Table 11.7) for a detailed breakdown of all behavioural subtypes by week.

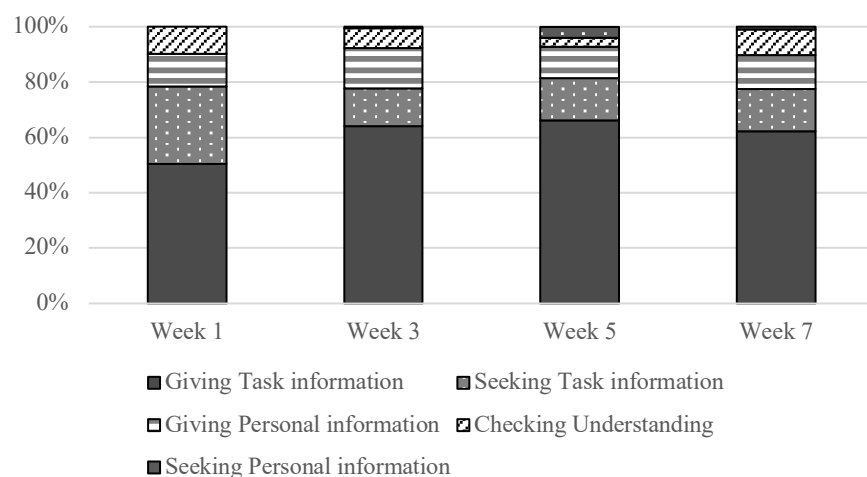


Figure 5.5 Breakdown of Clarifying behaviour subtypes by week, all members (% of total)

As shown in Figure 5.6 and Table 5.3, as the group sang more, the amount of Clarifying verbal behaviour was reduced. This suggests a reducing need to establish understanding through discussion, but rather through the act of making music together. It is most notable in Week 5 that there is a step change in these behaviours.

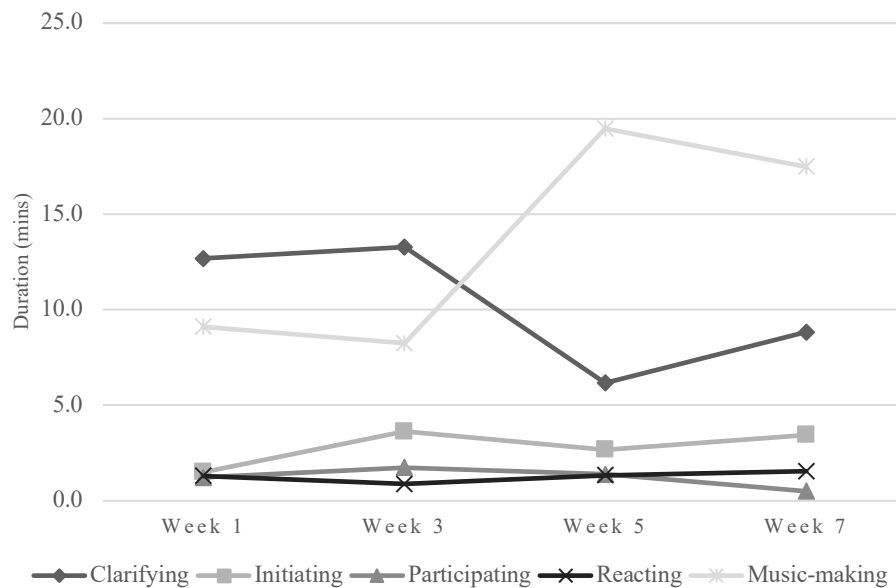


Figure 5.6 Time allocated to main behaviours, including Music-making (duration, mins)

#### 5.4.1.4 Individual contributions by week

The amount of time for which each member was speaking, as a percentage of the total rehearsal time, is summarised in Figure 5.7. Singer A was most consistent, with an average of 18.1% of the total time from week to week. Singer B was least consistent; her contributions decreased over time from 34.6% in Week 1 to 10.7% in Week 7, and she was absent in Week 5. After a quieter start, Singer C became one of the most vocal group members in Week 5 (29.6%) and Week 7 (28.6%). Singer D was overall the least vocal member, with a mean contribution of 12.7%. However, in Week 5, his contribution was greater (19.2%). Singer E was consistently a high to very high contributor and increased the amount he spoke steadily over time from Week 1 (17.9%) to Week 7 (28.6%) when he and Singer C were together the most vocal.

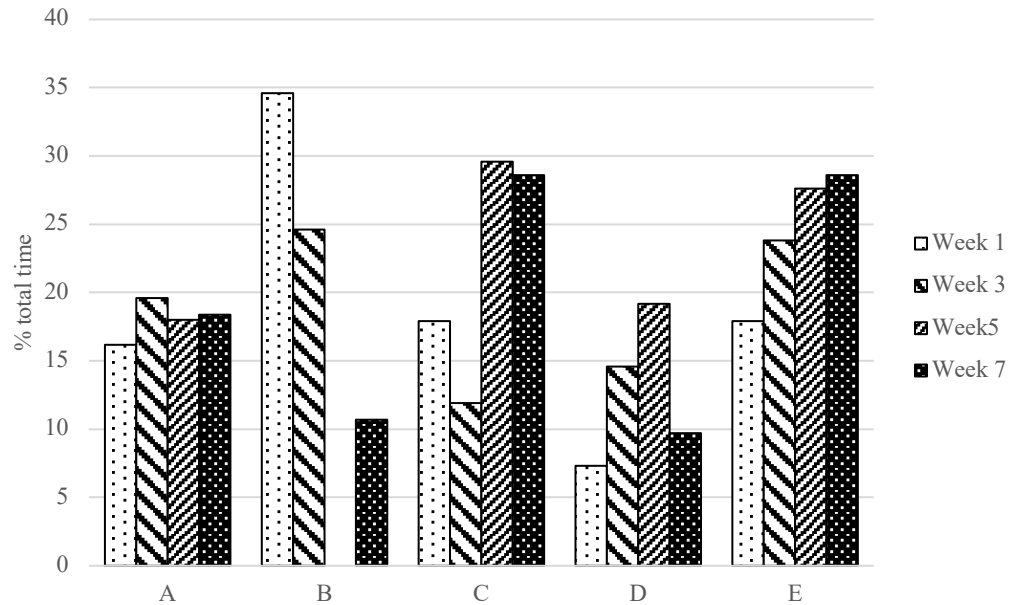


Figure 5.7 Total airtime by member (% total time) by week, for Singers A-E

#### 5.4.1.5 Types of verbal behaviour by ensemble member

The amount of each behaviour type observed by participant revealed differences both within and between weeks. Individual contributions to each behaviour type are shown in full in Table 11.6 (Appendix C) and summarised in Table 5.6. As most behaviours were in the form of Clarifying behaviour, these are shown separately. This way of exploring observed behaviour types over time reveals certain individual tendencies. An emerging dominance of Singer E seems evident, based on his increasing airtime from Week 1 to Week 7, and his consistent use of Clarifying and Initiating behaviours. Singer C was most ‘task’ based, with a strong focus on use of Clarifying and Initiating behaviours. There was a generally declining contribution from Singer B, although in Week 7, her use of Participating behaviour was relatively strong. Singer D showed an increase in Clarifying, Reacting and Participating behaviours over Weeks 1, 3 and 5, followed by a reduction of verbal contributions in Week 7.

Table 5.6 Main behavioural tendencies by singer

Singer	Clarifying behaviour	Other behaviour
A	Consistent over weeks	Decrease in Initiating behaviour and increase in Reacting behaviour over time. Variable amounts of Participating behaviour.
B	Reducing week to week	Increase in Participating behaviour in Week 7.
C	Reduced then increased	Initiating behaviour increased by week, Reacting behaviour low in Week 3, Participating behaviour dropped in final week.
D	Increased to Week 5	Increase in Weeks 3 and 5 in Reacting and Participating behaviours, which then dropped in Week 7.
E	Increased to Week 5 and dropped in Week 7	All increased over time except Initiating behaviour in Week 5.

### 5.4.2 Behaviour data over time

For the final level of analysis, time-stamped data was examined. Frequencies of verbal behaviour, including singing episodes, are shown for the whole study period, although still focusing on the first half hour of rehearsals in Weeks 1, 3, 5 and 7. The incidence and duration of each verbal utterance was coded by behaviour type and ensemble member, enabling investigation of how each individual's contribution changed over time. These are reported at two levels – firstly, the frequency of verbal behaviours by member, and secondly, the results of T-pattern analysis using Theme.

#### 5.4.2.1 Distribution of verbal behaviours over time

Each utterance and its duration are shown by individual speaker for all sessions in Figure 5.8. The speaker is shown on the left-hand side, coded as Singers A-E: 'ALL' refers to singing episodes during rehearsals. It shows the distribution of verbal behaviours and how it varies by person, confirming the patterns observed before. Contributions of Singers A, D and E are fairly evenly distributed across all sessions. Singer B's contributions are highly condensed into the first two sessions – after absence in Week 5, there are still only sparse comments in Week 7. Singer C's contributions become more frequent in Weeks 5 and 7. It is also notable that the singing episodes ('ALL') become longer in Weeks 5 and 7, with more of the rehearsal dedicated to singing.

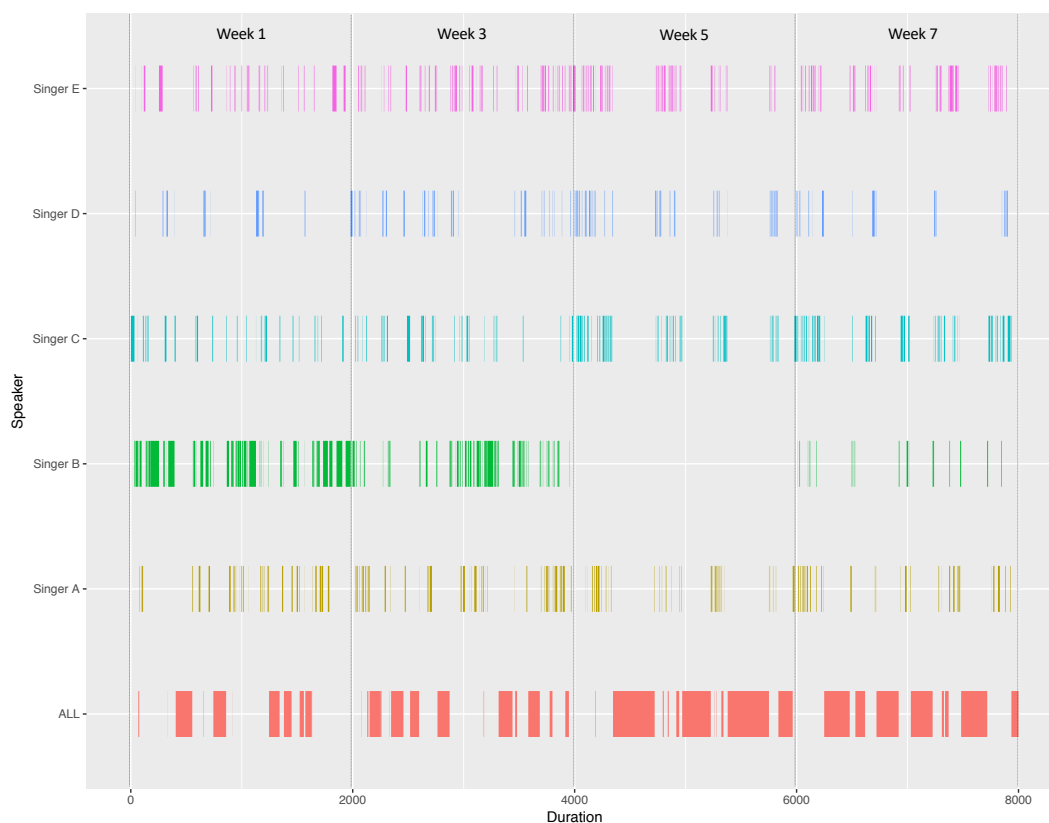


Figure 5.8 Distribution of verbal behaviours over time for Group 1

#### 5.4.2.2 Frequency of combined person/behaviour codes

Each pairing of singer and behaviour was classified as an ‘event type’. In the pattern descriptions each pair of letters represents first the singer(s) i.e. (A, B, C, D, E or ALL), followed by the type of interaction (Clarifying (C), Initiating (P), Reacting (R), or Participating (P)). For example, ‘A,I’ describes an event type in which singer A exhibits Initiating behaviour. Two additional types of event were included to support the pattern detection; M (Music-making) or N (no specific type assigned).

To get an impression of the distribution of these event types, the total numbers of each event type were plotted by week, grouped by ensemble member (see Figure 5.8). Each dot represents the onset (not duration) of a single person/behaviour event. The distribution of events shows clustering of behaviours; for example, how Singer D, whilst being one of the quieter members, tends to speak more at the start of each rehearsal, and the high frequency of Singer B’s contribution, especially Clarifying behaviours in Weeks 1 and 3, which is much less

apparent in Week 7. It also shows where there are gaps, resulting from periods where participants are not interacting verbally (e.g. for longer episodes of Music-making in Week 5) or for missing data (Singer B was absent from rehearsal in Week 5).

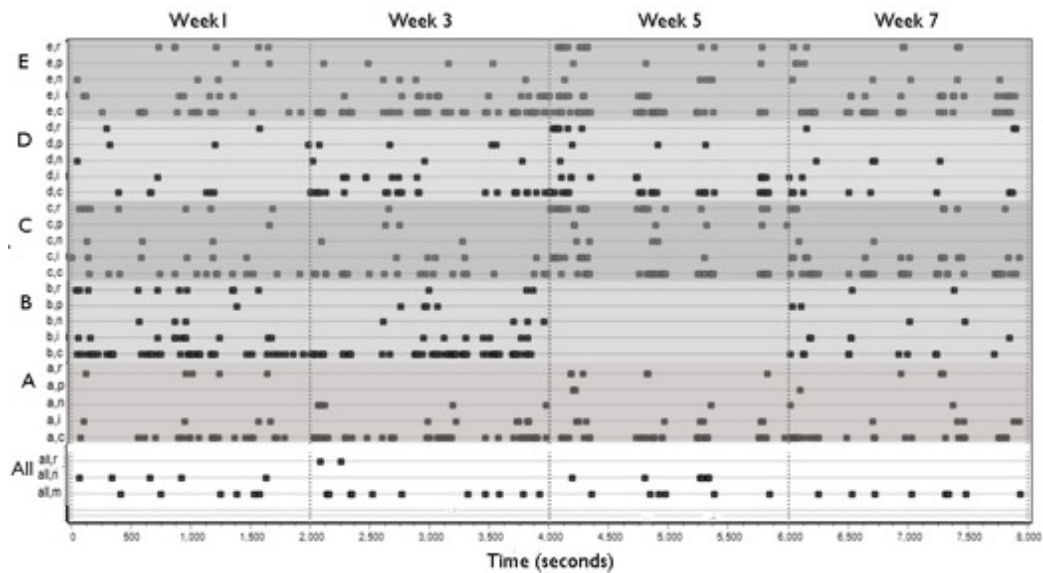


Figure 5.9 Events by participant (A-E) by week

### 5.4.3 T-pattern detection

In order to explore whether these behavioural events formed repeatable patterns, T-pattern analysis was performed. Results are reported by week of rehearsal, and then in combined form. For each analysis, the main patterns are identified and represented graphically. Detailed analysis of the patterns by week also show the rehearsal context and verbal exchanges associated with each pattern. The number of times patterns occurred, the number of unique patterns, the length (duration) of patterns, and the number of levels in the pattern hierarchies were recorded, and the number of mono-actor patterns are summarised.

#### 5.4.3.1 Pattern diagrams

The Theme pattern detection algorithm (Magnusson, 2000) uses these event types as the basis for pattern identification and creates pattern diagrams showing the sequence and detailed timing of those event types that are identified within the patterns. All instances of the event types that feature in the patterns are shown, and those in the patterns are joined by a solid black line. Other event types (i.e. those not



appearing in patterns) are excluded from the diagrams. Time is shown on the horizontal axis, and event types on the vertical axis. Each continuous line represents a sequence of events that recurs at least three times, at a confidence level of >95%, within a critical interval calculated by the algorithm and based on the time horizon and frequency of the data (see Chapter 3 for further details on this). Hence, there was a greater than 95% probability that the patterns did not occur by chance. Data was analysed for each week. For each rehearsal, the pattern search was conducted, main patterns extracted, and the verbal content was compared to the original transcript. This enabled a description to be given for each pattern, in addition to the specific exchanges that occurred between members in each case. Patterns are described in relation to their complexity, where complexity is a function of their length, levels (relating to the hierarchy of patterns), the number of actors (individual members) involved, and actor switches (the number of times there is change of actor in the pattern). Transcripts from the episodes of patterned interactions are shown in Appendix C (Table 11.10 – Table 11.13).

#### 5.4.3.2 Week 1 Patterns

In Week 1 there were three occurrences of a relatively simple pattern, involving three members of the group and a ‘shared’ activity. The main pattern is described below and shown in the pattern diagram (Figure 5.10).

Main pattern: ((ALL,N (A,I C,R)) D,P)

ALL,N – all working on a task together (not singing)

A,I, and C,R - Singer A Initiating, and Singer C Reacting

D,P - Singer D Participating

#### *Description of patterned behaviour sequence, Week 1*

The longhand description of the pattern is as follows: The group was engaged in a shared activity, followed by an interaction between Singers A and C, whereby A Initiated an event, and C Reacted. This was followed by Singer D Participating. The whole sequence occurs three times. The total duration of patterned behaviour was 888 seconds, which represents 44% of the rehearsal time analysed. The number of event types in the sequence was 4.

In comparison with results from other studies (e.g. Zijlstra et al., 2012; Lei et al., 2016), these interactions can be categorised as simple patterns (few event types and actors appearing in the patterned behaviour). Analysing the transcript from these interactions provides further qualitative information about the nature of these exchanges. They are all light-hearted interactions, triggered by a collective activity (either looking together at a score, or all laughing together) and closed by a humorous contribution from Singer D. (For full transcript of the patterned behaviours in Week 1, see Appendix C Table 11.10.)

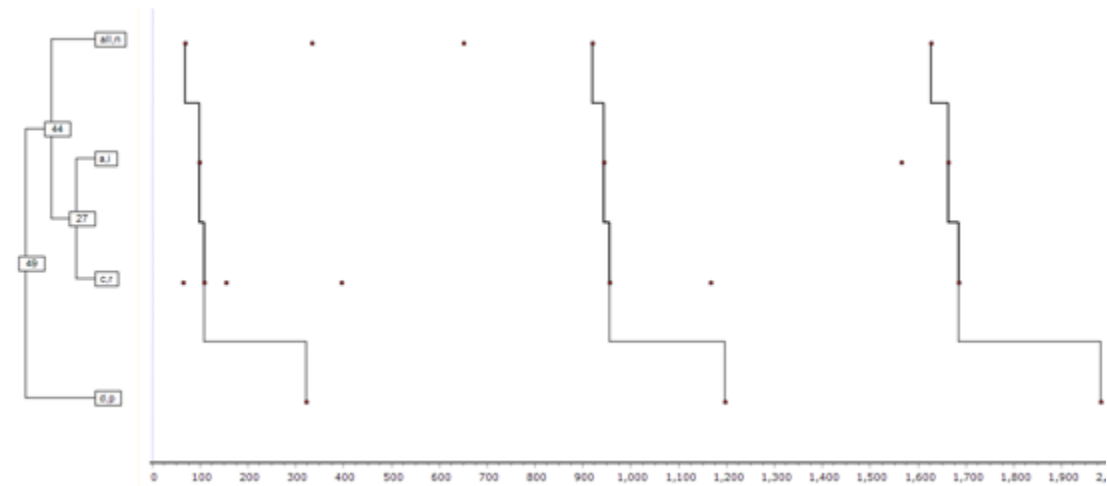


Figure 5.10 Pattern diagram output from Theme analysis, Week 1

The pattern diagram shows the recurrence of three patterns, illustrating the high degree of self-similarity not only of the sequence but also the time intervals, between behaviours, consistent with non-random occurrence of the patterns. There were no mono-actor patterns detected, which suggests the patterned interactions were well-balanced. In addition to the main (long) pattern, a number of significant, shorter ‘sub-patterns’ were detected. In this instance, all sub-patterns also appeared in the main pattern (see Table 5.7)

Table 5.7 Summary of sub-patterns in Week 1

Sub-pattern	No. of occurrences
A,I C,R	3
ALL,N (A,I C,R)	3
D,P (ALL,N (A,I C,R))	3

#### 5.4.3.3 Week 3 Patterns

Compared with Week 1, the detected patterns in Week 3 showed a higher degree of fragmentation into sub-patterns, were longer and had greater complexity. More complex patterns have been associated with more implicit coordination modes (Uitdewilligen et al., 2018) as groups adapt to their task.

The main pattern was:

(D,P (((E,C B,C )(D,C E,I ))(E,C B,C )))

Singer D – Participating

Singers E and B – Clarifying

Singer D – Clarifying and Singer E – Initiating

Singers E and B – Clarifying

#### *Description of patterned behaviour, Week 3*

The whole pattern occurred three times, and the total duration was 825 seconds, representing 41% of the Week 3 rehearsal time studied. There were 7 events in the pattern.

Analysing the transcript from these interactions provided further qualitative information about the nature of these exchanges. Three members of the ensemble featured in the patterns. Their interactions were a mix of light-hearted and more serious interactions where tempo, dynamics or choice of repertoire were discussed, as the ensemble worked on the repertoire. The first, or ‘triggering’ event in all the long patterns is a humorous contribution from Singer D. There is a gap in time (approximately 3 minutes) between this and the next event in the pattern, during which time there are dyadic interactions between Singers E and B, also included in the main pattern. Singer D’s humorous comments may therefore have a facilitating effect on the interactions of other members of the group. For the full transcript of the patterned behaviours in Week 3 see Appendix C (Table 11.11).

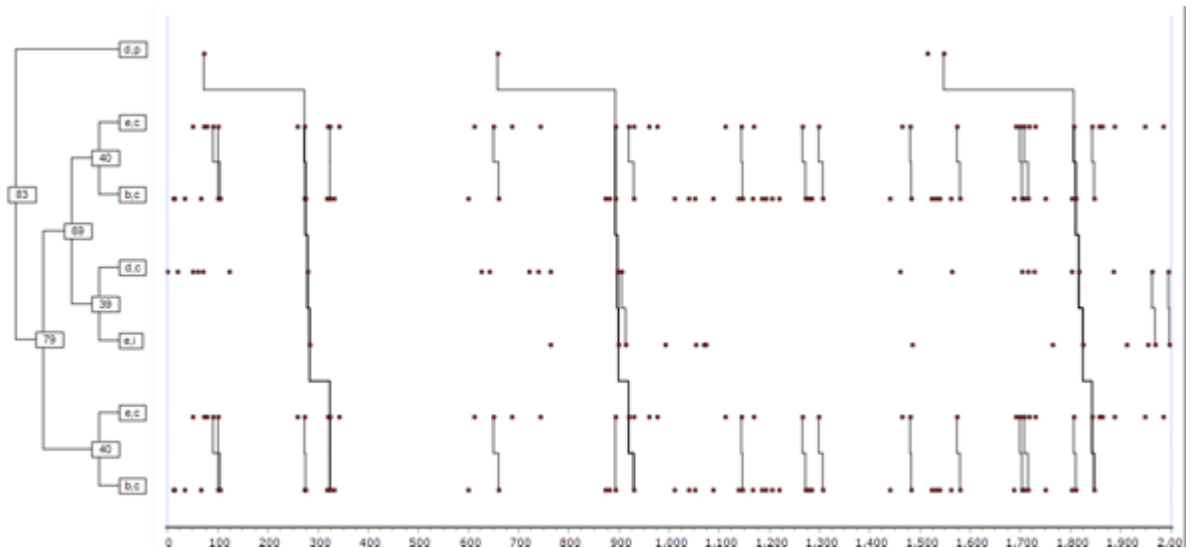


Figure 5.11 Pattern diagram output from Theme analysis, Week 3

In Week 3 short, simple, dyadic patterns appear, along with longer, more complex patterns. There are a high number of dyadic interactions between Singer E and Singer B: Dyadic exchanges such as these can indicate the emergence of social relationships (Kozlowski et al., 1999). Week 3 sub-patterns are shown in Table 5.8.

Table 5.8 Summary of sub-patterns in Week 3

Sub-pattern	No. of occurrences
E,C B,C	16
D,C E,I	6
(E,C B,C) (D,C E,I)	3
(E,C B,C) (D,C E,I) (E,C B,C)	3
D,P (E,C B,C) (D,C E,I) (E,C B,C)	3

#### 5.4.3.4 Week 5 Patterns

Compared to previous rehearsals, Week 5 was highly patterned. There were short bursts of interaction, prominently featuring Singer C, combined with longer, complex patterns involving all members. Even more sub-patterns were evident compared to Week 3, in the form of short, dyadic interactions (Figure 5.12). Longer singing episodes emerged, and also featured in the patterns. As with Week 3, Singer D's Participating behaviour initiates the main long pattern. There are three unique mono-actor patterns occurring with a high frequency; in Singer A (20 occurrences), Singer C (27 occurrences), and Singer D (19 occurrences). Mono-actor patterns can suggest less balanced interactions in the group (Zijlstra et al., 2012). This may be due to the absence of Singer B from the rehearsal, which is likely to have affected the dynamics of the interactions between the remaining four members.

The main pattern was:

(D,P (((C,C C,C)((E,C C,C) ALL,M))((A,C A,C) C,R)((D,C C,C)(E,C C,C)(D,C D,C))))).

Singer D – Participating

Singer C – Clarifying

Singers E and C – Clarifying

ALL – Music-making

Singer A – Clarifying

Singer C – Reacting

Singers D and C – Clarifying

Singers E and C – Clarifying

Singer D – Clarifying

#### *Description of patterned behaviour, Week 5*

The main pattern occurred three times, and the duration of these occurrences was 1600 seconds, 80% of the Week 5 rehearsal time studied. There were 15 events in the patterns. Referring to the transcript, these patterns were triggered, as mentioned, by a light-hearted or humorous contribution from Singer D, who, as in Week 3, appears to play a pivotal role in facilitating first dyadic Clarifying

interactions, and subsequent longer patterns. The long patterns featured Singers C and A offering opinions about the choice of music, followed by an exchange about pitch or intonation as they prepared to try a passage. They all sing together – these are fewer, longer singing episodes than in previous weeks, which is followed by further interaction between all four of the singers. There is evidence of close engagement with the score in these patterns, as they check and discuss composers’ or previous performers’ markings. (For full transcript of the patterned behaviours in Week 5 see Appendix C, Table 11.10.)

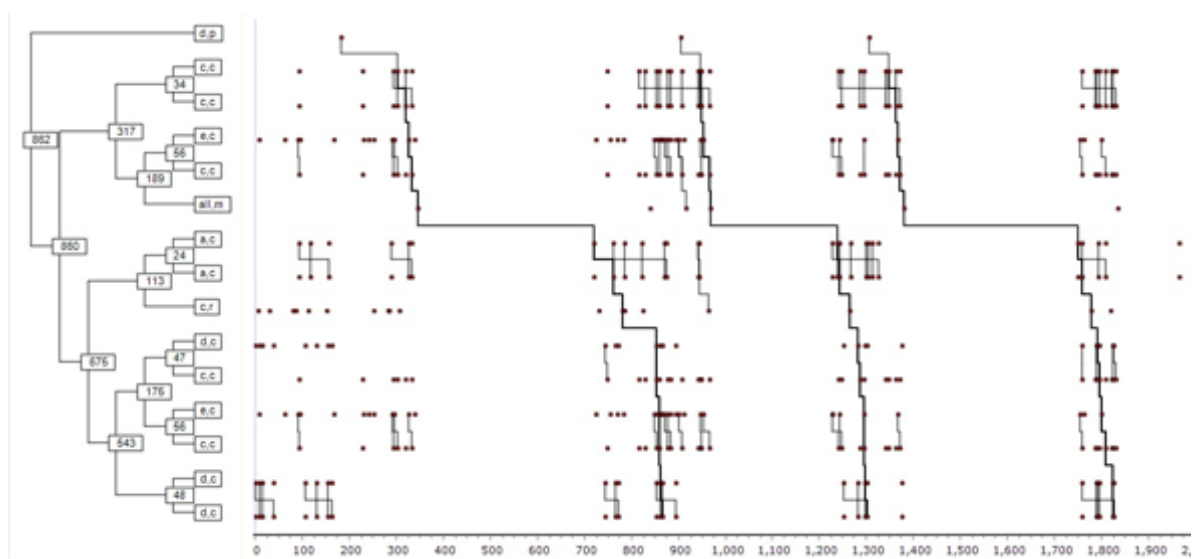


Figure 5.12 Pattern diagram, Week 5

Week 5 patterns were a mix of short, simple patterns and longer, more complex patterns. They appear to have a performative element, as each pattern includes an episode of singing. In previous studies, simple patterns have been associated with fast-moving, reactive situations, such as flight-crew simulation (Lei et al., 2016), whereas complex patterns have been found in complex, non-routine environments (Stachowski et al., 2009). In Week 5, a combination of simple and complex patterning, and an increased complexity of the longer pattern compared with previous weeks, implies an increasing tension between the need for stability (served by predictable, simple patterns) and change (suggested by the longer, more complex exchanges) as ideas are shared and tried in performance. The patterned behaviours preceding and following an episode of singing were as follows:

Preceding singing: (D,P (((C,C C,C)((E,C C,C)

This sequence, triggered by Singer D, is dominated by Singer C providing suggestions about how to approach the task.

Following singing: ((A,C A,C) C,R)((D,C C,C)(E,C C,C)(D,C D,C))

Singer A is the first to respond to what has just been tried, and dominates these moments – there is a high incidence of AC-AC mono-actor patterns immediately after a singing episode. Singers C, D and E then respond. These patterns suggest that Singer C has a role in harnessing the ideas to try out, whilst Singer A has a key role in responding to what has been tried. An overview of Week 5 sub-patterns and their frequency is shown in Table 5.9.

Table 5.9 Detailed description of Week 5 sub-patterns

Sub-pattern	No. of occurrences
C,C C,C	27
E,C C,C	17
(E,C C,C) ALL,M	4
(C,C C,C)((E,C C,C) ALL,M)	3
A,C A,C	20
(A,C A,C) C,R	4
D,C C,C	8
(D,C C,C)(E,C C,C)	3
D,C D,C	19
(D,C C,C)(E,C C,C)(D,C D,C)	3
((A,C A,C) C,R) ((D,C C,C)(E,C C,C)(D,C D,C))	3
(C,C C,C)((E,C C,C) ALL,M) ( ((A,C A,C) C,R) ((D,C C,C)(E,C C,C)(D,C D,C))	3
DP (C,C C,C)((E,C C,C) ALL,M) ( ((A,C A,C) C,R) ((D,C C,C)(E,C C,C)(D,C D,C)) D,P	3

#### 5.4.3.5 Week 7 Patterns

In Week 7 there are fewer, simpler patterns compared to Week 5. All members except Singer D are involved. There are also fewer sub-exchanges or dyads. Singer E shifts from Clarifying to Initiating mode, and Singer A plays a consistent role in Initiating singing episodes (Figure 5.12) .

The main pattern is (B,C C,C)((E,C E,I)(A,I ALL,M)).

Singers B and C – Clarifying



Singer E – Clarifying and Initiating

Singer A – Initiating

ALL – Sing

*Description of patterned behaviour, Week 7*

This main pattern occurred three times, and the duration of these occurrences was 685 seconds, 34% of the Week 7 rehearsal time studied. There were 6 events in the pattern. There were no mono-actor sub-patterns.

In Week 7 the patterns follow a remarkably consistent format, not just relating to the speaker and type of behaviour, but also to the musical content. Each patterned interaction comprises checking of pronunciation by Singer A, which is clarified by Singer C. Singer E makes a comment or gives an opinion on the interpretation or expression, followed by a further suggestion, either for immediate application or future ideas. Singer A makes a suggestion relating to the current task, then they all sing a passage or piece. (For full transcript of the patterned behaviours in Week 7, see Appendix C).

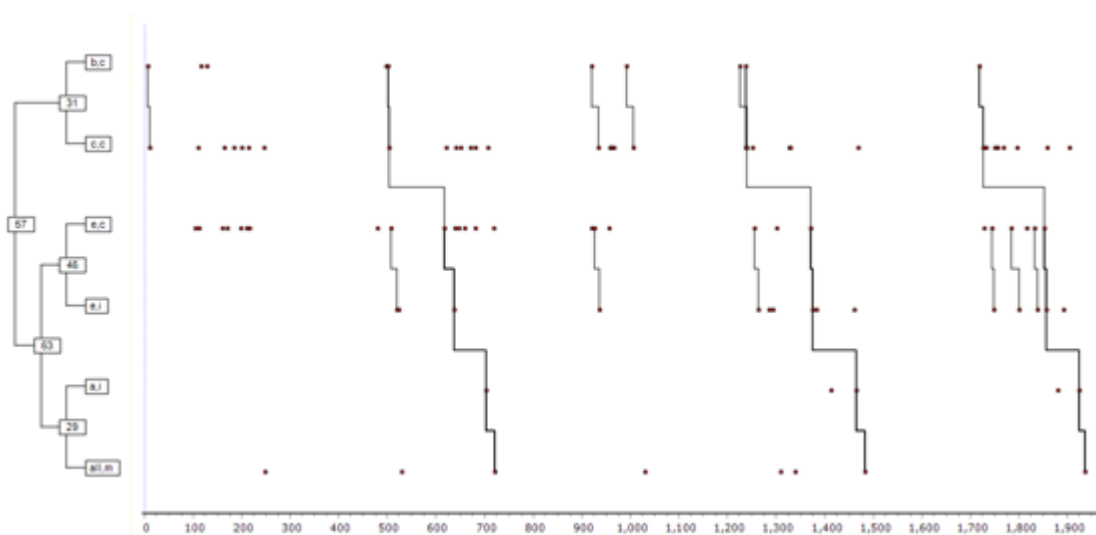


Figure 5.13 Pattern diagram, Week 7

In interpreting the Week 7 patterns there are two key areas of interest. Firstly, the high degree of self-similarity of the qualitative content of the verbal interactions appearing in the patterns suggests an increasing level of common understanding resulting in a greater predictability of exchanges. Predictability is a feature of routine

situations, which have been associated with simpler, shorter patterns (Lei et al. 2016). Secondly, therefore, the simpler patterns observed in Week 7 are consistent with this interpretation – as the group achieve a greater coherence and consistency in their approach, their behaviour patterns are simpler. Detailed descriptions of Week 7 patterns are shown in Table 5.10.

Table 5.10 Detailed description of Week 7 sub-patterns

Sub-pattern	No. of occurrences
B,C C,C	7
E,C E,I	9
A,I ALL,M	3
(E,C E,I)(A,I ALL,M)	3
(B,C C,C)((E,C E,I)( A,I ALL,M))	3

### 5.5 Patterned interactions across rehearsals

The pattern analysis revealed recurring patterns that changed in number and complexity of events from Weeks 1 to 7. Between Weeks 1, 3 and 5 there was an increase complexity. In Week 5, patterns had most events, with more actor switches (number of different participants in a pattern), mono-actor patterns (suggesting less balanced interactions), as well as the highest duration of patterned behaviour. These measures are summarised in Table 5.11. Previous research has shown how groups seek to adapt to tasks over time by seeking to reconcile the tension between the need for stability and change (Tsoukas & Chia, 2002; Uitdewilligen et al., 2018). In order to prepare for their performance, the ensemble are facing challenges related to impending deadlines, and the need to prepare a programme of repertoire to be performed at a high level. These are complex challenges requiring fluidity, adaptability, and change, giving rise to increasingly complex patterns. On the other hand, there is a need to establish a stable group that can work together on tasks, and in which members can predict each other's responses. This creates shorter, simpler patterns, often expressed as dyads, through which social relationships can form and be reinforced. In Week 7, after the complex patterns of Week 5, simpler patterns were evident, suggesting that as they approached their performance deadline, the group were achieving greater stability in their interactions.

Table 5.11 Summary of pattern data by rehearsal

Week	Observation time (secs)	Total event types	Length Mean (secs)	Length S.D.	Actor switches mean	Actor switches S.D.	Duration, patterned behaviour (% total)
1	2001	25	2.82	0.86	1.25	0.84	44%
3	2001	24	3.21	1.26	0.77	0.72	41%
5	2001	23	5.91	2.39	1.05	1.15	80%
7	2001	24	2.50	0.88	0.53	0.74	34%

#### 5.5.1.1 Week 5 - a ‘tipping’ point’?

Figure 5.14 and Figure 5.15 show two of the key pattern measures – the total amount of patterned behaviour as a percentage of the total, and the length of the patterns. They highlight the difference in Week 5, in which there was a greater complexity of patterns. Week 5 also coincided with the calendar midpoint of the group’s preparation timetable (with a performance in Week 9). Previous research has shown that groups experience a type of ‘tipping’ point transition around the midpoint, as their impending deadline creates a new sense of urgency and focus (Gersick, 1988, 1989). These and other potential mechanisms driving change and transitions in the ensemble are explored further in Chapter 8.

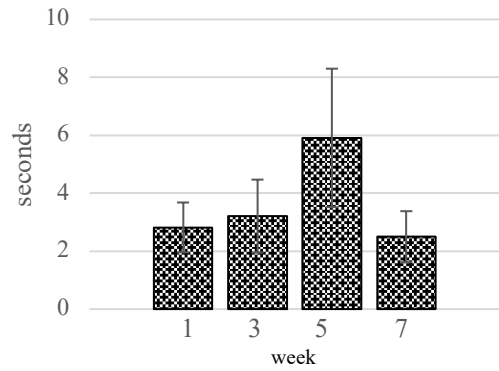
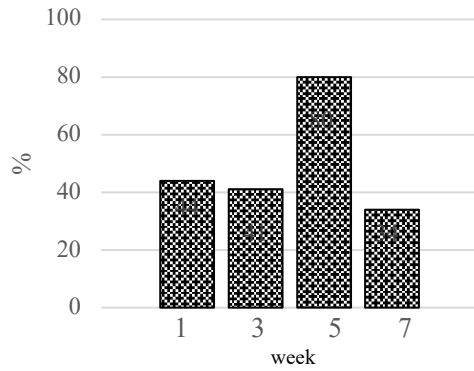


Figure 5.14 Amount of patterned behaviour in Weeks 1, 3, 5 and 7 (% total behaviour)

Figure 5.15 Length of patterns in Weeks 1, 3, 5 and 7 (mean and S.D.)

### 5.5.1.2 Contribution of individual members

In parallel with the behavioural events and the significant patterns revealed through T-pattern analysis, recurring interactions between individuals emerged. Some of these features were consistent with observable behaviours; for example, there was an increasing participation of Singer E from Week 3 onwards in the patterns, and he was also observed to be an increasingly vocal member of the group. However, other patterns involved the ‘quieter’ members of the group, and their contribution was accordingly harder to detect using traditional methods. An example of this was the Initiating behaviour of Singer A in Weeks 1 and 7, and the Participating role of Singer D in Weeks 3 and 5. Digging deeper into the exchanges by reviewing the transcripts of the patterned data revealed aspects of the verbal exchanges featuring in the patterns suggestive of the qualities of the interpersonal relationships and dynamics in these pivotal moments during rehearsal. The key features and involvement of actors in the patterns are summarised in Table 5.12.

Table 5.12 Summary of key features of pattern data by week

	Week 1	Week 3	Week 5	Week 7
Initiator of main pattern	ALL	D	D	B
Who involved in patterns	A, C, D	A, B, D, E	A, C, D, E	A, C, E
Frequent sub-patterns	-	B-E	A-A C-E C-D C-C D-D	B-C E-E
Number of unique mono-actor patterns	0	0	3	1

The extent and type of each individual’s involvement in patterns revealed different ways in which they influenced the group. Table 5.13 shows where patterned occurrences and types by singer appear by week. All members featured, often with particular ‘specialisms’. Within the patterns, Singers A and E were the only ones to show Initiating behaviour, and, in exploring the nature of the exchanges, these often happened before or after a singing episode. Singer C was the only one to show Reacting behaviour, often expressed as a strong opinion. Singer D was the only one to contribute Participating behaviour in the recurrent patterns, and these were often humorous remarks (e.g. Week 5, “Yes shall we just play the recording on loud!?”) which triggered general laughter as a response from other members, followed by a new focus.

Table 5.13 Singer behaviour types occurring in patterns, by week

Behaviour type in pattern	Week 1	Week 3	Week 5	Week 7
Clarifying		B, D, E	A, C, E	B, C, E
Initiating	A	E		A, E
Reacting	C		C	
Participating	D		D	

Together, these findings suggest emerging informal roles in the group. This aspect is explored further in Chapter 6, with a second group of singers.

- Singer A: Initiated and followed up with comments after singing episodes
- Singer B: Vocal in early rehearsals due to technical specialism, less in later sessions
- Singer C: Strong opinions, often contributed in patterns prior to a singing episode
- Singer D: Quiet. Use of humour created shifts of focus and subsequent interactions
- Singer E: Increasingly vocal over time and featured in patterns from Week 3

## 5.6 Summary of findings

There were consistent findings relating to changes over time in the amount of talking and singing, the choice of rehearsal methods, and emergent patterns. In each case, notable changes were evident in Week 5 of the study, suggesting a transitional change in the group's process. The type of changes and their significance are summarised below and explored further in Chapter 8 (General Discussion).

The pattern data provided data on the interactions of the group, including pattern complexity, and the presence of formative (dyadic) patterns and dominant behaviours as indicated by mono-actor patterns.

### 5.6.1 *Talking and singing*

Over time, there was less time spent talking, as there were fewer, longer episodes of singing. The amount of Clarifying behaviour (questions, answers, the offering of opinions, and sharing of facts) reduced; and the balance between contributions from individuals changed; for example, Singer B's contributions reduced, and Singer E's increased. As can be seen in Table 5.14, Weeks 1 and 3 are similar in terms of most dominant behaviours, amount of time singing, and the frequency of singing episodes. In Week 5 there is a change, with different behaviour types and longer, fewer singing episodes. This change is sustained to Week 7, although not to such a marked degree.

The absence of Singer B in Week 5 makes interpretation more difficult, as the changes observed could be attributed to the fact only four group members were

present. However, the direction of change before (in Weeks 1 and 3) and the sustained changes observed in Week 7 suggest that these observations are valid, and worthy of further investigation.

Table 5.14 Summary of main features of observation data: Group 1

	Week 1	Week 3	Week 5	Week 7
Main behaviour types	Clarifying	Clarifying	Less Clarifying, more Reacting	More Initiating
Music-making – amount (% time)	Moderate (33%)	Moderate (29%)	High (61%)	High (53%)
Music-making – frequency (n)	High (13)	High (11)	Low (6)	Medium (8)

### 5.6.2 Rehearsal methods

There was a progression of rehearsal focus over time, in which the main rehearsal tasks shifted from ‘basic’ in Weeks 1 and 3 to ‘strategic’ in Week 5 and ‘interpretive’ in Week 7. Whilst such changes have been observed in previous studies (Ginsborg et al., 2006), what is notable in this context is the timing of the change. Week 5 is a pivotal point in which the group changed focus, and the high proportion of strategic tasks is consistent with more planning, as the deadline for performance approaches. This change appears sudden, rather than gradual, as far as the data can show this, suggesting it constitutes a fundamental transition in the group development (Bush et al., 2017).

### 5.6.3 Interaction patterns

There is evidence of temporal patterns in the group interactions from the first minutes of the first rehearsal. Patterns started to form very early – the first were identified in Week 1, in the first five minutes of rehearsal. The early patterns established in groups have been shown to persist over time (Gersick, 1990) and provide the basis on which further interpersonal relationships can be built (Zijlstra et

al., 2012). This, indeed, appears to be the case here, and will be explored further in Chapter 7, in which results of a qualitative study are reported.

Pattern complexity increased to Week 5 and decreased slightly to Week 7. More complex patterns in this group may indicate increasing use of implicit coordination modes, and that the group has more complex decision-making processes to navigate. Simpler patterns such as those found in Week 1 suggest the group were able to make fast decisions, drawing on their knowledge of normal, 'routine' rehearsal practices without the need for elaborate discussion.

It has previously been found that the presence of mono-actor patterns is indicative of less balanced contributions across teams, and hence an indicator of lower effectiveness (Zijlstra et al., 2012). In this study, mono-actor patterns were infrequent, indicating that the balance of contributions was generally good. There were three mono-actor patterns in Week 5; whilst there are other differences in the patterns in Week 5, this may reflect the absence of one group member.

In Weeks 5 and 7, dyadic sub-patterns appeared. The significance of these has not been studied directly, but one possible interpretation of these frequently occurring interactions (Week 3: Singers B and E, 27 occurrences; Week 5: Singers C and E, 19 occurrences) is that they indicate development of social relationships in the group as members explore ways of working; this is predicted by the emergent 'compilation' model of team development advanced by Kozlowski et al. (1999). A visual summary of these influences and early pattern establishment is shown in Figure 5.16.



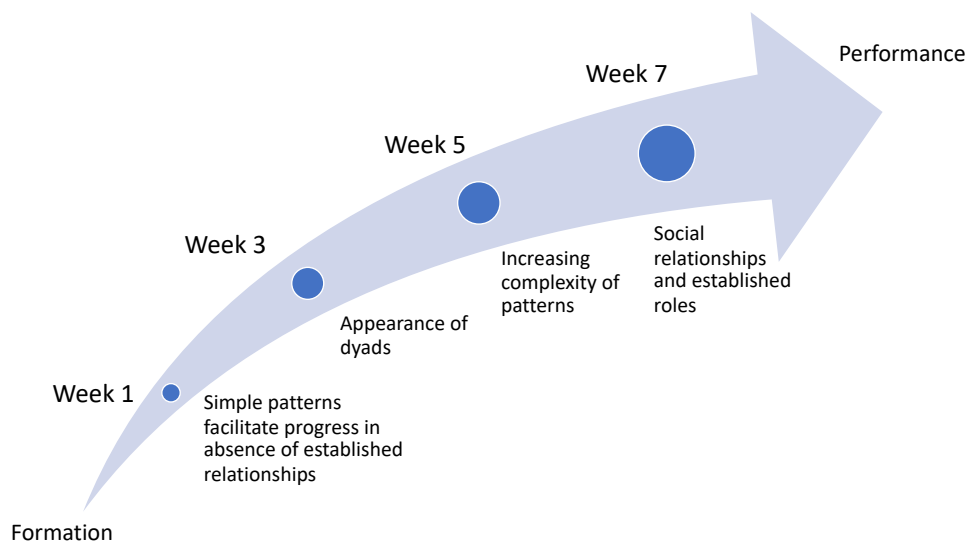


Figure 5.16 Emerging patterns and progress of the group from formation to performance

## 5.7 Conclusions

The context of this study was a newly formed music ensemble, with clear motivation for success in the medium term in the form of forthcoming performances and attainment of individual educational goals. They started the process with no previous experience of working together, but they were able to get started quickly and establish effective ways of working. The group's homogeneity (all singers, with training in early vocal tradition) and the structured nature of their programme of study also provided a solid basis for collaborative work and progression.

The study used a mix of methods to understand coordinating behaviours through both explicit (the number and type of verbal utterances) and implicit ('hidden' patterns) interactions. It reported ways in which the characteristics of these patterns, for example their complexity (number of events and group members involved), provided insights into the nature of the exchanges, and the inter-relation between explicit and implicit behaviours. There were several elements that evolved over time. The roles of group members changed, evidenced by their degree of involvement in interaction patterns, and in emerging specialisms within the group. There was a process of (earlier de-integration and then) integration of rehearsal

activities as performance approached; and a shift to more implicit coordination in later rehearsals, shown by the reduction in talk and increase in patterned behaviours. There was evidence of very early patterns, apparent within a few minutes of the first rehearsal. Qualitative differences in the exchanges were reflected in the constituent behaviours, such as the higher frequency of Clarifying behaviours in more complex patterns. These behaviours, relating to problem-solving activities or information gathering, tended to expand or open up further discussion. On the other hand, more Reacting behaviours were associated with simpler and more swiftly moving patterns, which suggest more convergent processes. Participating behaviours acted to trigger social exchanges, or create a shift in focus.

By taking a holistic view, including rehearsal structure and content, behavioural observation, and dynamic, repeated patterns of interaction, a rich picture emerges of this developing group. Combining observed behaviour with pattern detection methods reveals subtle interpersonal dynamics not evident from direct observation alone. In a group of musicians who haven't previously worked together, developing coordination can be regarded as a process of convergence of disparate perspectives, in which group members negotiate their ideas (Macritchie et al., 2018). This can also relate to the creative processes found in other creative groups (Harrison & Rouse, 2014).

In the following chapters, a second newly formed group ('Group 2') provided the setting for a lab-based longitudinal study and a second case study of exploration of verbal interactions and patterns behaviour across a similar period of time as investigated in this chapter. Chapter 6 investigates the patterned verbal interactions within this second case study, relationships with musical structure and performance outcomes related to coordination – specifically tuning and vocal synchronisation – and different modes of influence of group members. In Chapter 7, interviews with all members of both case study groups provide opportunities to triangulate these studies and offer participant perspectives on their experiences.

## 6 CHAPTER SIX

### Emergence of coordination in a vocal quintet: time, tasks, and contributions

*Talking to other people and making music in an ensemble both provide an experience of time. It is not possible to repeat what has happened a moment before. You cannot hold on to anything, you can only join in or get involved, at the very moment, constantly new and unrepeatable.*  
(Häusler, 2015, p. 43)

This chapter further investigates emerging coordination through a series of rehearsals. In a longitudinal case study of a second newly formed vocal ensemble, it explores verbal behaviours, patterns of interaction, and their evolution over time. In addition, it relates these dimensions to the musical material being rehearsed, and to how individuals contribute within the ensemble.

A core concept explored in this study is that of emergence. Kozlowski and Klein (2000) offer the following definition: “A phenomenon is emergent when it originates in the cognition, affect, behaviours, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon” (p. 55). There are some key assumptions associated with this view of emergence in the evolution of group working, specifically that changes arise from the transformation of individual skills and knowledge into collective team-level manifestations, that they are shaped by the team context, and they are variable in process and form (Kozlowski & Bell, 2008). The absence of experience combined with a creative setting can create high levels of ambiguity and uncertainty for groups. However, processes of emergence and integration support group working as they help to provide predictability and structure (Chang et al., 2017; Harrison & Rouse, 2014; Rico et al., 2008). It is not well understood, however, what type of interpersonal processes emerge in an inexperienced team tackling a creative task, such as the case of a newly formed music ensemble.

What, then, are the particular challenges that an ensemble has to address in fulfilling its function? A core purpose, at least in the Western classical tradition, is to read, interpret, and perform from written scores. Often, a number of scores are prepared in parallel for a future performance. In an ensemble rehearsal, one of the challenges is to balance this parallel activity by spending time on different pieces of

music. In any given session, therefore, time may be spent on a number of different pieces, potentially contrasting in style, structure or other musical dimension, and at different stages of preparedness. In becoming familiar with a new piece, musicians need to assimilate aspects of its features, which include rhythm, pitch, style, articulation and other expressive elements. In the classical tradition, this knowledge is generally acquired through visual inspection of a printed score and/or parts, which is then performed aloud. In vocal groups, a multi-stave score is often used, in which all parts are visible to everyone, to show how the parts fit together into the musical ‘texture’. This textural aspect in turn has rhythmic and melodic features and may, for example, be described as ‘homophonic’ or ‘homorhythmic’ (same rhythm, usually different pitches in all parts) or ‘polyphonic’ (different rhythms and pitches). *Grove Music Online* gives the following definitions:

*Polyphony*: A term used to designate various important categories in music: namely, music in more than one part, music in many parts, and the style in which all or several of the musical parts move to some extent independently (Frobenius, Cooke, Bithell, & Zemtsovsky, 2001)

*Homophony*: ... Music in which all melodic parts move together at more or less the same pace” (Hyer, 2001)

*Homorhythmic*: Having all parts or voices moving in the same rhythm, hence a special type of Homophony (Anon, 2001)

The establishment of a shared concept of a piece also requires familiarity with and agreement among co-performers’ expressive intentions and idiosyncrasies, including deliberate deviations of tempo. Previous studies have shown that music with different degrees of rhythmic complexity affects interpersonal timing coordination in ensembles. Specifically, different note ratios within ensemble parts have been shown to influence achievement of synchronisation, whereby those performing parts with more notes had a tendency to precede others (Goebel & Palmer, 2009). The presence of distinct phrases or other structural features has also been found to coincide with timing deviations for communicating expressive intentions (Palmer, 1997). Manipulations of structural features of music have not been explored in relation to patterns of verbal interactions in rehearsal. Interaction pattern data can indicate ways in which groups perform and adapt to changes of task, for example in

‘routine’ or ‘non-routine’ situations (Lei et al., 2016), and increased pattern complexity in team tasks has been related to the presence of increased levels of implicit coordination (Uitdewilligen et al., 2018). The effect of changes of task focus have been explored in other types of organisation. In research with small groups, Kelly and McGrath (1985) found that interactions varied with task type and time limit, and that routines established in the first session persisted, even if conditions changed. Gersick and Hackman (1990) also found that, even in newly formed groups, patterns of behaviour that are established early, and quickly, will generally persist unless a new focus or challenge prompts change. They offer a framework for changing task situations, in which the establishment of habitual routines may be influenced by severity and frequency of changes (see Figure 6.1) and propose that social mechanisms, including entrainment, may underly this. In a music ensemble, groups are most likely to encounter frequent, low severity changes (see Cell 2 in Figure 6.1) as the basic purpose remains whilst the specific task (musical material) generally changes frequently. However, based on the work of Gersick and Hackman (1990) and others, a change of task has to be of sufficient impact for changes of patterned, or ‘routine’, behaviours to arise; it is not known whether a change of musical piece would trigger such changes.

		FREQUENCY OF CHANGES IN THE SITUATION	
		Low	Moderate to high
SEVERITY OF THE CHANGES	Low	1 Infrequent minor changes	2 Frequent minor changes
	Moderate to high	3 Infrequent major changes	4 Frequent major changes

Figure 6.1 Frequency and severity of situational changes (reproduced from Gersick and Hackman, 1990, p. 74)

## 6.1 Aims

In this study verbal behaviours were captured in a second newly formed group across a series of rehearsals, in which two contrasting pieces of music were prepared for performance. Following on from the study reported in Chapter 5, a

second five-piece ensemble, in the same educational setting, with a similar age profile, gender mix, and purpose was recruited for the study. Through observation and coding of verbal utterances, and exploration of patterned interactions, it investigated rehearsal processes over time.

In group interaction dynamics, individual actions influence the direction and choices that the group makes, and the ways in which group members exert this influence can be highly idiosyncratic (Brown, 1988). This may be especially the case in the absence of formal roles, such as in a small musical ensemble. Individual contributions were therefore also explored in order to identify ways that decisions were made in the absence of formal leadership. This group rehearsed unsupervised in a laboratory setting with times, location, and duration set by the researcher. Musical material was provided: two pieces with different characteristics ('homophonic' and 'polyphonic'), that may afford different forms of interaction. In the piece with the polyphonic texture, the voices were relatively independent, whilst in the homophonic piece, the vocal quintet was performing more uniformly and with greater interdependence. The group were given general guidance for performance outcomes and ask to create their own interpretation. The study period spanned 16 weeks.

Two additional parallel studies were conducted over the same time period, under the same conditions and with the same participants. These studies investigated two widely established measures relating to the coordination of sounds, used by music groups as indicators of ensemble performance: synchronisation (as measured by micro-timing of vocal onsets) and tuning (as measured by individual matching of pitches). These studies are reported in full elsewhere; however selected results are included here for further context (D'Amario, Daffern, et al., 2018; D'Amario, Howard, et al., 2018).

The following research questions were investigated in this study:

- How do interaction patterns form and how do they impact changing group behaviours in a newly formed ensemble?
- How does verbal and nonverbal communication vary by stage of preparation?
- How do interaction patterns relate to other aspects of the rehearsal context, including rehearsal methods, roles, and musical interactions as manifested in timing and intonation?

- In what ways do interaction patterns vary depending on the task at hand? For example, does the musical organisation of performed repertoire have an influence?

## 6.2 Methods

A longitudinal study was designed to track developments in behavioural, verbal and musical interaction in a newly formed vocal group during regularly scheduled recording sessions from the first week that the vocal group rehearsed together until the final week before a public performance. Recording sessions were organised specially for the purpose of the studies at two-week intervals that always consisted of the same sequence of events: the vocal group performed a set excerpt of music, rehearsed it for 10 minutes, and then performed it again. This procedure was repeated for a second musical excerpt. The same musical excerpts were used throughout the recording period, and the order was changed randomly. This procedure enabled tracking of the verbal behaviours and interactions between performers during rehearsals. Use of specialist recording equipment allowed individual tracking of vocal parts.

### 6.2.1 Participants

Members of a second newly formed singing quintet took part in the study (3 females, 2 males, age  $M = 24$ ,  $S. D. = 2.3$ ), collectively referred to as 'Group 2'. The first rehearsal recording was their first formal session together, although they had met briefly before. The singers were advanced level performers with five or more years of experience of ensemble singing enrolled on an advanced course of study. All participants gave their informed consent to participate in the research and to be audio and video recorded.

To distinguish from Singers A–E in in Group 1 (Chapter 5), the ensemble members of Group 2 were allocated the codes V–Z as follows:

Singer V, female – Soprano

Singer W, female – Mezzo-Soprano 1

Singer X, female – Mezzo-Soprano 2

Singer Y, male – Tenor

Singer Z, male – Bass

### 6.2.2 Materials

For this study two original pieces were provided for the group to work on. Created for the purpose, they were based on Bach chorales and arranged to provide material suitable for the study of vocal onsets (D’Amario, Daffern, et al., 2018) and to provide different demands in rehearsal relating to independence of entries and melodic lines (see Figure 6.2 and Figure 6.3). The pieces had no text and were sung to the vowel sound ‘e’. No expressive markings were included – the singers were asked to develop their own expressive interpretation. The contrast in the structure of the two pieces was primarily in the texture, whereby one piece was in rhythmic unison (‘homophonic’, literally ‘one voice’), and the other contained multiple, overlapping melodic lines with differences in rhythms to each other (‘polyphonic’ or ‘many voices’). The participants only had access to the material during the session; no rehearsal on these pieces happened outside the study sessions. However, the singers were regularly working together on other materials, both independently and in coached sessions, in the intervening days and weeks between sessions.

Sara D’Amario

The image displays a musical score for a homophonic piece. It consists of two systems of music. The first system has five staves labeled Soprano, Mezzo-soprano, Mezzo-soprano, Tenor, and Bass. The second system has five staves labeled S., Mzs., Mzs., T., and B. The music is in 4/4 time and features a homophonic structure where all parts move together with identical rhythmic features. The score includes various musical notations such as notes, rests, and bar lines.

Figure 6.2 Piece 1: ‘homophonic’ structure, with identical rhythmic features, so that all parts moved together throughout.



The figure displays a musical score for five vocal parts: Soprano, Mezzo-soprano 1, Mezzo-soprano 2, Tenor, and Bass. The score is organized into three systems. The first system shows the initial entries of the parts, with Mezzo-soprano 2 entering first in bar 3, followed by Soprano in bar 5, Mezzo-soprano 1 in bar 7, Tenor in bar 9, and Bass in bar 11. The second system, starting at bar 6, shows the parts continuing their independent lines. The third system, starting at bar 10, shows the parts concluding their phrases. The notation includes various note values, rests, and phrasing slurs, illustrating the staggered and independent nature of the polyphonic structure.

Figure 6.3 Piece 2: ‘polyphonic’ structure, whereby parts moved more independently. Entries were staggered so that all individual parts were required to ‘lead’ at least one phrase; Mezzo-Soprano 2 (Singer X) entered first in bar 3, Soprano (Singer V) in bar 5, Mezzo-Soprano 1 (Singer W) in bar 7, Tenor (Singer Y) in bar 9, and Bass (Singer Z) in bar 11

A reflective questionnaire was presented to each singer at the end of the final rehearsal, with questions regarding their self-reported perception of group working and individual contributions. The questions were:

*How would you describe leadership in the group?*

*How has the group worked together on this task?*

They were further asked to indicate whether synchronisation got worse, better or stayed the same, and any reasons for this. There were additional questions on synchronisation perceptions, which are reported elsewhere (D’Amario, Daffern, et al., 2018).

### 6.2.3 Apparatus

The study took place in the recording studio of the Department of Electronic Engineering at the University of York, which had absorptive acoustic lining. A

single video camera was set up to record all interactions throughout the session, using a tripod-mounted Sony MV1 Music Video recorder, which had a built-in XY stereo microphone. The camera recording was started at the beginning of the session and left running throughout.

#### *6.2.4 Procedure*

The participants were approached to take part in the study before their first rehearsal took place. Ethical approval for the study was obtained from the Physical Sciences Ethics Committee (PSEC) at The University of York (UK). This allowed informed consent for participation to be arranged in time to organise a first recording session in the first week that the vocal group was formed. The study was set up to capture a series of five sessions over a 16-week period. Each session comprised two rehearsals, each of approximately 10 minutes duration, when the researcher left the room and the participants were asked to work independently as they normally would. The sessions were timed using a digital timer and after 10 minutes the researcher returned to the rehearsal room at which point the rehearsal stopped. In the first session the task was explained to the participants, in which they were asked to prepare both pieces for a possible future performance, and to create an expressive interpretation. The two pieces were randomised for order in which the singers worked on them (see Table 6.1): Piece 1 was rehearsed first in three sessions; Piece 2 was first in two sessions. The singers were not aware of the purpose of the study. Each session, which was approximately one hour long, also included separate recordings of repeated performances of the pieces pre- and post-rehearsal, captured for the parallel studies on synchronisation and tuning, and which are reported elsewhere. The participants were interviewed after the rehearsal sessions had concluded. The findings from those interviews are reported in Chapter 7.

The timing of the sessions reflected the intention to track the progress of the group over a natural cycle of development, based on the structure of their academic programme (Table 6.1). The goal at the start of the study was to capture data at approximately two-week intervals, up to the time of the first formal recital, which was planned for Week 9. However, due to illness, the recital date was postponed, with an intervening long Christmas break. An extra session was therefore included, which took place the day before the group's first assessed recital, in Week 16.

Table 6.1 Study design

Session	Week	Order
1	Week 1	Piece 1, Piece 2
2	Week 3	Piece 2, Piece 1
3	Week 6	Piece 2, Piece 1
4	Week 8	Piece 1, Piece 2
5	Week 16	Piece 1, Piece 2

### 6.2.5 Analysis

Behaviour coding was conducted as in Chapter 5, using predefined codes drawn from the Behaviour Analysis (BA) coding system (see Chapter 3). As before, verbal utterances were coded using 15 categories, which were then assigned to the four higher-order subcategories of Initiating (related to ideas and suggestion creation), Clarifying (creating a common understanding), Reacting (which aim to establish agreement and disagreement), and Participation behaviours (which balance people's contributions, including social or humorous comments). Singing (music-making) was used as a further higher-order code. The full duration of each of the rehearsal sessions were transcribed and coded. For each rehearsal session (one for each of the two pieces) and for each singer, the frequency of utterances, the percentage of utterances in relation to total number, and the duration of verbal utterances for each rehearsal were calculated. Further comparisons were conducted by rehearsal, by singer, and by piece: Combined data from all singers were used as the basis to relate rehearsal session to total amount and type of rehearsal talk and time spent singing. The number, type, and duration of verbal utterances were used to explore differences between singers over the whole rehearsal series and establish rankings of contributions.

The pattern detection software Theme (Magnusson, 2000) was used to explore emergent patterns in each rehearsal (combined and for rehearsals of Piece 1 and Piece 2). Patterned interactions were analysed based on the distribution of behaviour types and singer. Each unique combination of singer and type of verbal behaviour constituted an 'event type', which were used as the basis for pattern identification and analysis. As with previous studies, the software was configured to identify patterns recurring three or more times, with a confidence interval of >95%. The patterns identified were therefore only retained if they satisfied these criteria.

The summary statistics of pattern length (duration of patterns), level (an index of complexity based on the hierarchical structure), and actor switches (an indicator of turn-taking by group members) were used to summarise the main pattern features over time. Qualitative descriptions with reference to video transcripts were used to draw comparisons between the interactions over time.

### 6.3 Results

Results are presented for group interaction, including observed verbal contributions (talking and singing), and their contribution to patterns of interaction as detected by T-pattern analysis, as well as differences in group behaviours during rehearsals of the two contrasting pieces. Individual contributions are explored in relation to roles and modes of influence in the ensemble. Finally, the results of two parallel studies are reported and their implications are summarised in relation to the current study.

#### *6.3.1 Group interactions*

Group interactions are reported as observations of verbal behaviours, patterned interactions, and differences in behaviours with the two contrasting pieces. Figure 6.4 shows the proportion of singing and talking by session. The total amount of time spent talking from the combined sessions ranged from 55% (Rehearsal 5) to 79% (Rehearsal 4). This transition (Rehearsals 4 to 5) indicates a marked shift from a rehearsal where there is much discussion, to one where changes and ideas are tried out by music-making, ready for impending performance.

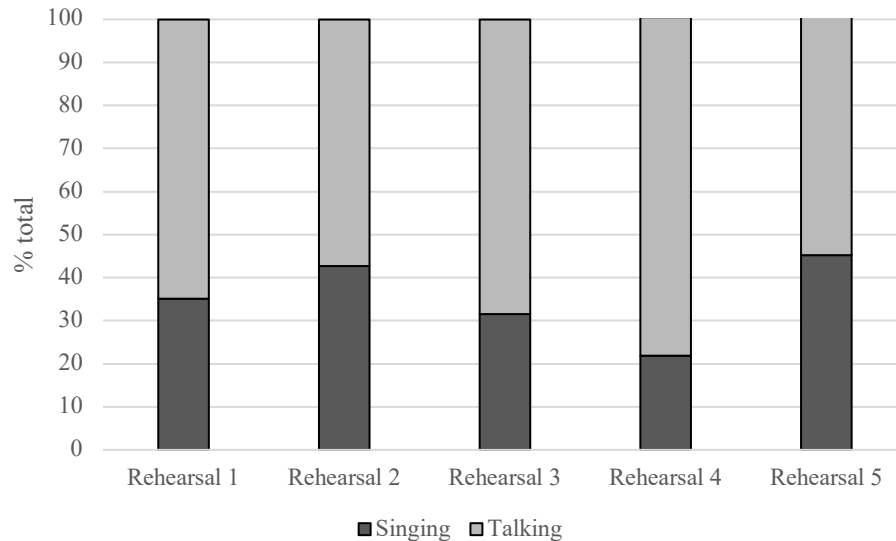


Figure 6.4 Total amount of rehearsal talk and singing by Rehearsal 1–5, as percentage of rehearsal time

Of the four types of verbal behaviour analysed in this study, most frequent were Clarifying (47%) and Initiating (26%) behaviours. Reacting behaviours constituted 20% of the utterances, and very few (6 %) were classified as Participating behaviours.

The distribution by rehearsal of the behaviours is shown in Figure 6.5. The most notable changes over time are the increase in Clarifying behaviour (and fewer Reacting behaviours in Rehearsal 4), indicative of more task-focused activity. Also notable is the increasing occurrence of Participating behaviours in later rehearsals. These Participating behaviours, which include humour and social ‘off-topic’ chat, start to appear more frequently in Rehearsals 3, 4 and 5, suggesting the group members are finding ways to balance their task focus with social interactions.

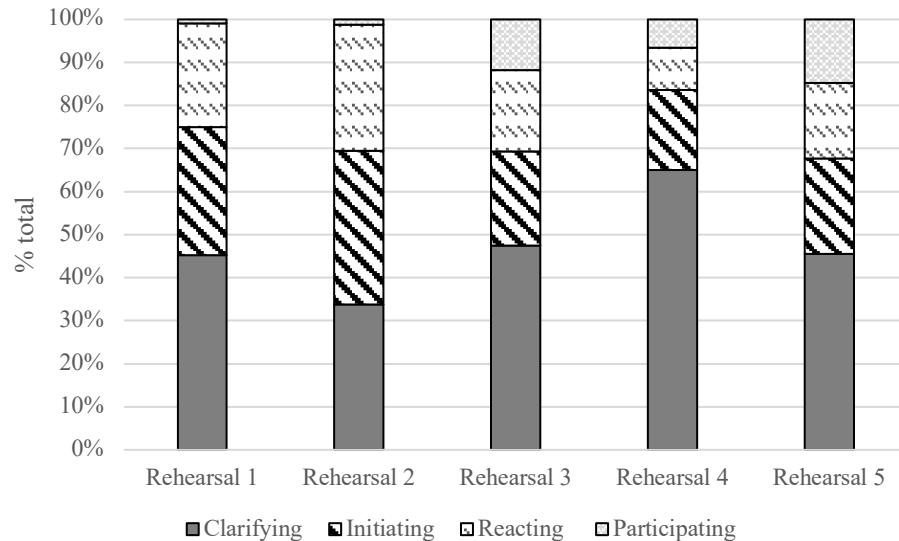


Figure 6.5 Distribution of behaviour types for Rehearsals 1–5 (% total frequency of behaviours)

#### 6.3.1.1 Patterned interactions

As with the study reported in Chapter 5, verbal behaviours were used as the basis to determine patterns of interaction between participants. As mentioned before, comparing frequency and complexity of interaction patterns can reveal ways in which the rehearsal processes are unfolding; for example how fast-paced decision-making is. This has implications too for how much implicit (related to faster decisions) versus explicit (slower decisions) communication there is. The occurrence of dyadic patterns provides an indication of emergence of group member social relationships, which are often dyadic. As each rehearsal in this study included work on two distinct pieces, interaction pattern data also provides a way to explore how these changes of task impact behaviours.

Following the approach of others (Lei et al., 2016; Stachowski et al., 2009; Zijlstra et al., 2012), statistics from the pattern detection software were used to compare pattern features over time. Brief summaries of the main pattern features by rehearsal are given below (see Table 6.2 and Table 6.3, below). Data from each rehearsal is presented first as a brief description of the main recurrent pattern of participants and the types of behaviours, for the whole rehearsal session and for each piece (Piece 1, homophonic and Piece 2, polyphonic). Any dyadic sub-patterns are also described. The codes used were as follows:

V – Soprano  
W – Mezzo-Soprano 1  
X – Mezzo-Soprano 2  
Y – Tenor  
Z – Bass  
All – All 5 singers  
SOME – 2, 3 or 4 singers  
C – Clarifying  
I – Initiating  
R – Reacting  
P – Participating  
N – Unclassified  
M – Music-making (singing)

The results of the pattern analysis are presented for Rehearsals 1–5. The pattern diagrams provide a visual representation of the patterns over time. Pattern diagrams indicate the sequence and detailed timing of event types that are identified within the patterns. All instances of the event types that featured in the patterns are shown, and those in the patterns are joined by a solid black line. Other event types (i.e. those not appearing in patterns) are excluded from the diagrams. Time is shown on the horizontal axis, and event types on the vertical axis. Each continuous line represents a sequence of events which recurs at least three times, at a confidence level of >95%, within a time interval specified by the algorithm. This ‘critical interval’ is based on the frequency and timescale of the data (see Chapter 3).

The number of patterns, events, actor switches and dyands occurring during the rehearsals of Pieces 1 and 2, are shown in Table 6.2. Overall, with the exception of Rehearsal 3, there were three main patterns detected, with number of events highest in Rehearsals 4 and 5. Pattern length varied by rehearsal: there was a positive correlation between rehearsal number and pattern length ( $r=.883, p=.047$ ) (See Appendix D, Table 11.15). The number of dyadic interactions in rehearsal ranges from 5 (Rehearsal 2) to 30 (Rehearsal 4). In all except Rehearsal 2, more dyadic patterns are evident during rehearsals of Piece 1 (mean =9.2, S.D. = 5.8 ) than Piece

2 (mean =7.4, S.D. = 4.2). Actor switches represent the number of times that there is a change of group member in the patterned interaction.

Table 6.2 Summary of main patterns by rehearsal and piece; number of main patterns, events, number of dyads and actor switches

Rehearsal	Piece	Piece order	Number of patterns	Number of pattern events	Number of dyads	Actor switches (mean)	Actor switches (S.D.)
1	Piece 1	H	1		11		
	Piece 2	P	2		10		
	Combined		3	5	21	1.26	0.73
2	Piece 1	P	3		3		
	Piece 2	H	1		2		
	Combined		4	3	5	1.20	0.63
3	Piece 1	P	2		4		
	Piece 2	H	1		5		
	Combined		3	4	9	1.04	0.65
4	Piece 1	H	2		17		
	Piece 2	P	1		13		
	Combined		3	8	30	1.95	1.16
5	Piece 1	H	2		11		
	Piece 2	P	1		7		
	Combined		3	8	18	2.04	1.40

The interaction pattern data shows a change in pattern event and dyad frequency after Rehearsal 3, no marked differences between piece types, and variation across rehearsals in contributions and behaviour types. Up to Rehearsal 3, event number was steady, the amount of turn-taking was low (as indicated by actor switches). Rehearsals 4 and 5 showed an increase in all three measures (see Table 6.2), with the longest and most complex patterns, and most turn-taking, in Rehearsal 5. There was a change between Rehearsals 3 and 4, with an increase in pattern complexity, which persisted to Rehearsal 5 (see Figure 6.6). The increase in pattern events over time suggests that sequences of individual contributions were sustained for longer. It may be that the group were experimenting with different ways of interacting up to Rehearsal 3.



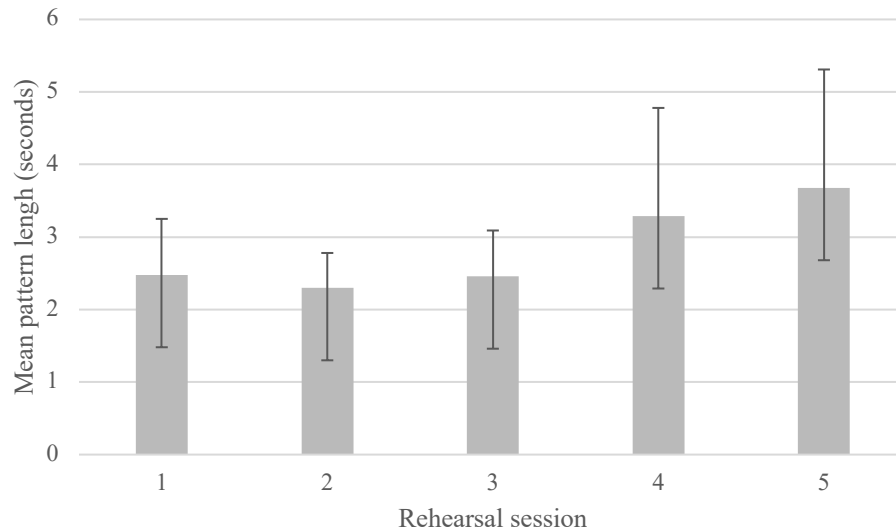


Figure 6.6 Mean pattern length by rehearsal session. Error bars represent S.D.

The event types (person, behaviour) occurring in each of the main significant patterns, and the content and number of the dyads for the combined rehearsal period are shown in Table 6.3. Brief descriptions of the main features of the patterns, and the pattern diagrams for each rehearsal follow.

Table 6.3 Main recurrent patterns and dyadic sub-patterns by rehearsal

Rehearsal	Whole pattern	Dyadic sub-pattern	Number of dyads
1	(((SOME,M, SOME,M) X,I) Y,C ALL,M))	(SOME,M, SOME,M) (Y,C ALL,M)	7 14
2	((X,C Y,C) ALL,M))	(X,C Y,C)	5
3	((X,I V,R) (Z,R X,I)	(X,I V,R) (Z,R X,I)	5 4
4	((W,C Z,C)((W,I Y,C) ALL,M))((W,C V,C) Y,C))	(W,C Z,C) (W,I Y,C) (W,C V,C)	11 4 15
5	(((Y,I (Z,R ALL,M))(V,I Y,R)(Z,P (V,P Z,P)))	(Z,R ALL,M) (V,I Y,R) (V,P, Z,P)	6 6 6

Qualitatively they differ from each other too – Rehearsal 4 has more of a Clarifying task emphasis, consistent with a focussed, problem-solving approach, whilst Rehearsal 5 patterns are more light-hearted in tone, including more Reacting, Initiating and Participating behaviour. Notably, these two rehearsals also incorporate episodes of ‘All singing’ as part of the main patterns, reinforcing their focus on

performance outcomes. The number of dyadic sub-patterns is greatest in Rehearsal 4. This supports the prediction of the team compilation model advanced by Kozlowski et al. (1999), which suggests that dyadic interactions increase over time but are ultimately a stage toward holistic team function, which is suggested by the more balanced interactions, longer patterns and fewer dyads in Rehearsal 5. Results by rehearsal follow, including a short description and the pattern diagrams from Theme.

### *Rehearsal 1*

In the first rehearsal there were three occurrences of a long pattern; one during rehearsal of Piece 1, and two during Piece 2. In this pattern, a subset of singers ('SOME') rehearsed an extract, after which Singer X Initiated further suggestions or ideas. Singer Y offered Clarification relating to what was needed, and they all sang a passage together.

There were a total of 21 occurrences of two dyadic sub-patterns, and the first dyadic pattern occurred within the first minute. Both 'dyadic' interactions comprised group events, so whilst they may represent the origination of a longer pattern, in this instance they do not represent specific, nascent social relationships. However, it highlights a significant role for Singer Y as there are 14 instances when an idea or clarification offered by Singer Y is followed shortly afterwards by a singing episode. The pattern diagram for Rehearsal 1 is shown in Figure 6.7.

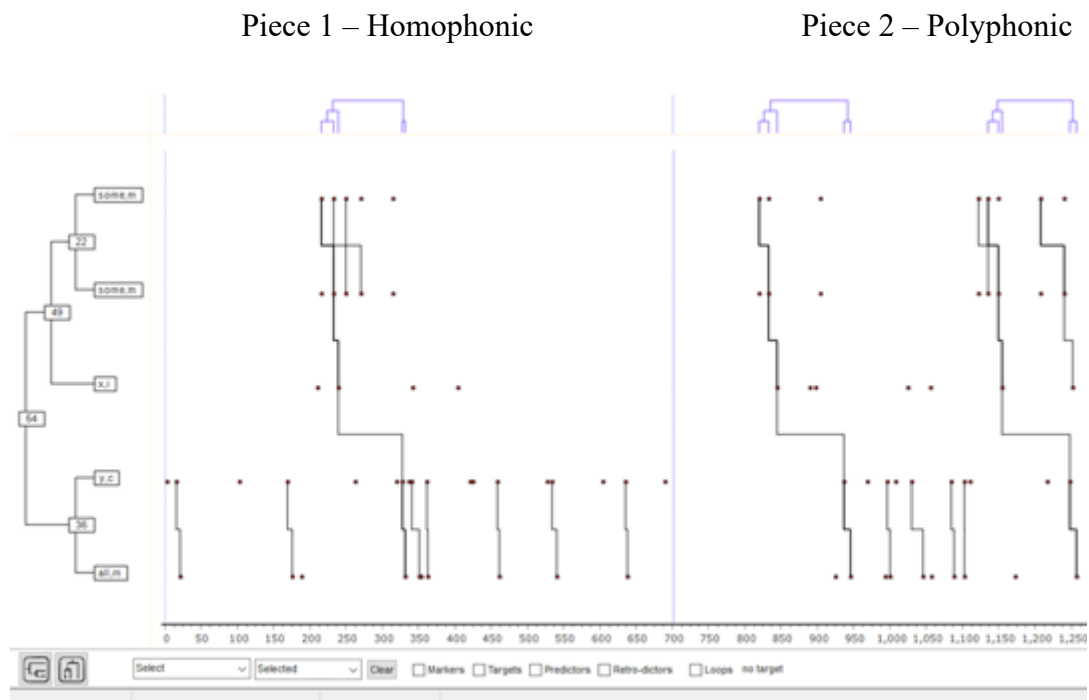


Figure 6.7 Pattern diagram from Theme – Rehearsal 1

## Rehearsal 2

The main pattern in Rehearsal 2 was short and had four occurrences. (Table 6.2). In the main pattern, Singers X and Y exchanged task Clarifications, followed by the whole group singing. There were 5 occurrences of the dyadic sub-pattern between Singer X and Y, suggesting this as an important developing interaction. The second part of Rehearsal 2 was cut slightly short as one member had to leave for a comfort break for a few minutes. The pattern diagram for Rehearsal 2 is shown in Figure 6.8.

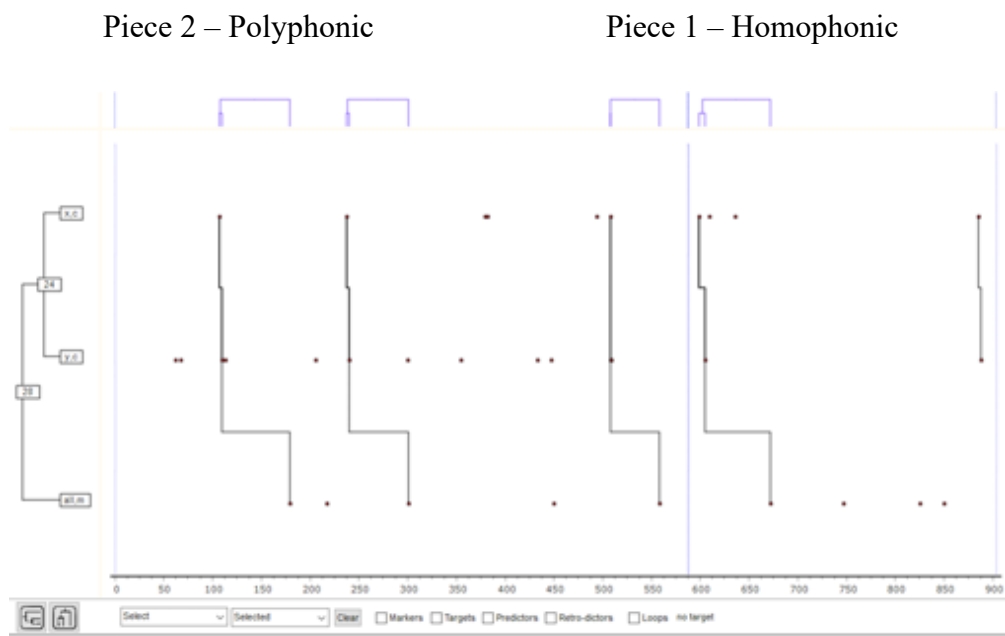


Figure 6.8 Pattern diagram from Theme – Rehearsal 2

### Rehearsal 3

Rehearsal 3 had relatively few patterns. In the main pattern Singer X Initiated an activity, to which Singer V Reacted. This was followed by an exchange between Singers Z and Singer X - who again Initiated an idea. There were 9 occurrences of the dyadic sub-patterns. The pattern diagram for Rehearsal 2 is shown in Figure 6.9.

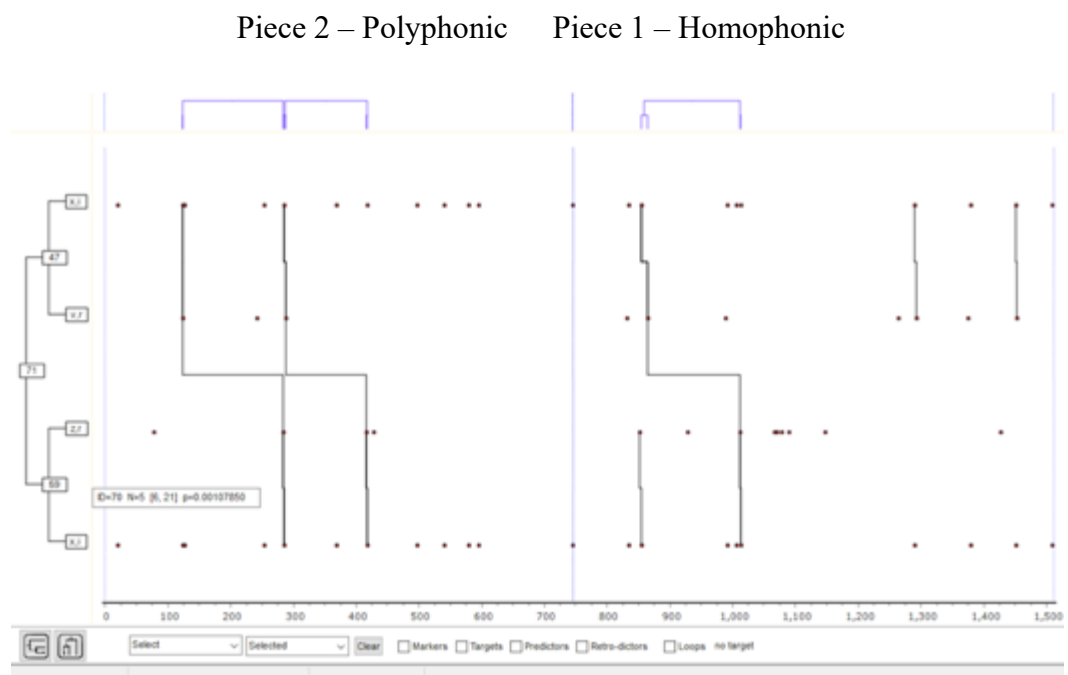


Figure 6.9 Pattern diagram from Theme – Rehearsal 3

### Rehearsal 4

In contrast to Rehearsal 3, Rehearsal 4 was highly patterned. In the main pattern, which was dominated by Clarifying exchanges, Singer W made multiple attempts to Clarify and Initiate. Singer Y also featured prominently, both in the sub-pattern prior to the singing episodes, suggesting he was providing direction or otherwise prompting the group to try an idea, and also following on from a dyadic exchange between Singers W and V. The whole pattern ran as follows: first Singer W and Singer Z engaged in Clarifying behaviour. Singer W then Initiated, and the Singer Y Clarified, after which All sang a passage. Singers W and V Clarified, and, finally, Singer Y Clarified. There were a large number of dyadic sub-patterns (30 in total) distributed across the session, suggesting that multiple interactions were occurring across different members of the group. The pattern diagram for Rehearsal 4 is shown in Figure 6.10.

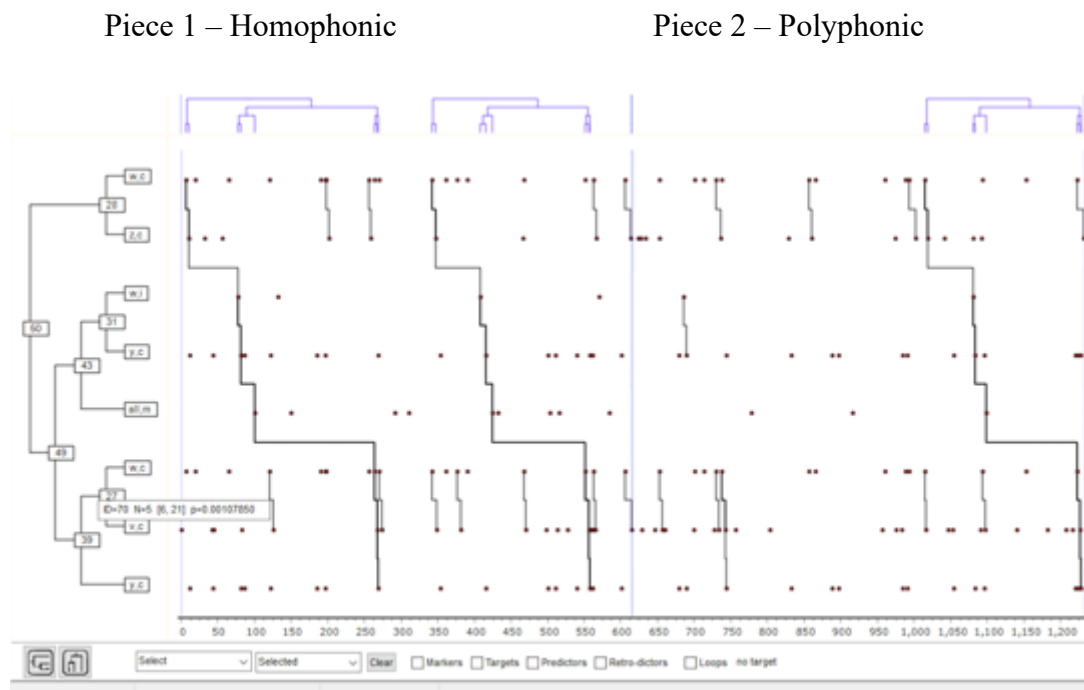


Figure 6.10 Pattern diagram from Theme – Rehearsal 4

### *Rehearsal 5*

Rehearsal 5 was also highly patterned. The main pattern in Rehearsal 5 included Participating behaviours, which were light-hearted or social in nature, and featured Singer Z more than in previous patterns. The pattern ran as follows: Singer Y Initiated an action, to which Singer Z Reacted, followed by All singing. Singer V Initiated, and Singer Y Reacted. Finally, Singer Z engaged in Participating behaviour, then Singers V and Z exchanged Participating behaviours. There were a total of 18 dyadic sub-patterns (see Table 6.2). The pattern diagram for Rehearsal 5 is shown in Figure 6.11.

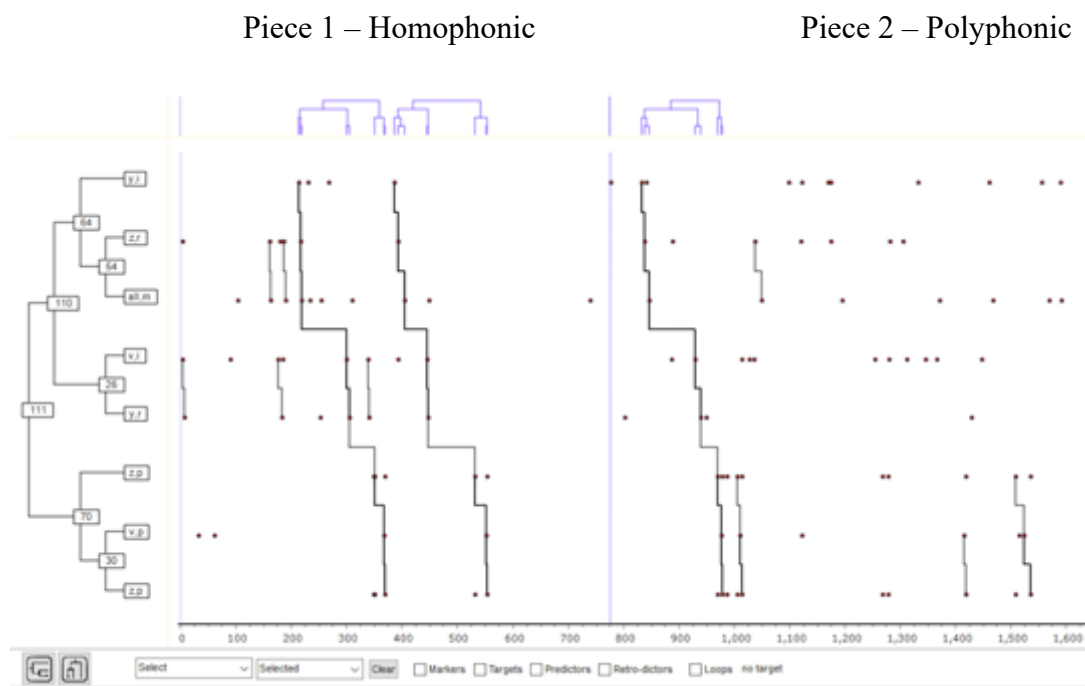


Figure 6.11 Pattern diagram from Theme – Rehearsal 5

### 6.3.1.2 Group interactions during rehearsals of homophonic and polyphonic pieces

A further aspect explored in this study was whether there were differences in rehearsal behaviours with the two pieces rehearsed. Amount of talk during rehearsal, and patterns of interaction, were compared in the two pieces in order to explore whether the structure of the piece (homophonic or polyphonic) influenced ways in which the group approached their task.

Amount of talk (and singing) were compared for rehearsals of the homophonic and the polyphonic piece to explore whether musical material influenced overall levels of contributions. There were consistent differences in all except Rehearsal 3, with more time spent singing than talking during rehearsal of the homophonic piece. A paired sample *t*-test was used to evaluate the effect of piece on the frequency of verbal contributions. There was a statistically significant difference in frequency between homophonic ( $M=111.34$ ,  $S.D.=29.05$ ) and polyphonic rehearsal sessions ( $M=120.33$ ,  $S.D.=21.89$ ),  $t(1152)=6.233$ ,  $p<.001$  (two-tailed). The mean difference was 8.99 with a 95% confidence interval, ranging from 6.15 to 11.81. As the sample size was small, a further test was conducted to calculate the strength of association. The effect size was small (partial eta squared = .03), so although the differences reached statistical significance, the actual difference in mean values was small. There may also be order effects – whilst the order was randomised, the odd number of rehearsals meant that they could not be fully counter-balanced, so that in three rehearsals the homophonic piece was rehearsed first, and the polyphonic piece only in two.

Differences in the amount of talk and singing by piece and rehearsal are shown in Figure 6.12. Whilst these differences were not significant, visual inspection of the data reveals differences over time.



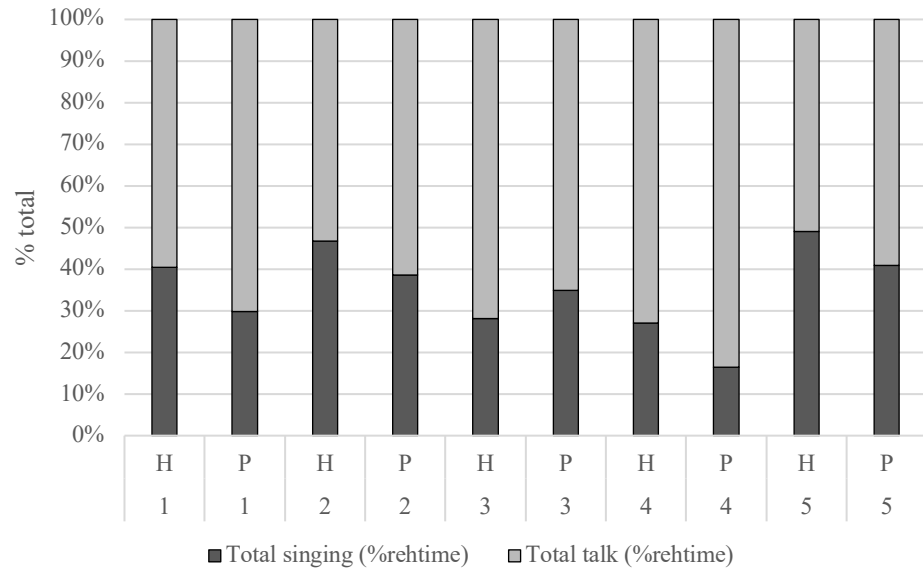


Figure 6.12 Amount of singing and talking as percentage of rehearsal time, by rehearsal number (1–5) and by Piece 1 (homophonic, H) or Piece 2 (polyphonic, P)

From the reflective questionnaire, the singers were asked how well they felt they succeeded in getting their ideas across about how the pieces should be performed. Scoring out of 100 for each piece, generally the singers scored the homophonic piece lower, indicating they felt they were less successful in conveying ideas in rehearsal of the homophonic piece (see Figure 6.13).

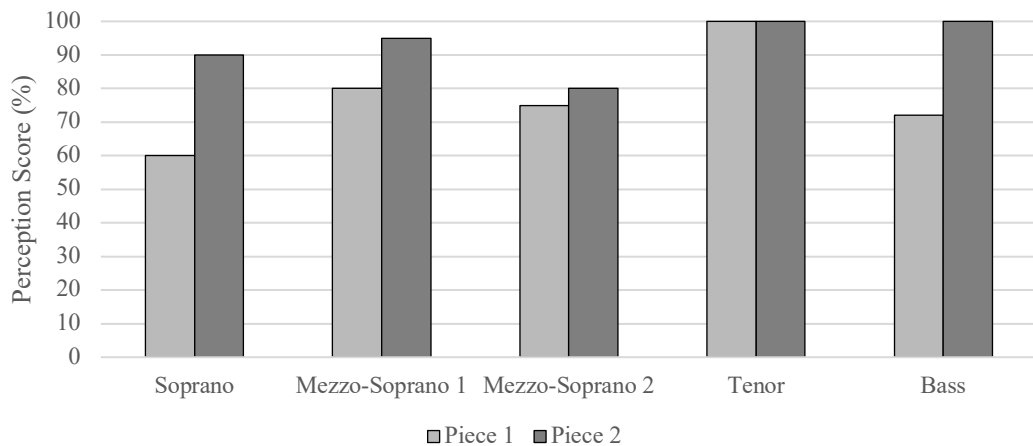


Figure 6.13 Perception score (%): how satisfied each group member was in getting ideas across in rehearsal of Piece 1 and Piece 2

Whilst this is a small sample there is a consistency between these findings. The reason that group members felt less able to convey their ideas could be ascribed to the reduced opportunity to do so, as there was generally less talk in rehearsals of the homophonic piece. On the other hand, it may be due to the simpler structure

providing less opportunities for ‘things to say’ about the interpretation, with accordingly more focus on synchronising entries and blending of sounds that were embedded through singing rather than discussion. The fact that more dyadic interactions appeared during rehearsal of the homophonic piece (Table 6.2) may be related to the simpler texture, which therefore allowed more opportunity to build relationships within the group, rather than focusing on musical challenges. This is also a factor that could be followed up in future research.

### 6.3.1.3 Patterns during rehearsal of homophonic and polyphonic pieces

Pattern length (duration), level (number of levels in the hierarchy of patterns) and number of actor switches were also compared by piece structure (Figure 6.14). No significant differences were found using paired sample *t*-tests. For Piece 2, patterns were observed to be generally longer, with more levels, and with more actor switches, so may warrant further investigation with larger samples. These observations, suggesting that the more ‘complex’ musical task results in more complex patterned behaviour, are also consistent with the greater amount of talk generally identified during rehearsals of the polyphonic piece.

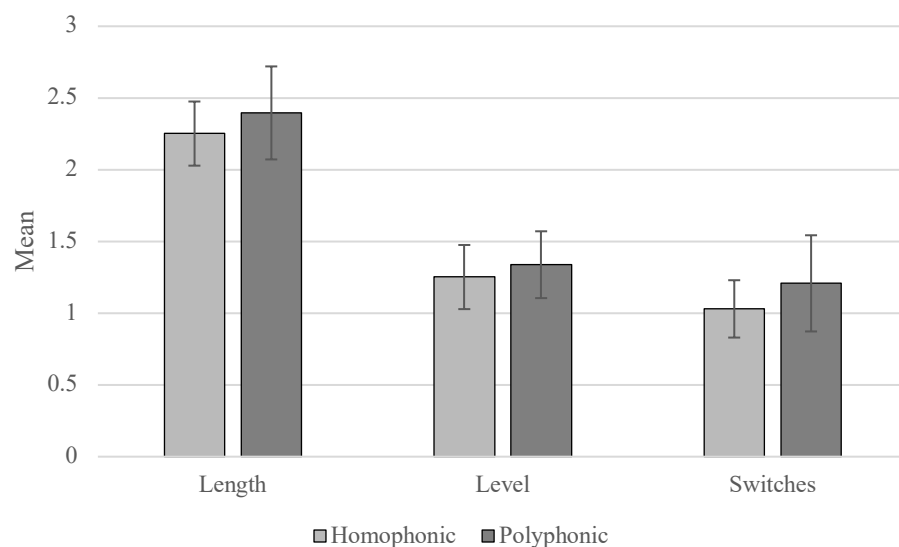


Figure 6.14 Pattern length, level and number of actor switches, mean and S.D. by homophonic and polyphonic structure.

The distribution of main patterns between the segments of rehearsal allocated to the Piece 1 or Piece 2 was not consistent (Table 6.2). In Rehearsals 1–3, more

patterns appeared in Piece 2 segments than in Piece 1; however in Rehearsals 4 and 5 this is reversed. It may rather be an order effect – in all except Rehearsal 1 the first segment contained more patterns, regardless of type of piece. However, sample sizes were not large enough to examine this statistically.

#### 6.3.1.4 Summary – differences in interactions during rehearsal of homophonic and polyphonic pieces

There were some indications from these findings that piece structure may influence behaviour and perceptions of group interactions, resulting in more talk and more complex interactions during rehearsal of more complex material. However, this was a small-scale study and further research with a larger sample and/or with more highly contrasting musical material could usefully explore whether rehearsals of pieces of different structure or complexity result in differences in amount and type of verbal interactions, and in complexity of patterns. What this does suggest, however, is that a change of musical material during rehearsal can result in an observable change of behaviour as the group adapts to a change in task (Gersick & Hackman, 1990).

### *6.3.2 Individual contributions during rehearsals*

The pattern data suggest not only changes in complexity over time, but also changing roles and contributions from members of the group. To investigate this further, their total contributions, how this changed over time, and the different modes of influence used by individual members of the group were explored.

#### 6.3.2.1 Contributions by group members

To investigate relative contributions from individuals, the number and duration of verbal utterances was analysed by rehearsal.

Table 6.4 Frequency of verbal utterances by singer, by rehearsal

Singer	Vocal role	Rehearsal					Total
		1	2	3	4	5	
V	Soprano	64	44	77	56	76	317
W	Mezzo-Soprano 1	20	18	13	42	11	104
X	Mezzo-Soprano 2	28	29	59	29	35	180
Y	Tenor	56	51	60	56	55	278
Z	Bass	54	17	39	35	74	219
Total		222	159	248	218	251	1098

Singer V, Y and Z contributed most frequently, and also for the longest duration, when expressed in terms of mean percentage of rehearsal time (see Figure 6.15). Singer W was the least frequent contributor.

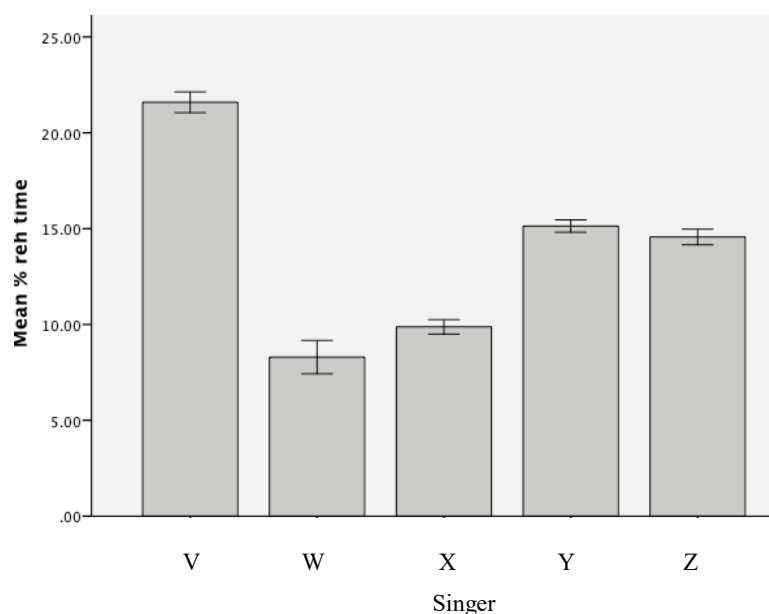


Figure 6.15 Contribution of verbal utterances for each singer, expressed as percentage of rehearsal time. Error bars represent 95% confidence level.

A chi-squared test for independence indicated a significant association between singer and frequency of utterances,  $\chi^2(16, n = 1098) = 76.83, p < .01$ , Cramer's  $V = .132$ . Residuals from chi-squared goodness-of-fit tests are shown in Figure 6.16. Clustering around the mean value for each rehearsal, it shows the variance by singer. Singers V and Y consistently contributed more, Singer W

consistently less, and Singer Z's contribution fluctuates most around the mean. Singer X contributed less than the mean, except in Rehearsal 3.

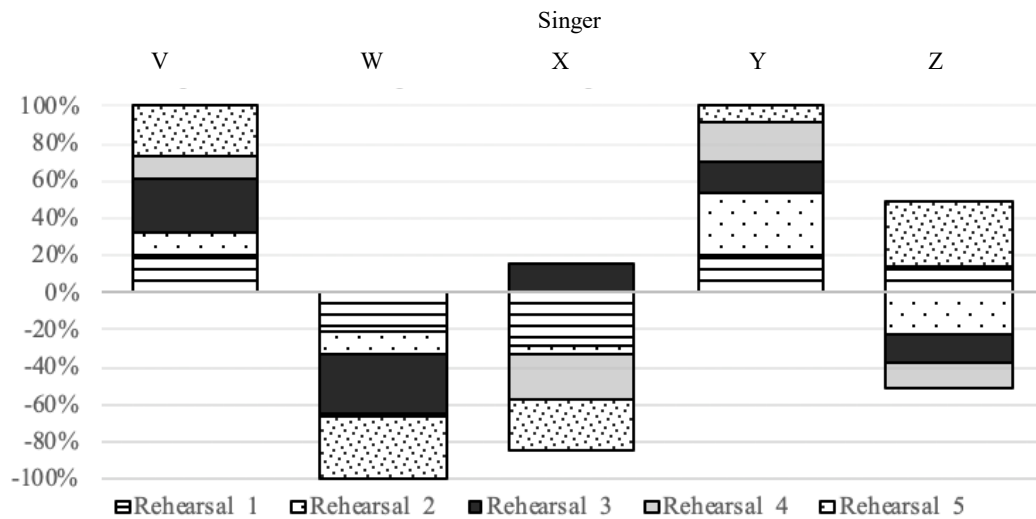


Figure 6.16 Contribution of singers by rehearsal, from residuals of observed-expected frequency data calculated from chi-squared goodness-of-fit.

Further analysis by individual reveals how each singer contributed within each behaviour type, showing a tendency to reduce the range of behaviours by Rehearsal 5 (see Figure 6.17). For all singers there appears to be a shift in the balance of behaviour types in Rehearsal 4; for all except Singer X there is an increase in Clarifying behaviours. This reduces in Rehearsal 5 in all except Singer Z. Between Rehearsal 4 and 5 there is an increase in Reacting and Participating behaviours in all singers except Singer W. In all except Singer Z the transition from Rehearsal 4 to 5 shows a shift from a wider variation in Rehearsal 4, to a convergence of behaviours in Rehearsal 5.

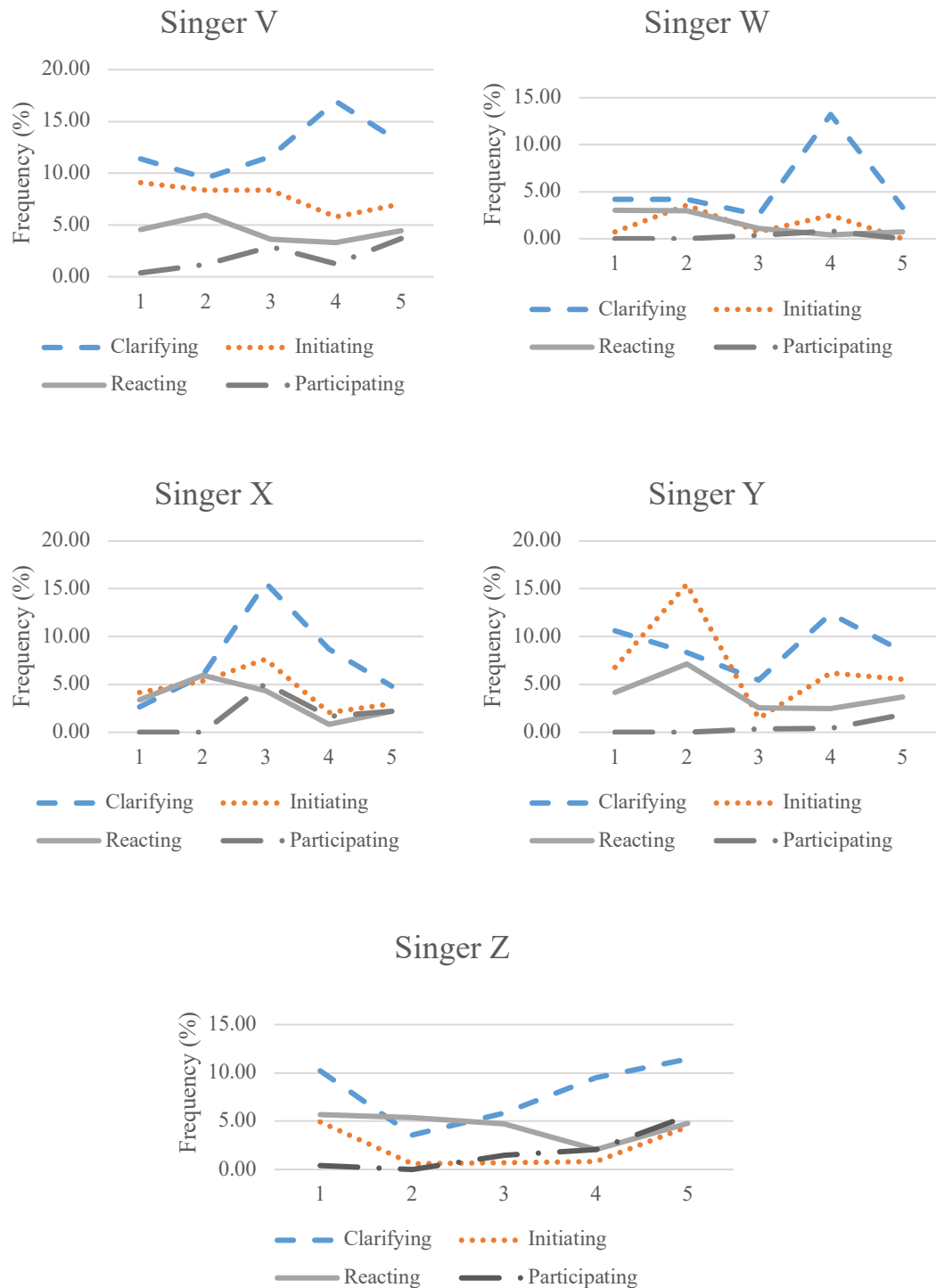


Figure 6.17 Frequency of four main behaviour types (Clarifying, Initiating, Reacting and Participating) over rehearsals 1–5, by Singers V, W, X, Y and Z

### 6.3.2.2 Rank order of singers

Amount of verbal contribution by rehearsal and singer was analysed to establish the rank order of amount of contributions for each group member and provide an overall picture of relative contributions. There was also evidence of

variation in contribution with rehearsals. The grid diagram shown in Figure 6.18 indicates which group member was most verbal, (those ranked ‘1’) in each rehearsal, and who is least verbal (ranked ‘5’). Singer V was most verbal in all except Rehearsal 5, and Singer Z’s verbal behaviour varied most throughout.

	Rehearsal 1	Rehearsal 2	Rehearsal 3	Rehearsal 4	Rehearsal 5
Singer V	1	1	1	1	2
Singer W	5	4	5	2	5
Singer X	4	3	3	5	4
Singer Y	3	2	2	3	3
Singer Z	2	5	4	4	1

Figure 6.18 Ranking of amount of verbal contributions by singer, for each rehearsal

### 6.3.2.3 Contributions to patterns

The previous analyses relate to observable behaviours. As reported in Section 6.3.1.1, the results of behavioural pattern analysis using Theme suggested further differences in individual contributions to the non-conscious, ‘hidden’ patterns. To explore this further, the number of times that each singer (or group of all/some singers) appeared in a significant pattern is summarised in Table 6.5. Whilst there are some consistencies with amount of talk, the representation in patterns revealed other ‘layers’ of contributions. Singer V features in patterns from Rehearsal 2, and in a total of 32 dyadic exchanges within the significant patterns. Singer W, who was a low contributor in terms of airtime, featured three times in the main pattern, and in 30 dyads in Rehearsal 4. Singer X, also a low verbal contributor, featured 6 times in patterns, distributed throughout all rehearsals except Rehearsal 4. Singer Y featured 5 times in patterns, and in dyads during each session except Rehearsal 3.

Table 6.5 Number of times each singer (or group of all/some singers) appeared in unique significant patterns (P) and instances of dyadic patterns (D)

Singer	Role	Reh 1		Reh 2		Reh 3		Reh 4		Reh 5		TOTAL	
		P	D	P	D	P	D	P	D	P	D	P	D
V	Soprano	0	0	0	0	1	5	1	15	1	12	3	32
W	Mezzo-Soprano 1	0	0	0	0	0	0	3	30	0	0	3	30
X	Mezzo-Soprano 2	1	0	1	5	2	9	0	0	2	0	6	14
Y	Tenor	1	14	1	5	0	0	2	4	1	6	5	29
Z	Bass	0	0	0	0	1	4	1	11	4	12	6	27
ALL		1	14	1	1	0	0	1	1	1	6	4	20
SOME		2	7	0	0	0	0	0	0	0	0	2	7

The observed verbal contribution data (number, airtime) and the occurrence of significant patterns suggests a mixture of modes of contribution and influence. These are explored further by considering the ranking of the verbal and pattern data in relation to preferred style of contribution.

#### 6.3.2.4 Combining data from total verbal contribution and patterns of behaviour

Total verbal contributions and patterned behaviours were further explored by ranking those who were the most verbally active, and those most frequently appearing in patterns. The amount of Verbal Contributions (VC) were ranked 1–5, based on total amount of airtime. The contribution to patterns (PC) was based on the number of significant patterns in which each singer appeared, and in how many dyads (DC) (Table 6.6).

Combining these dimensions, the Singer V is ranked overall most influential, then the Singers Z, Y, X and then W. This is the same ranking as with the verbal contributions only. However, what emerges from this way of exploring the data is that the relative weighting varies by group member in relation to more explicit/more implicit behaviours: Singer V ranked higher in verbal contributions (VC) than patterned contributions (PC), whilst Singers W, X and Z were higher in PC than VC, and Singer Y was equal in both. These weightings suggest a preferential style in which influence can be exerted through modes other than ‘amount of talk’. It may also suggest a dominant mode of behaviour that can be characterised as generally more explicit (Singer V) more implicit (Singer W), a mixture (Singer X and Z) or equally balanced (Singer Y).



Table 6.6 Ranking of verbal (VC), patterned (PC) and dyad (DC) contributions by members of the ensemble

Singer	VC ranking	PC ranking	DC ranking	Combined (VC+PC+DC)	VC rank > PC/DC?
V	1	4	1	1 (6)	Yes
W	5	4	2	5 (11)	No
X	4	1	5	4 (10)	Mixed
Y	3	3	3	3 (9)	Equal
Z	2	1	4	2 (7)	Mixed

### 6.3.2.5 Individual contributions and reflections

After the final rehearsal session, all the singers completed a short reflective questionnaire about their experiences and the contributions of group members. The responses are included in Appendix D (Table 11.16). The questions included their perceptions of leadership in the group, how they had worked together on the task, and the reasons for any improvements in synchronisation.

There were two key themes that arose from this data – the first related to perceptions of roles and balancing contributions, and the second to changes over time.

#### *Roles and balancing contributions*

When asked individually how they described ‘leadership’ in the ensemble, the consensus view of the singers was that there was no leader, but rather that everyone had a contribution to make:

Everybody contributes. Different people offer different things. [Singer Y] often comments on tuning/ensemble balance. I often give interpretational ideas, I think. [Singer X] gives some technique stuff ... but everyone gives a bit of everything. (Singer V)

I would say that we don't really have a “leader”. We all contribute ideas and opinions and make decisions collaboratively. (Singer X)

Communal. Very much a group equally led. (Singer Y)

Everyone has a say and we rarely disagree in a way that can't be solved by trying both suggestions and letting the music decide (Singer Z)

Some distinct roles were identified. For example, Singer V gave ‘interpretational ideas’, Singer Y usually contributed ‘comments on tuning and ensemble’, and Singer X gave ‘technique suggestions’. There were also changing roles over time, for example between rehearsal and performance:

[Singer V and Y] probably emerge as the initiators of the vision for the group, with me joining them to lead in performance. (Singer Z)

### *Changes over time*

Singer X acknowledged that more balance in contributions had emerged over time, and at first three members dominated but later all felt able to offer suggestions and constructive criticism:

Initially the three who also conduct [Singers Z, Y, V] very much had all the ideas and talking time at the start. It is now much more balanced, with input and confident suggestions and constructive criticism from all. (Singer X)

Several members of the ensemble commented on how their group working had changed over time. For example, the Singer Z expressed a sense of ‘convergence’;

I feel that our conception of the piece converged as time went on. (Singer Z)

All indicated that synchronisation of both pieces had improved, and that ‘time together’ was an important element in achieving this:

Definitely improved as we grew and bonded as a group – easier to suggest ideas, on same ‘wavelength’ etc. (Singer X)

Worked on breathing together and listening to other parts with smaller note values. Also got better as we just spent more time together as a group as the term went on. (Singer Y)

The longer we spent together as a group the more we listened to each other’s parts in polyphony. (Singer Z)

These individual reflections provide an additional insight from the participants relating to their own perceptions. The absence of formal leadership and the changing roles over time are themes that are further considered in the following sections, and the group’s perceptions and reflections on the ways that interactions evolved in the ensemble are explored in Chapter 7.

#### 6.3.2.6 Summary – individual contributions

In summary, individual contributions were explored using three different perspectives. Firstly, by measuring the frequency and amount of time spent talking; secondly by identifying the type and frequency of individual appearances in significant patterns of interaction; and thirdly by exploring the ways in which the group members themselves perceived their own and others' contributions. Combining these perspectives, the findings suggest that group members found different modes by which they could exert their influence. These modes include explicit and implicit behaviours, and nonverbal auditory cues. As well as the different rankings for verbal contributions and presence in patterns, there were other ways in which the individuals made their influence felt in the group. One way they did this is through triggering key events, such as when the group rehearsed the ideas being discussed by singing through a passage. The influence of Singer Y was particularly evident in this way. He was not the most verbally active, nor did he appear in more patterns than others; however the timing of Singer Y's contributions suggested that they often preceded or elicited action by other members of the group. For example, in Rehearsal 1, there were 14 instances where a Clarifying contribution from Singer Y resulted in the action of all singing, the first of which occurred within 1 minute of the rehearsal starting. It also appeared as the penultimate event type in the significantly recurring longer patterns. This sequence also appeared in Rehearsals 2 and 4, suggesting that this was a recurring feature.

#### *6.3.3 Parallel studies on ensemble synchronisation and tuning*

Two independent, parallel studies were conducted with the same group of singers, using separate data sources captured during the five rehearsal sessions. These parallel studies explored the development of synchronisation and tuning over time and provided additional measures of the ensemble activities during the study period. The studies provide additional data on the group and the way they developed over time. An overview of these studies are included in Appendix E, and selected results reported here where they relate to the current study.

#### 6.3.3.1 Parallel study 1 – Development of synchronisation (D’Amario, Daffern and Bailes, 2018)

The study aimed to explore how synchronisation of parts in a vocal quintet developed over time. Specifically, it investigated whether interpersonal synchronisation and/or ‘leader-follower’ relationships changed with practice (i.e. rehearsal), and whether these changes differed in relation to the contrasting musical features of the pieces. The findings of Parallel Study 1 provide further insights into individual tendencies, and on the impact of the piece being rehearsed.

Firstly, the individual tendencies to precede/lag shows that there was a significant improvement of synchronisation over time, such that by Rehearsal 5 there was no significant difference between performers, supporting the perceptions of the singers that there was an overall improvement, and that their performance ‘converged’. However, it revealed individual tendencies that can be compared to those found in the previous analyses. Most notably, Singer Z had a tendency to precede others (in 3 of 5 rehearsals). The verbal contribution and pattern data for Singer Z suggest a somewhat inconsistent but increasing influence in the group, and this appears to be reflected in the synchronisation data. There was no correlation between precedence in synchronisation and total amount of verbal contribution. Singer Z tended to precede co-performers in all except Rehearsals 2 and 5. Singer Y tended to precede others in Rehearsal 2. In Rehearsal 5, there was no significant difference between singers, suggesting a change during the rehearsal period, in which differences in tendency to precede or lag co-performers were moderated by time (see Figure 6.19).

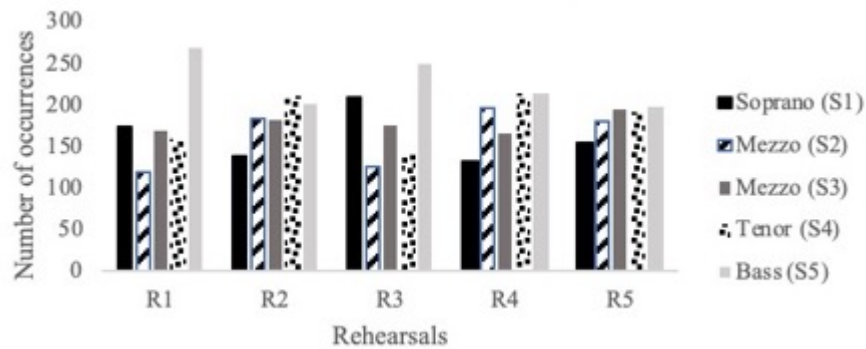


Figure 6.19 Distribution of performer precedence across rehearsals, based on number of occurrences each singer preceded all co-performers. Singer V (here referred to as Soprano (S1)), Singer W (Mezzo (S2)), Singer X (Mezzo (S3)), Singer Y (Tenor (S4)), Singer Z (Bass (S5)). (Reproduced from D’Amario, Daffern et al., 2018, p. 10).

There was also an effect of rehearsal, and of piece on synchronisation. For Piece 1, precision (how close singers were in their timing) improved between Rehearsals 1 and 2; whilst Piece 2 improved across all five rehearsals (see Figure 6.20). In measures of consistency in timing (same amount of lag or lead rather than variation across rehearsal), there was less variation in Piece 1 than in Piece 2. There were significant differences in all rehearsals between synchronisation in Piece 1 and Piece 2 (See Figure 6.20).

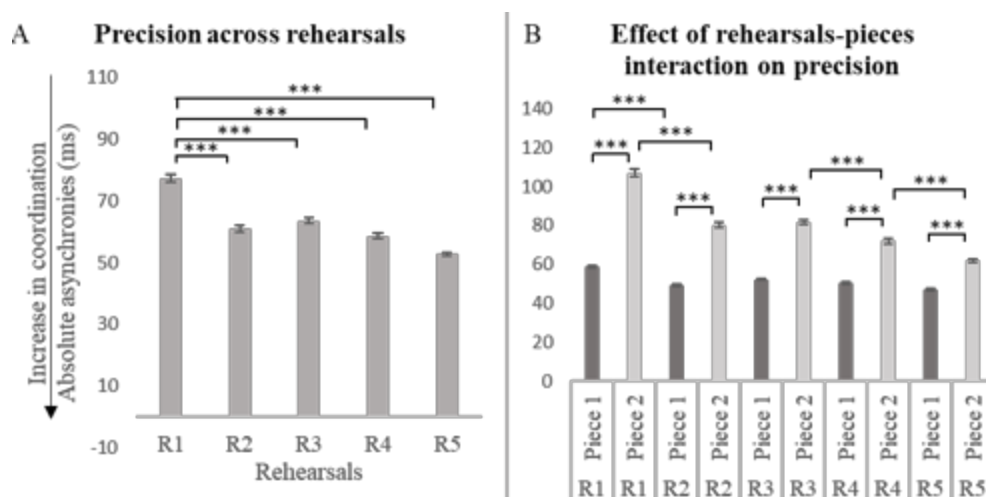


Figure 6.20 Effect of five rehearsals on precision of synchronisation (A) and effect of the interaction between rehearsals and the two pieces on precision of synchronisation (B). Error bars represent 95% confidence interval of the mean, \*\*\* $p < .001$  (reproduced from D’Amario, Daffern et al., 2018, p. 8)

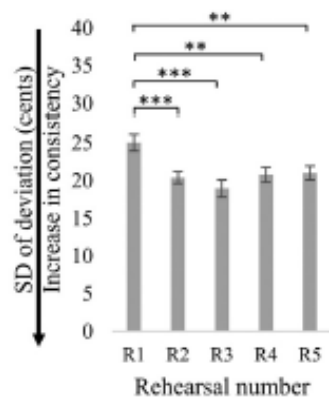
Based on the reflection questionnaire completed after the final session, singers rated their achieved level of synchronisation in Piece 1 (homophonic) as being  $M=82.4$  ( $S.D.=12.2$ ) on a scale from 0 to 100, where 0 was ‘not at all synchronised’ and 100 was ‘fully synchronised’. The timescale of improvement varied with piece: there was a consistent improvement in precision over time in Piece 2, and an improvement in the first two rehearsals in Piece 1. Consistency of synchronisation improved in the polyphonic piece in the first two rehearsals.

#### 6.3.3.2 Parallel study 2 - Development of tuning (D’Amario, Howard, Daffern and Pennill, 2018)

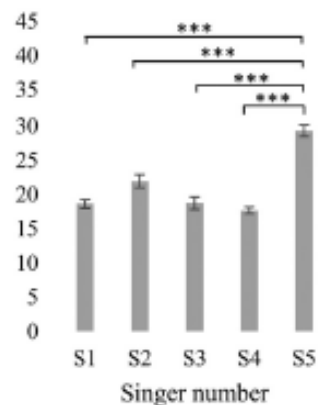
This study compared tuning consistency across rehearsals, and by singer. It aimed to investigate ‘horizontal’ tuning (in relation to how far the ensemble drifted from just or equal temperament over a series of rehearsals), and ‘vertical’ tuning of chords within the ensemble. A further aim was to investigate how the group addressed these issues through their verbal exchanges.

The results highlight a number of attributes of the group working and individual differences. There was convergence in pitch over time. To make improvements to tuning, the singers used a range of strategies, including repeating a short section, bar, chord or part of chord, and rebalancing voices. The variation in tuning attributed to Singer Z suggested a further source of implicit influence, in which less consistent and precise intonation require the other members of the group to adjust their own pitch throughout the rehearsal period.

It was found that Singer Z was significantly less consistent than other members of the ensemble in consistency of tuning of chords. There was agreement on tuning system – singers tuned closer to equal rather than just temperament, although there was a general drift flatter in pitch over time. Individual variations were highlighted, including the tendency for Singer Z to be less consistent in pitch (Figure 6.21).



Consistency of tuning by rehearsal



Consistency of singers

Figure 6.21 Consistency of tuning by rehearsals 1-5 (R1-R5), and by singers V (S1), W (S2), X (S3), Y (S4) and Z (S5). Error bars represent 95% confidence interval of the mean (\*\*  $p < .01$ , \*\*\*  $p < .001$ ) (reproduced from D'Amario, Howard et al., 2018, p. 9)

#### 6.4 Summary of findings

This study further investigated the evolution of group working between advanced singers in a newly formed singing working towards a performance. Observed verbal interactions and patterned behaviours based on these exchanges were analysed within and across rehearsals, and in relation to the musical material performed.

As was found in the study reported in Chapter 5, and in previous research (e.g. Zijlstra et al., 2012), interaction patterns formed early. Previous studies have shown that, as group members accumulate experience of working together, these experiences shape future interactions, and the likelihood of repetition of similar patterns increases (Gersick & Hackman, 1991). As they became familiar with the task, the group had more time to explicitly coordinate their work (hence, also, more talk) and to anticipate the actions of others. These interactions may also cultivate a sense of psychological safety in this new group and allow all members to find opportunities to contribute (Edmondson & Lei, 2014). In Rehearsal 1, the singers spent time familiarising themselves with the new music, through sight-singing, but as a newly formed group there was also the need to establish social bonds through talk. In the second rehearsal, there was more singing (and proportionally less talk), as they dealt with specific problems identified in the music. In Rehearsals 3 and 4,

there was more talk, less singing, and in Rehearsal 5, most singing and least talking as they put into practice and embedded their ideas for an expressive interpretation.

Over the five rehearsals, after an initial decrease, interaction patterns increased in complexity. This is consistent with research in other dynamic work situations, where teams demonstrated increased pattern complexity over time (Lei et al., 2016; Uitdewilligen et al., 2018). There may be other, more subtle, mechanisms at work, too, in the way this group moved towards more balanced and inclusive interactions. The number of dyadic sub-patterns was greatest in Rehearsal 4, reducing in Rehearsal 5. Dyad formation has been shown to be an indicator of emerging group interrelationships. The compilation model of Kozlowski et al., (1999), predicts dyad formation as part of team development, and a ‘contagion’ effect was reported by Bourbousson, R’Kiouak, and Eccles (2015) in basketball teams, whereby the presence of tightly coupled dyads made it easier for a third member to join and create a triad, resulting in longer patterned interactions. It is notable that, even after a break between Rehearsals 4 and 5, complex patterning was retained. This may be an effect of attunement to the task, whereby patterns that fit the task requirement tend to be retained (Uitdewilligen et al., 2018). It is also consistent with the theory of small groups as complex systems, which relates the achievement of coordination goals to “ongoing patterns of interaction among the group’s constituent elements as the group pursues its function” (Arrow, McGrath & Berdahl, 2000, p. 55).

As well as the increasing complexity of the patterns, more group members were involved in the patterns over time. This reflects the willingness among members for more involvement and created more balanced team interactions. This is further underlined by the feedback from the participants indicating a perceived change over time as the contributions became more balanced. Individuals were also found to exert their influence through nonverbal, auditory mechanisms. From the results of the parallel study, it is evident that Singer Z had a consistent tendency to precede the other singers (Figure 6.19) and to be less consistent in pitch (Figure 6.21). Overall, a picture emerges of how members of this ‘leaderless’ ensemble exerted their influence over events, which was expressed through different modalities:



Explicit:

- Being the most vocal or opinionated (Singer V)
- Making contributions that trigger important events (Singer Y)

Implicit:

- Being part of a sequence of behaviours that triggers important events (Singers W and X)
- Being ahead in time (Singer Z)
- Being at a different pitch (Singer Z)

The group worked on the same two pieces, presented in different order. More talk and more complex patterned behaviour were observed in rehearsals of the polyphonic piece. The differences between the two pieces were fairly modest, only relating to texture, rhythm, and pitch, and they were similar in style, length, and level of difficulty. It is therefore all the more notable that some small, but measurable behavioural differences were found. Even when working within narrow limits of genre or style, it is likely that ensembles will encounter much more widely varying repertoire, so this has implications for further understanding the influences on ensemble working practices and warrants further investigation. Apart from Rehearsal 1, in all other rehearsals there were fewer significant patterns after the change of piece than before. This may be explained as a result of a reduced ability of team members to predict behaviours of other members with a resulting temporary loss of adaptive capability (Grote et al., 2018).

Overall, there was an aim for coherence and convergence in the output of the group. Referencing the results of the parallel studies shows that by Rehearsal 5 more consistent synchronisation and tuning were achieved. Table 6.7 summarises the key features over time by rehearsal. Most notably, Rehearsal 4 represents a pivotal session in creating conditions for further integration in Rehearsal 5. In terms of elapsed time, Rehearsal 4 occurs at the mid-point of the timeline. This has been identified as a critical point at which groups review and revise their situation in relation to future goals (Gersick, 1988, 1989). This transition point can initially trigger discord within the group as conflicting views are surfaced in the light of

forthcoming deadlines, but ultimately gives rise to greater focus and convergence around agreed goals.

Table 6.7 Summary of key features of rehearsals over time

Rehearsal 1 Week 1 <i>First singing encounters</i>	Rehearsal 2 Week 3	Rehearsal 3 Week 6	Rehearsal 4 Week 8	Rehearsal 5 Week 16 <i>Final session before recital</i>
'Baseline' session	Shortest, least complex patterns	Least turn-taking in patterns	Most talk, least singing	More balanced talk and singing
Synchronisation and tuning least consistent	Fewest dyadic patterns		More complex, longer patterns	Most complex, longest patterns and turn-taking
			Most dyadic patterns	Tendency to precede others least marked
			Most task-driven (Clarifying) behaviours	Synchronisation and tuning most consistent
				More balanced contributions (behaviour types, singers)

## 6.5 Conclusions

This study explored some of the multiple complex factors contributing to the rehearsal processes of a newly formed group. It addressed a core challenge of ensemble coordination – as ensemble members work together in rehearsal, information is acquired about fellow performers, their preferred styles, and the musical features of the piece, in order to support coordination goals. This is a challenging group task, and the challenge of achieving these tasks in real time is increased if the complexity of the musical material is greater. The balancing act that must be achieved between stability of the group and the forces creating uncertainty and change lie at the heart of this challenge.

By adopting a case study approach, this research enabled detailed exploration of a number of key aspects, including task complexity, individual contributions, and how these processes evolve over time. It also responds to calls from other scholars for more research on emergent and dynamic approaches to team behaviour (Ballard et al., 2008; Cronin, 2015; Cronin, Weingart, & Todorova, 2011) including those driven by events occurring over time (Morgeson, Mitchell, & Dong, 2015) and to an understanding of behaviours that contribute to team adaptation (Grote et al., 2018; Maynard, Kennedy, & Sommer, 2015). It offers an example of how a range of complex factors impact the work environment of musicians. It provides an examination of the interaction patterns that result from a changing task environment, and also builds on the findings of Chapter 5, supporting the mid-point transition previously found in other team types (Gersick, 1988). These time shifts will be explored further in Chapter 7. Previous work on pattern development in teams has produced contrasting findings relating to the role of interaction patterns in team performance (Lei et al., 2016; Uitdewilligen et al., 2018; Stachowski et al., 2009). This research contributes to that ongoing exploration. It also contributes to knowledge on how the nature of the music being rehearsed can influence behaviour in musicians. The modes of influence exhibited by group members provided a further way to understand how group dynamics shift over time, suggesting it is not so much a question of 'leadership', rather of how each member finds a way to participate that allows them to actively contribute to the collective.



## 7 CHAPTER SEVEN

### Shared experiences of preparing for performance in newly formed groups

*In human society, organizations embody a powerful way to coordinate complex behaviour. (Boella and van der Torre, 2006, p. 3)*

A primary focus of this investigation was to explore the ways in which ensembles manage and pace their activities over time. The experiences and behaviours of two newly formed musical groups were investigated over a six-month period, in order to understand how they accomplished their goals from first rehearsal to performance, and how effective working relationships were established and social aspects of performance negotiated. It focuses on the formative months in order to investigate ways in which preparation for performance unfolded over time, from the very beginning to a well-established level, and what activities, processes, and emotions were experienced by the group members.

As highlighted in Chapter 2, there is little research on the development of newly formed ensembles over a series of rehearsals. By investigating the rehearsal processes of two groups over several sessions, this study explores how performance was accomplished and experienced through the rehearsal process, and the extent to which different stages of development were apparent. It aims to contribute to a conceptual understanding of the achievement of performance goals and working relationships over time.

#### 7.1 Aims

This study aimed to investigate the perceptions of ensemble members regarding how they rehearsed and prepared for performance, in order to address the following questions:

- How do members of newly formed ensembles experience the process of preparing for performance?
- How are stages of rehearsal perceived and managed?

The process approach underpinning this research assumes that organisations are constantly changing entities, and at any given point in time are in a state of 'becoming' (Tsoukas & Chia, 2002), and need to balance flexibility and stability

(Grote et al., 2018). Given this assumption, the events and experiences encountered by organisational members are key, and described by Langley et al. (2013) as representing a point at which ‘process’ meets ‘practice’ (p. 5). This qualitative study therefore seeks to foreground the experiences of the participants and does so in a way that captures their general reflections on the group experience and perceptions of changes over time. Finally, building on findings reported in previous chapters, it adds experiential evidence to the behavioural analyses, thus providing triangulation to the research design.

## 7.2 Method

The research setting for this study was two cohorts of students on an international programme of study at a UK higher education institution, recruited over a period of two consecutive years. This concerned the same setting and cohorts as previous studies (reported in Chapters 5 and 6). This study provided the opportunity to compare the experiences and perceptions of the participants with the empirical data reported previously. It was therefore designed to address multiple personal perspectives within this highly specific ensemble setting. The overall study design was based on qualitative methods, and data included observations based on video-recorded rehearsals over an eight-week period (Group 1) or 16-week period (Group 2), rehearsal logs, and reflective interviews in Week 20 (both groups). The interviews were also supported by visual representations captured from the participants.

### 7.2.1 *Participants*

A total of 10 singers participated in the study. All were members of one of two newly formed vocal quintets. Based on the aims of the study, this homogenous sample was considered sufficient to capture individual experiences, whilst allowing participants’ responses to reach ‘saturation’ – or “when no new properties, dimensions, conditions, actions/interactions, or consequences are seen in the data” (Strauss & Corbin, 1988, p. 136). As described earlier (Chapters 5 and 6), each group comprised five advanced solo singers, formed as a quintet and selected as a matched vocal ensemble for a one-year programme of study under the overall supervision of the course director. They were taught and assessed as a group, and also rehearsed independently as a self-directed ensemble. The two groups followed

very similar programmes, one year apart, and both were coached by the same course director between their self-directed rehearsals. Both sets of participants were preparing for a forthcoming recital, planned for Week 9.

Case Study 1: Group 1, age range 23–35 years.

Singer A – Soprano, Group 1, female  
Singer B – Mezzo-Soprano, Group 1, female  
Singer C – Singer C, Group 1, female  
Singer D – Singer D, Group 1, male  
Singer E – Singer E, Group 1, male

Case Study 2: Group 2, age range 22–29 years.

Singer V – Soprano, Group 2, female  
Singer W – Mezzo-Soprano 1, Group 2, female  
Singer X – Mezzo-Soprano 2, Group 2, female  
Singer Y – Singer Y, Group 2, male  
Singer Z – Singer Z, Group 2, male

Performance standards were set at professional level. The highest assessment band (90% or higher) was intended to accommodate performance of the highest commercial quality. The full rubric for performance assessment is included in Appendix G. Whilst the groups' progress and achievements against this rubric were not directly investigated as part of the study, the criteria indicate an important aspect of their shared goals, that required them to demonstrate core skills, including insight and/or interpretation, technical command and communication of ideas. These standards are in line with the professional aspirations of the participants, who aimed to perform at a high professional level as soloist or chamber musicians. Throughout the course they were assessed as a group. There was thus an additional requirement to assimilate the expectations and requirements of the university, and to benchmark their individual capabilities – both against each other, and the criteria for assessment.

### *7.2.2 Procedure*

Multiple methods of data collection were adopted for each of the two cohorts, in order to create rich descriptions of the experiences and perceptions of the ten participants. Primary methods of data collection were interview and video

observation, which have been used in a number of studies of rehearsal practice (Davidson & Good, 2002; Lim, 2013; Seddon & Biasutti, 2009a; Williamon & Davidson, 2002). Semi-structured interviews enabled all participants to describe their experiences from their own personal perspectives. During the interviews they were also asked to describe the timeline of progression, including any key milestones encountered. Rehearsal activities and their changes over time were recorded using rehearsal logs to record the mix of activities during rehearsal (Group 1), a reflection questionnaire after the final observed rehearsal (Group 2), and participant observation (Groups 1 and 2). Data collection was conducted in each study period as shown below (Table 7.1).

Table 7.1 Data collection timeline

		Week										
Data collection		1	2	3	4	5	6	7	8	16	20	
Group 1	Observation	✓		✓		✓		✓				
	Rehearsal logs	✓		✓		✓		✓				
	Interviews										✓	
	Timelines										✓	
Group 2	Observation	✓		✓		✓			✓	✓		
	Development trajectories										✓	
	Interviews										✓	

#### 7.2.2.1 Interviews

Semi-structured interviews explored perceptions and experiences of the musicians and allowed further elaboration as the interview evolved (Robson, 2011). Interviews were conducted approximately five months after the groups formed. This allowed them to reflect on the period of development over the first months, with some distance.

The main questions are included in Appendix G, and were used to guide the discussion, the precise nature of which varied by the individual and their responses. Interviews were audio recorded and transcribed verbatim. Transcripts were used as the basis for identifying codes and themes, using the software package NVivo (QSR International). No predefined codes were used in the analysis of the interviews.



#### 7.2.2.2 Observation

To complement the interviews, observation was used to gain first-hand understanding of the groups' working methods, using video recordings to minimise disruption of the group's processes through the presence of an observer.

#### 7.2.2.3 Rehearsal logs

Rehearsal logs were summarised from the sheets submitted by the participants post-rehearsal for Group 1. They were not used for Group 2 as all rehearsals were observed through video-recording of the entire session.

#### 7.2.2.4 Drawings – timelines and trajectories

To draw out further data relating to progress over time, visualisation methods were used in conjunction with the interviews, following the approach used by Bischof et al. (2011). During Group 1 interviews, the participants were asked to draw a simple timeline of the key events during their time together and to annotate any milestones. Building on the timeline data from Group 1, for Group 2 this was developed further to provide a further dimension of progress over time. Group 2 were provided with a blank sheet indicating time shown on the horizontal axis and 'progress' on the vertical. Each group member was invited to create a visual representation of their own view of the group's development. No further guidance was given, so the singers were free to depict their own perspectives in any way they liked, whilst talking about the reasons for their choices. The resulting visual representations were annotated with relevant comments made by the participants, as they described their experiences, events, and milestones, whilst simultaneously drawing their accounts. This commentary was later used to annotate the trajectory drawings, also using NVivo. The annotated drawings are included Appendix F (see Figure 11.1 to Figure 11.5).

Ethical approval for the study was obtained from the Physical Sciences Ethics Committee (PSEC) at The University of York (UK).

### *7.2.3 Data coding and analysis*

Data was drawn from four sources – interviews, observations, trajectory diagrams, and rehearsal logs. As described in Chapter 3, coding and analysis of the data generated first-order concepts, from which second-order themes were identified.

Data coding and analysis followed the approach of Gioia et al. (2013) in which a data structure is generated from first-order coding and second-order themes.

Given the wider aims of this research to further understanding of the process of performance preparation, these themes and relationships were organised in relation to the way events unfolded over time. For this, a ‘temporal bracketing’ approach (Denis, Langley, & Cazale, 1996; Langley, 1999) was used to identify groupings of activities in relation to time. Bracketing events in this way assumes there is some continuity of activities within a bracketed time period, and some discontinuity at its boundary. A further assumption is that the structural basis of these time periods is formed by the actions of individuals, and that they can therefore be reconstituted in the future. Time brackets were assigned to the coded concepts and themes drawn from the participants’ accounts and observation data. Assigning time brackets was based on reported or observed order and sequence of events, to assign themes, and also to consider relative timing (e.g. early, middle, or late in the process), supported by participants’ own interpretation of phases and stages of development.

### 7.3 Findings

The results of this study revealed three main clusters of activity, broadly equivalent to bracketed time periods of *exploration*, *transition*, and *integration*. These phases had distinct characteristics, based on the participants’ accounts. The findings are also related to the ways that the groups characterised and dealt with key (‘critical’) events, and how they negotiated transitions between phases. Changes in communication and building of shared knowledge are also explored. The following section first gives an overview the groups’ experiences and trajectories of development. The main themes aggregated during each identified time period are given, and each of these is considered in relation to the participants’ accounts.

#### 7.3.1 Overall group experiences and trajectories

As both groups participated in the same course of study, with the same broad schedule, coaching and assessment demands, there were parallels in their experiences. During the interviews and the discussion of group trajectory, participants reflected on the overall development of their groups. Whilst the details

varied, there were analogous accounts relating to their early encounters, which were followed by a period of disruption and increasing pressure, resolved prior to performance. Early rehearsals were focused on getting to know each other and familiarising themselves with the repertoire they would be performing and the requirements of their course. After this initial familiarisation, there was a less settled period in which both groups experienced emotional highs and lows, early performances of mixed success, illness, and conflicting demands. In this period there was also a perceived pressure of time, and a growing awareness of gaps between their desired and current performance level. As the performance date approached, key decisions were made about repertoire choice, programming, and what was needed for timely preparation. During this time the groups experienced a more focused and efficient period in which they grew in confidence, and were able to collaborate to bring elements of performance together.

There were also similarities in the way they described the arc of their development. Based on the coding of the data, three distinct aggregated themes emerged. The first clustered around processes of ‘exploration’, which was characterised by familiarisation with co-performers and goals, establishing communication, and trying out new ideas. The second theme emerged around processes of transition, in which the groups experienced disruption, challenges, and emotional volatility. They were also very ‘permeable’ (King, 2012), in that they were open to external influences. The third main theme was ‘integration’, which included the emergence of mutual trust, more direct communication, more efficient ways of working, and growth. In the following section, findings relating to each of the three aggregated themes is explored in more detail. The data structure is shown Figure 7.1. In addition to the quotes included in the text, a full summary of the themes organised in relation to the data structure, and with further illustrative quotations is included in Appendix H (Table 11.17).

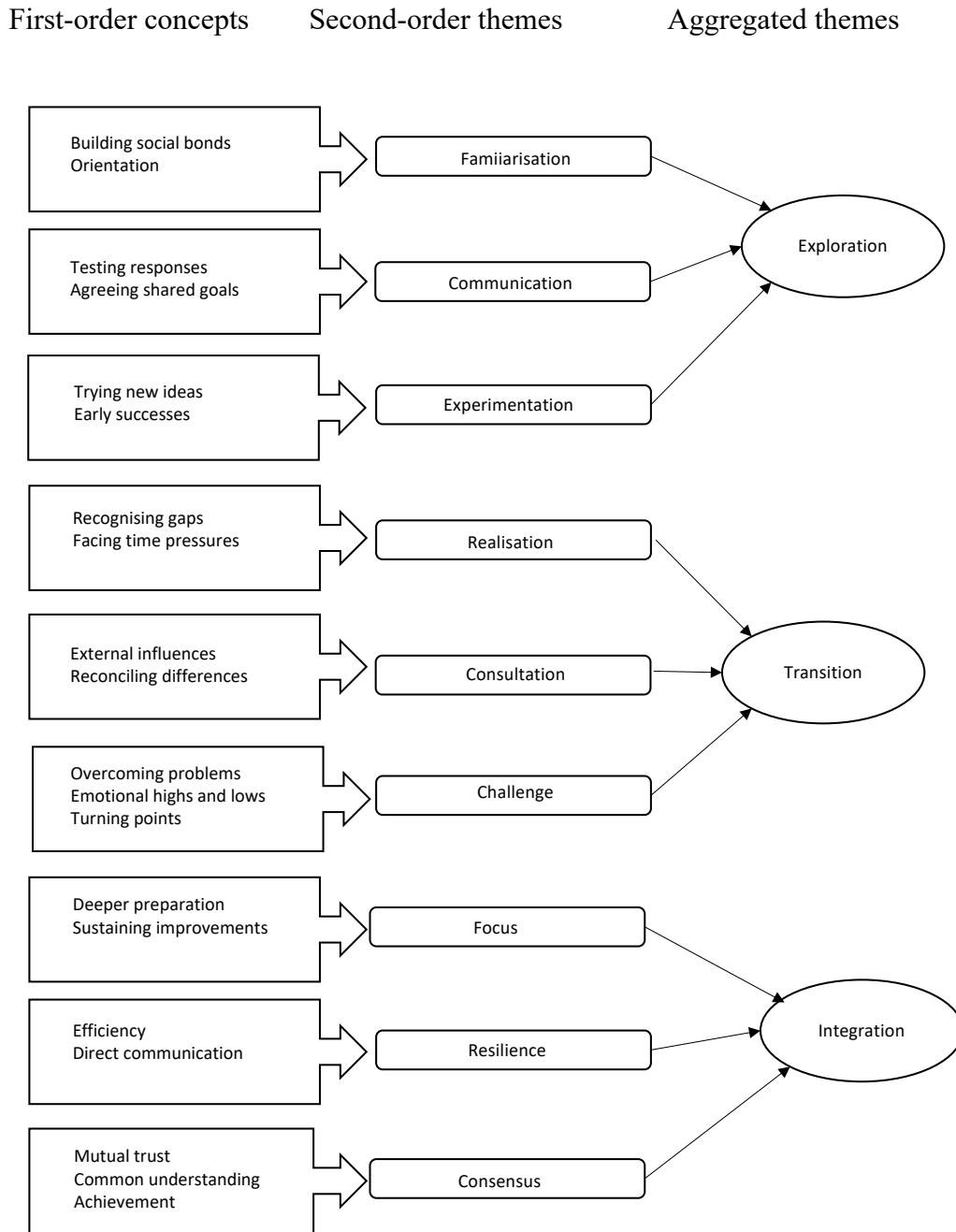


Figure 7.1 Data structure showing emergent themes

### 7.3.2 Main aggregated theme 1 - Exploration

The theme of exploration was characterised by the establishment of social and musical familiarity, finding the most effective ways of communicating, and by processes of experimentation. Each of these sub-themes is considered in turn, relating to participants' accounts and to observations.

### 7.3.2.1 Familiarisation

Reflecting on their experiences, the participants did not emphasise their very early experiences of meeting and singing together for the first time, but rather focused on the musical repertoire they had decided to work on for each rehearsal. This was generally decided in advance by members of the group before each session, although the order and length of time spent on pieces appeared to be more spontaneously decided in response to what issues were encountered. The first rehearsal for Group 1 started with a mix of serious work as they got started with their first piece, mixed with light-hearted social chatter. Later rehearsals followed a similar format, although with less social chat. Observations of Group 2 were in the lab, where they had more limited time available. Their social interactions were therefore more constrained; however during interviews they described their early rehearsals (outside the lab) as relatively unstructured, with lots of sight reading. It was notable that, from the outset, both groups were able to engage immediately with their task, as a result of their previous similar experiences. In both groups there was a sense that they were ‘well matched’ vocally, and ready to make progress, with the result that they could immediately start to work together without the need to discuss process. They just ‘got on with it’ in ways they had previously experienced in other similar settings.

#### *Building social bonds*

Group members reflected on how the group’s social relationships had evolved, and realised that there had been a change from the start. For example, one participant described the change as follows: “It’s just got better the more time we spend together” (Singer A, Group 1, interview). In the early rehearsals they became more aware of their co-performers’ behaviours and habits. They got to know each other socially, whilst also learning new repertoire:

... but it was sort of note bashing whilst also getting to know one another,  
... whereas now we’ve got our rapport. (Singer A, Group 1, interview)

We’ve sort of gelled more as a group now, and I think it took a little while  
to settle at the beginning which is natural. (Singer W, Group 2, interview)

... Social skills as well, having to get to know, in this context with these  
other four getting to know each other and being sensitive of each other –  
kind of you know little things we all have. (Singer Y, Group 2, interview)

Social bonds were described as reciprocal, and arising through verbal and nonverbal interactions, as they recognised that tacit judgements were being made during those earliest encounters. This was a period of delicate balance, with the need to ‘be sensitive’ to fellow group members.

### *Orientation*

The musicians were aiming to work at a high level of performance capability. Their previous experiences helped them to approach this in similar ways. They initially tried lots of repertoire, most of which was new to everyone. Early rehearsals therefore involved extensive exploration of new repertoire in a range of styles and languages, during which they expressed opinions and preferences, as well as working on the technical and stylistic aspects. The amount of repertoire tackled at the start meant there was relatively little focus on interpretation and expression. They were also aware of how they sounded together, as Singer A, Group 1 reflected; “From the very first time we sang together it was a really nice blend” (Singer A, Group 1, interview).

Yeah it took us a bit of time, I remember the first session back yeah it was great to sing together but we didn’t really get the music ... at the beginning of term the pieces weren’t that tricky in terms of notes, but it was learning the geography and getting the shape, we’re just trying to get the notes right. (Singer E, Group 1, interview)

This early period therefore proved to be a useful testing ground for technical orientation as the group spent time revisiting the basics, establishing their shared concepts of the pieces, ensuring the notes were in place, and sharing opinions and preferences.

#### 7.3.2.2 Communication

Making music together and rehearsing were important for different ways of communicating to be tried out and established. Members of the groups described how communication styles developed, and observations of rehearsal videos provided further data. Verbal communications often involved expressing opinions, giving responses to ideas, agreeing to shared goals, and discussing preferred repertoire.

### *Testing responses*

Verbal communication during early rehearsals was quite tentative. Suggestions were often made in the form of questions and, where personal views were expressed, they were generally offered using positive language, e.g.:

... what do you guys feel at 9, I feel it's leading into it, to the final phrase, or ...? (Singer V, Group 2, observation)

That's really cool! I think quickly that could be really good. (Singer E, Group 1, observation)

The participants appeared to be aware of this slightly cautious approach and attributed it to a lack of familiarity and knowledge of co-performers. As they got to know each other, there was a change in tone, as for example expressed by Singer D; "I suppose there's been more of a change from 'I think we should all do this on a consonant' to, 'you should do this on a consonant'" (Singer D, Group 1, interview). At first there were moments when it was apparent that their ability to communicate nonverbally had not been fully established:

Last term one of our assessed pieces opened with four singers singing a pair of bare fifths and it didn't start moving until about the third bar and in that first instance obviously we had to come in bang together. But there seemed to be in that first couple of seconds a brief moment of conflict where someone was ready to move a fraction of a second sooner. And it was whether the two people were going to go with the other two, or those two were going to move to that you know ... we had to know it. (Singer Z, Group 2, interview)

### *Agreeing shared goals*

There were some key decision points during the process of recital preparation, which required the groups to agree a programme and repertoire for recital. Having been exposed to lots of material, these decision points provided opportunities for establishing shared goals, which would later have implications for preparation and, ultimately, performance. The groups also had input from their course director to guide their choices, although they made independent choices through discovering repertoire the group liked:

Choosing repertoire was an important decision point. (Singer A, Group 1, trajectory)

... and we were looking around for things to pad out our programme and we found some new ones, Gesualdo and Monteverdi, and we pretty much liked them straight away. (Singer E, Group 1, trajectory)

Overall, the process of familiarisation included negotiation, as individual preferences and strengths were weighed against the need to provide a balanced programme. Establishing a sense of the group was achieved through verbal and nonverbal means, including the ability to sing well together in the early stages.

### 7.3.2.3 Experimentation

There were examples of personal as well as group discoveries, although there was also a tendency to stay in individual ‘comfort zones’ vocally, and to focus on getting the basics right. Feedback from peers and from their course director instilled a sense of growing confidence in both groups:

There was lots of experimenting. I think we mainly agreed on what wasn’t going to be feasible – it was a very collegiate decision on what was in.  
(Singer E, Group 1, interview)

#### *Trying ideas*

Interpretive choices were sometimes made organically or by ‘accident’ through trying new ideas and responding to what happened in rehearsal. This process provided a way in which the singers could respond explicitly (through expressing an opinion or bringing something to the group’s attention) with the goal of embedding these decisions in a performance:

Most of the expressive elements started out or the most expressive moments started out as either accidents or one person trying them and then saying ‘oh, what just happened?’ (Singer Z, Group 2, interview)

#### *Early successes*

Both groups also experienced positive reinforcement from some early performance experiences. Group 1 had a performance early on which went well, giving them a sense of ‘feeling like a group’ (Singer E, Group 1, trajectory). Members of Group 2 reported the ‘boost’ they got from an early performance, and a feeling of noticeable improvements in rehearsal:



We had our first session or two ... and loads of stuff kicked in and we did like loads of work on our own. (Singer V, Group 2, interview)

... as a group over the course of weeks, you know the five or six weeks but you know hearing differences in blend and tuning but also attitudes of working in a group that size. (Singer Z, Group 2, interview)

The process of experimentation emerged as important for fostering creativity and confidence around group decisions about choice of repertoire, and expressive interpretations.

### *7.3.3 Main aggregated theme 2 - Transition*

After these early weeks of preparation, things started to change for both groups. The groups began to encounter problems, face time pressures, and confront gaps between current and required standards. This was a volatile period characterised by greater diversification of views expressed during their interactions, dealing with emotional issues, and finding practical solutions. The recurring themes related to realisation (of gaps and of deadlines), consultation (within and beyond the group), and overcoming challenges (addressing and dealing with problems).

#### *7.3.3.1 Realisation*

Both groups faced moments where they recognised that their current level of attainment was falling short of where they wanted to be. This had a galvanising effect, resulting in realisation of how much work they needed to do, and a collective determination to achieve it. They recognised these issues as gaps to address and became increasingly aware of forthcoming deadlines. This created a sense of urgency and purpose, and an increased level of anxiety.

#### *Recognising gaps*

There were experiences which fell short of expectations, including performances mid-term. Reflecting on these experiences of disappointment, group members described how it increased their capabilities:

We did one of the pieces that we then did in our recital, which didn't go well but then it made us better afterwards. (Singer C, Group 1, interview)

But after that [disappointing performance] we sort of then really got our heads down and got our programme sorted for Christmas. (Singer X, Group 2, trajectory)

There was also a recognition that preparation needed to be at a higher level than ‘just’ getting the notes. This perceived gap related to the refinements and agreement needed for an expressive musical interpretation:

... I think the majority of our progress and work is done in this kind of chunk where we’ve got the notes now yeah but we’re miles away from having something recital ready. (Singer W, Group 2, trajectory)

### *Facing time pressure*

Time pressure was also a key issue that prompted a shift in focus. This pressure arose due to tension between the fixed deadline of recital and the desire to spend time exploring repertoire, being slow to realise they were running out of time, or because it was taking time to agree a collective interpretation:

It happened this term actually, it took us a while to get going, and we coasted a bit, and then realised we didn’t have very long to prepare. (Singer E, Group 1, interview)

There were some differences of opinions in what we should do, because we were on a very tight schedule for getting the music ready ... (Singer D, Group 1, trajectory)

Time pressure also created feelings of anxiety about delivering on time, such as the experiences of a member of Group 2 who described the time pressure of a rescheduled recital, shortly after returning from a break:

So we had a few days before the recital to sort of jam everything back and that was quite scary. (Singer W, Group 2, trajectory)

Overall, this realisation of recognising where work needed to be done, and facing time pressures involved to achieve it created a sense of urgency and purpose in the groups.

### 7.3.3.2 Consultation

Observation data revealed changing styles of communication. Compared with the early rehearsals, group members were more likely to challenge each other’s opinions, and actively seek feedback from others.

### *External influences and feedback*

The groups were exposed to intense coaching and exposure to advice from members of a professional group. These sessions and the input they provided were influential, encouraging the singers to move away from their usual modes of operation and trying new ideas, including ‘breaking rules’, moving beyond their comfort zones, and actively seeking input:

And then the Course Director sort of started saying things to us like, you know, he was breaking rules, breaking rules left and right and centre, or breaking the rules that we knew and saying no doesn’t need to be like this. Everyone says it’s wrong, but it’s more exciting [to do it another way].  
(Singer Z, Group 2, trajectory)

Audiences provided a further source of reinforcement and feedback. Informal performances were an important part of preparation, as the groups sought to embed their prepared material prior to a formal recital. For example, performing to friends and trusted colleagues enabled Group 1 to actively seek views on what they were preparing, and to help them develop as a collective:

... it really helps to perform to an audience, to get feedback, we got a lot of different views on repertoire, and helped us to perform, and really feel like a group. (Singer E, Group 1, interview)

### *Reconciling differences*

Rather than tentative suggestions framed as questions, there were more critical and evaluative contributions made, and individuals were more likely to express their own views, but also seek views from others. There were examples of mild artistic disagreements and differences in interpretation as they discussed ideas. The following exchange in observed Group 2 illustrates this:

Singer Y: Why are we doing it so pointedly? I feel like ...

Singer V: Because it sounds patriotic. Because of our interpretation!

Singer Y: I feel it might be a bit overcooked, because we are still growing in bars 10–11

The process of consultation was therefore both internal and external. The singers expressed a willingness and openness to external feedback and coaching, and were more prepared to strongly express their views.

### 7.3.3.3 Challenges

As they gained more feedback and understood the performance criteria expected of them, the singers acknowledged there were gaps between where they were and where they needed to be. Accordingly, the groups adapted their approach and rehearsal methods to suit the specific challenges of the task. Both groups found themselves facing hurdles and problems, which they needed to address in order to achieve their goals. For Group 1, this took the form of illness or competing priorities for some members, putting pressure on available rehearsal time; for example in the case of Singer B:

I had a crisis part way through the first term, I got ill, I had to have 2–3 weeks off. (Singer B, Group 1, interview)

For Group 2 illness was also an issue, which impacted severely on their preparation timeline. One member lost their voice and was unable to sing at all, resulting in the postponement of a recital.

#### *Overcoming problems*

These problems and the way the groups addressed and reflected on them were key events in their overall progress. They created short-term disruption for the groups, and they described some of the emotional highs and lows associated with these unexpected events.

#### *Emotional (highs and) lows*

The cancellation of a recital was described by all members of Group 2 in terms of emotional impact – ‘an emotional day’, ‘disappointing’, and ‘stressful’. However, there was a sense that this made the group ‘stronger’ and therefore, on reflection had value as a learning experience:

We had a setback because the assessment was cancelled, and that was a very stressful thing. That was a big test of the group vocally and emotionally.  
(Singer Z, Group 2, trajectory)

#### *Turning points*

Both groups reached a point where they were in a position to harness the experiences and emotional highs and lows of preceding weeks, and at which practice

sessions created a sense of urgency. They described a renewed sense of collective confidence and feeling ‘like a group’:

Then we had a practice recital ... and then we were like OK we’ve got to start. Yeah, we’ve got to seriously get on with it. (Singer D, Group 1, trajectory)

Yes, I think that was where we decided we could do a really, really good job of it so we were like let’s put everything into it, lighting, staging, costumes. (Singer A, Group 1, interview)

These challenging moments and events helped to provide impetus for a final stage in which the group achieved a greater degree of integration, which is considered next.

### *7.3.4 Main aggregated theme 3 - Integration*

The theme of integration was dominated by sense of coming together around a shared goal, with a new sense of mutual understanding and confidence. They experienced ‘special musical moments’ and a sense not only of goal attainment but also of sustained improvement and ability to deal with pressure. There was a sense of achieving or approaching goals, and also of transcending the technical preparation to add more artistic refinement and expression. Participants described their development of mutual trust, enjoyment, and risk-taking. These actions were purposeful, focused, and selective. After the initial exploration of many different methods in the early phase, the groups reduced the number and type of approaches they used in order to address the specific challenges faced. This is evident from the rehearsal logs, in which there are fewer activity types reported. Tasks were mainly focused on refining tuning and expression. Observation data also showed more time spent singing through whole pieces or movements together, and less time breaking down into sections and parts.

#### *7.3.4.1 Focus*

With the performance goals more clearly defined or imminent, a number of the participants recalled their need to ‘get focused’. For some this included going deeper with preparation, and moving beyond the notes to include additional elements such as staging, and more expressive and interpretative aspects:

### *Deeper preparation*

'Deeper' preparation allowed time for extra-musical performance ideas to be explored and tried:

... by the time we got to our recital we were a lot more focused on presenting more of a performance than like freaking out about the notes, so we did things like staging and got into costumes and were able to focus a lot more on the extra-musical things, like lighting, and our collective and individual emotional responses to the music as well. (Singer A, Group 1, interview)

### *Sustaining improvements*

Members of the group were pleasantly surprised how well their group ethos and energy was sustained despite a break for the Christmas vacation:

We were expecting ourselves to be a lot worse than we were ... we also then thought you know we had the break and everyone's voice was back and we were just full of new you know January ideas and we could do this. (Singer X, Group 2, interview)

Triggered by an approaching deadline or having made some decisions about programming, getting focused implied a greater sense of urgency, but also a narrowing of attention to address priorities.

#### 7.3.4.2 Resilience

There was evidence of more robust processes and more direct communication in the later stages of rehearsal. Having the ability to share freely, admit errors, and work effectively created a sense of confidence in their performance capabilities:

I don't think I've ever felt so comfortable, despite how difficult some of it is. (Singer D, Group 1, interview)

### *Direct communication*

There was a more direct tone to verbal interactions. Participants were more likely to admit errors, or personal shortcomings. For example, in Week 7, Singer A in Group 1 admitted she needed to work more on the meaning of the text:

I felt like I just don't really know what the words really mean, I need to work on that, you know. (Singer A, Group 1, observation)

Compared with the tentative communication style characteristic of 'exploration' and of the more confrontational exchanges of 'transition', in the 'integration' phase, participants were more inclined to share personal views in a direct but constructive way. There were fewer instances of disagreement on artistic matters. They were also more direct in saying to others what they thought, or how or what they wanted to happen, such as this comment in Week 16:

You were doing it fine; we just need to make an effort to do a bit more.  
(Singer V, Group 2, observation)

### *Efficiency*

They also refined their rehearsal methods to improve efficiency. The self-report rehearsal logs (Group 1) highlighted a shift towards more work on expressive aspects, performance cues, and planning in Week 7 as performance approaches, with less focus on technical demands, slow passages, and blending of voices (see Table 7.2).

Table 7.2 Self-reported activities for Group 1, from rehearsal logs

Action	'Exploration'		'Transition'	'Integration'
	Week 1	Week 3	Week 5	Week 7
Work on intonation		✓	✓	
Work on expression		✓	✓	✓
Work on synchronisation		✓		✓
Work on balance and clarity of voices		✓		✓
Work on blending of voices	✓	✓		
Work on technical demands	✓			
Establishing performance cues				✓
Breaking the music into sections	✓	✓		✓
Slow practice of passages	✓	✓		
Planning			✓	✓

Group 2 were asked to describe their rehearsal process and how it changed over time. At the start there was no clear strategy, and progress was slow. Singer Y, Group 2 described this, and also what he saw as the need for a democratic process to be in place:

When we first started, I remember the first couple of rehearsals we just didn't really get much done because we didn't have a strategy, and it's difficult because there's no leader and there shouldn't be as the point of this is that there's five of us. We all need to have an equal voice. (Singer Y, Group 2, interview)

They subsequently established a rehearsal process that enabled them to work more efficiently, and which ensured all voices were heard. A notable feature in Group 2 was their 'formalised process' whereby each singer was given the chance in turn to offer feedback, in response to singing a whole piece or section, and each idea was acted on or tried. It was described as a "kind of a conch system", a reference to William Golding's *Lord of the Flies* (Golding, 1954), in which the blowing of a conch shell was a signal that discussion or consensus checking was about to happen:

We kind of have a bit of a democratic kind of a conch system in rehearsal – we'll do something, we'll start with a piece, and we'll do it once, and at the end every person picks one thing they want to say about what just happened. (Singer Z, Group 2, interview)

Reflecting on the evolution of their rehearsal methods, later rehearsals became 'more efficient':

I think well I think our rehearsals have kind of evolved from the beginning as we've got to know each other, and I think I guess the general trend would be that ... they've become more efficient. (Singer Y, Group 2, interview)

The following steps summarise the overall rehearsal process they ultimately established, which emerged gradually but became routine in later rehearsal stages (see Table 7.3).

Table 7.3 Rehearsal process established by Group 2 over time, and consolidated during their later rehearsals

Revised rehearsal process, Group 2
<ul style="list-style-type: none"> <li>• Establish goals prior to rehearsal (using messaging app to ensure everyone is aware in advance</li> <li>• Use the first 10–15 minutes to warm up together on suitable repertoire</li> <li>• Work intensively on one or two selected pieces, ensure everyone has the opportunity to give notes – using their 'conch' system, a formalised process whereby each can suggest ideas, which are systematically tried one at a time.</li> <li>• Exact focus depends on material but may include work on tuning, ensemble, vowel blend, interpretation</li> </ul>



Whilst they didn't establish such a formalised structure, more efficiency in rehearsal was also recognised by members of Group 1, as they gained confidence in their own decision making, rather than relying on advice from others:

So, I suppose ... where we've improved is that we're more acutely trained to what to look for in ourselves ... (Singer D, Group 1, interview)

... I think we've got more efficient, knowing the things we have to work on and using our rehearsal time better. (Singer C, Group 1, interview)

Taking ownership of rehearsal processes, and with more use of constructive, direct communication therefore resulted in an increased sense of preparedness and created greater resilience to deal with pressure.

#### 7.3.4.3 Consensus

The groups both worked hard on cultivating a common understanding. An example of this in action was in their shared responsibility for entries, where the group 'just kind of feel it all together', in a 'really organic' way. This non-verbal communication also required time and familiarity to develop.

#### *Mutual trust*

A further consequence of this was the ability of the groups to step beyond the constraints of a pre-determined performance, develop a sense of mutual trust, and take more artistic risks. An example was given whereby other group members adapted to catch their co-performer who made 'a bit of a slip' during performance:

You know, just holding a beat there ... or making a really clear lead here and there ... (Singer Z, Group 2, interview)

... there are few moments where it will go to silence and we all have to come in together ... and then we come in, we just kind of feel it all together. After practising lots of times, but yeah that was the same with all the openings as well, it's very collaborative, because we are all standing next to each other, very close to each other. So, yeah, once you just get used to singing with everyone it's very clear, which is really nice. And we do it without looking at each other, as well. (Singer A, Group 1, interview)

A further indication of this developing trust is the willingness to take more risks, by considering options other than the 'less obvious' ones, and having the

willingness to be ‘a bit more daring’, and giving full emotional commitment in performance:

So when it came to the actual recital when we walked offstage we all felt very emotionally spent, because we’d all really gone for it! (Singer A, Group 1, interview)

### *Common understanding*

There was a desire to take a more holistic view in which there was a ‘central message’ that the groups agreed on, and which they focused on communicating. The importance of developing and sharing ideas was a frequently recurring theme, with the sense of reaching a common understanding:

... And so it felt like we knew what we were doing, we knew what the formation of the programme was going to be, what our sort of general message was on the whole. (Singer X, Group 2, interview)

And I just remember there was one time where we performed all of our pieces after working on it loads and it was just like such a big change from some of the basic thing ... Early on it’s inevitable that we just sing through. Later on, I’ve come out of rehearsals feeling quite excited. Presenting ideas is the bit I’m excited about. (Singer V, Group 2, interview)

### *Achievement*

Putting everything into practice enabled the groups to achieve their performance goals. There were two aspects to this – fulfilling the requirements of their course and programme, but also feeling there had been a sense of progression and artistic excellence, exemplified by the following comment from Singer E in Group 1:

A high point would probably be the recital ... every single piece was performed better than we’ve done it before. (Singer E, Group 1, interview)

An increased sense of trust and mutual understanding was described in ways that suggested these elements represented the culmination of ensemble goals – not only the ability to deliver a performance, but also the experience of working effectively together as an artistic unit.

These themes are next considered in relation to their order and timing over the whole performance preparation period, and in relation to their relative durations and milestones.

### *7.3.5 Emergent, time-bracketed periods*

Two participants (from different groups) described their experiences in terms of three phases of development. These observations arose spontaneously and in response to very general enquiries about how they saw their group developing; the concept of phases was not mentioned by the interviewer. Each person described the phases differently.

#### 7.3.5.1 Task-focused ‘stages’

Singer C described them as task-focused ‘stages’: Stage 1) Learning the repertoire; Stage 2) Doing the technical work; and Stage 3) Performance refinements.

It’s in three stages I think; learning rep, technical work, performance refinements. First off we don’t know it, it’s not in our voices, we don’t know what’s coming up next. That stuff has to happen before we start meeting with the Course Director, then we can start working out things like tuning, where we’re going to speed up and slow down. Then the last bit is more performance-focused. They are probably, so far, about roughly equally divided into those sections. Then each of three phases need to happen in order so can’t start the next until one is complete ... The technical work [...] and performance preparation are both really important. Ideally we’d like the first bit to be a bit shorter and so we had more time [for refinement]. (Singer C, Group 1, interview)

#### 7.3.5.2 Developmental ‘phases’

By contrast, Singer Z described the phases more in terms of group development and creative growth: Phase 1) Everyone singing the way they were used to, and in different styles; Phase 2) Being exposed to new ideas and being eager for input; and Phase 3) Considering alternatives and taking risks as the group makes bolder choices:

I see it as having been in three phases. So, as I say, we started at the start of the year we know you had everyone singing in the way they were totally

used to ... and I think there was a period around half way through the term where we were just like very eager for instruction and a still a little reticent ... and [now] I think the trend is that ... we are a bit maybe a bit more daring, with certainly when it comes to discussions of well shall we do this way, should we do it that way, shall we do it the other way. We've spent a lot longer trying the less obvious option ... and saying dare we do this, how does that sound? And previously we would have dismissed it out of hand or not considered it. (Singer Z, Group 2, interview)

### 7.3.5.3 Key events and triggers for change

As well as the clustering of data around the main themes, there were events and triggers associated with progression between phases. There were a number of key milestones, or 'critical events' encountered by the participants. These are summarised in Table 7.4. Recognising events as critical as part of the evolving group system (Morgeson et al., 2015), along with awareness of associated emotions, thoughts and actions, has been associated with positive action and resourceful behaviour in successful groups (Lindh & Thorgren, 2016). Whilst the experiences were different in their respective groups, members of both described aspects of their preparation that provided special focal points, or those which they felt were particularly influential in shaping subsequent events (Figure 7.2).

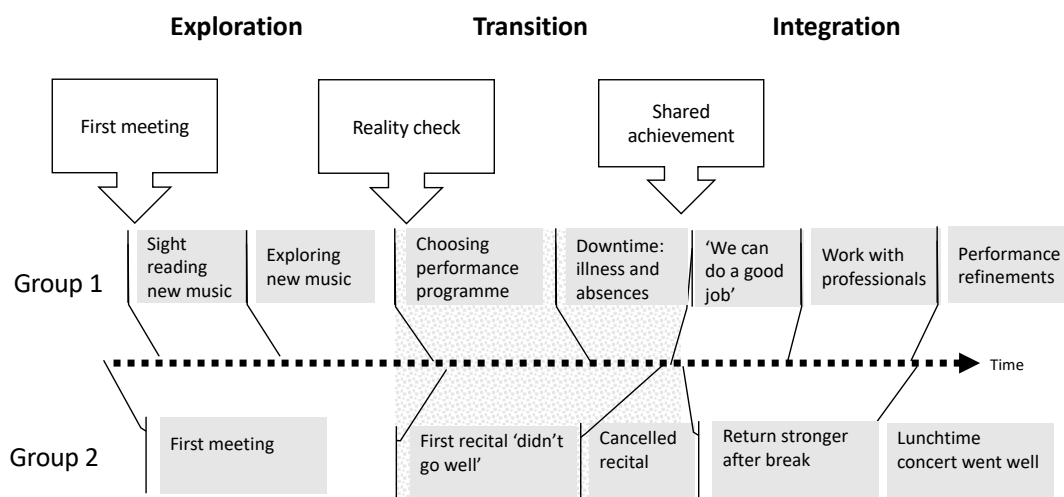


Figure 7.2 Key milestones over performance preparation period, as reported by group members, showing exploration, transition, (grey shaded area), and integration

In the early stages, both groups experienced rapid progress and exposure to lots of new material. Group 1 then had a difficult period due to absences and competing commitments, whilst Group 2 had a disappointing early performance, and then experienced a major setback when their planned recital was cancelled due to illness. Both groups then experienced a more settled period, in which they were able to recover and work together with a new sense of purpose and focus.

Table 7.4 Critical events and emotional highs and lows – combined from both groups

Theme/phase	Highs	Lows
Exploration	Getting together for first time (Group 2) A boost from ideas for new repertoire (Group 2) Exploring repertoire (Group 2)	
Transition	Chose recital repertoire earlier, ‘came together around repertoire’ (Group 1)	Choice for recital was finalised very late (Group 1) First performance slightly disappointing (Group 2) Downtime for group due to members’ commitments and illness (Group 1) Cancelled recital (due to illness) – ‘an emotional day’ (Group 2) Illness of group members: ‘we all started to get a bit ill’ (Group 2) ‘we crashed and burned’ (Group 1) Rescheduled recital not as successful as hoped (Group 2) Dress rehearsal for recital ‘very last minute’ (Group 1)
Integration	Overseas tour and performances with professionals (Group 1) Experiencing ‘special musical moments’(Group 1) Second recital went very well (Group 1) Lunchtime concert went really well (Group 2)	

There were some key events that also acted as turning points for the groups in entering and leaving the transition phase. Transitions in teams have been related to the length of time and the similarity of tasks (Marks et al., 2001) and may occur abruptly in response to time or situational constraints (Gersick,1988, 1989). The

singers described a sense of increasing urgency as deadlines approached, providing conditions where a more sudden change is needed for group effectiveness. To achieve this, group members need to recognise the constraint, disengage from some existing tasks, and change the focus of communication and interactions (Bush et al., 2017). There was evidence of each of the elements associated with more abrupt transitions in the participants' accounts.

#### *Entering transition - the reality check*

Making decisions about choice of programme was pivotal and created a sense of urgency, but also highlighted how much work was required to match the standard of performance they were aiming for, creating pressure and some anxiety. There were more emotional lows as a result of this increasing pressure, as can be seen in Table 7.4. They also changed focus from reading 'loads of new repertoire' to more detailed work on fewer pieces. In his account of the rehearsal practices of a professional vocal consort, Havrøy (2015) describes how, within this culture, the technical work of rehearsals was "driven by the repertoire" (p. 230). As they were still early in their development, it is likely that the groups became more acutely aware of their technical shortcomings when considered through the lens of their chosen pieces, rather than their more superficial readings of lots of new repertoire up to that point. They also changed the focus of their conversation and interactions, with ideas being more explicitly expressed, discussed, and challenged, both within the group and with others, including audience members, tutors, and members of professional vocal consorts.

#### *Leaving transition - shared successes*

For Group 1, participating in an overseas tour and having a good practice recital provided shared experiences to allow them to develop the confidence that they could achieve their goals. The sharing of 'special musical moments' contributed to a shared history of music-making together, which strengthened their sense of unity and trust. After working through their downtime and illnesses, there was a feeling of growing resolve when they decided they 'could do a good job', and from which point they were more positive and focused.

Group 2 had also prepared effectively for successful performance. However, they experienced a setback from their cancelled recital, which effectively stalled

their progress to the ‘integration’ phase and triggered doubts and conflict within the group. However, after a break they were able to regroup and prepare effectively despite this and described feeling like they had ‘come through it stronger’. This experience, albeit disappointing and difficult, was reflected on positively as a shared achievement, and provided the sense of resolve needed for the group to realign around their shared goals.

### *7.3.6 Changing communication over time*

The balance of talking and singing changed over time, giving an indicator of how much explicit (verbal) and implicit (nonverbal) communication took place. In Group 2, the perception of group members varied, but that the balance of singing: talking in rehearsals was between 50:50% to 75:25%. Singer V and W described it as ‘variable’, and that it depended on how close they were to a recital, with more singing closer to performance. As Singer V described it:

Let me just imagine ... [pause] maybe like almost 50 per cent or maybe a bit more singing and then that’s not forgetting if we just run. It also depends nearer to a recital, much more singing ... in itself, that ten minutes where you’re rehearsing something like tuning is actually lots of talking. Yeah but the focus is singing, if that makes sense. It’s just singing ... OK again maybe 60:40, 50:50. (Singer V, Group 2, interview)

Singer W said that the group were agreed that singing was more effective than talking, but that sometimes more discussion was needed, whilst Singer X emphasised that the talking was, “about the music, but with a bit of social chat thrown in”. Singer Z described the proportion as “probably a ratio of three to one”.

A sense of developing trust enabled the groups to communicate more intuitively and nonverbally, such as in the moment described by a member of Group 1, who described a shared entry that was considered to be particularly well executed despite lack of close proximity in the space. Trust is a hallmark and pre-requisite of high-level performance, as articulated by Ann-Elliott Goldschmid (1999), reflecting on her experience as a member of the world-class Lafayette string quartet:

[...] when you get up on stage, it's the ultimate moment of truth, and I have to trust these three women with everything I'm doing. I have to trust that they're going to be listening (Ann-Elliott Goldschmid, in *Rounds* (1999), p. 73).

Their growing familiarity as co-performers influenced the groups' ways of working as they worked towards performance. Part of this process arose through the sharing of individual knowledge and experiences. As established solo and ensemble performers, each participant had already gained extensive experience of rehearsal and performance. This formed the basic 'schema' or outline process, which facilitated rapid progress at the start. This was largely tacit, but important in enabling five relative strangers to engage quickly with their task. As they moved closer to performance, these individual knowledge repositories started to overlap and to merge, creating a shared sense of mutual understanding (Tovstiga et al., 2005). The integration processes that arose as the groups neared performance were associated with a more common understanding.

#### 7.4 Summary of findings

The overall arc of progress for both groups was quite similar, despite some differences in experiences, choices, and the individual characteristics of group members. Collectively, the experiences of ensemble members over time included themes of similar activities and process elements, from which bracketed time periods were identified. A number of critical events provided triggers for discontinuities between these periods or phases. The results of this study suggested that ensembles experienced a series of time-bracketed phases of performance preparation – an 'exploration' phase characterised by processes of social bonding and familiarisation, a 'transition' phase in which barriers were identified and overcome, and a final 'integration' phase, in which performance refinements could be achieved. The transition phase appeared to be the most variable in timing and duration but was a necessary step in moving from exploration to integration (see Figure 7.3). Whilst each phase proceeded in order, the findings suggested that the transition phase was flexible in both chronological time (how early or late in the process the groups entered this phase) and duration (whether a relatively long or short time was spent in this period). Indeed, in describing studies where temporal bracketing has been used,



Langley (1999) suggests that, whilst the time periods may be clearly defined, they do not always imply a sequence or process.

The phases may be described as follows, and depicted visually in Figure 7.3.

**Exploration:** processes of orientation, familiarisation with co-performers and goals, establishing communication, and trying out new ideas.

**Transition:** experiences of disruption, openness to external influences, and emotional volatility. The start, end and duration of this phase is flexible.

**Integration:** emergence of mutual trust, more direct communication, more efficient ways of working, and growth..

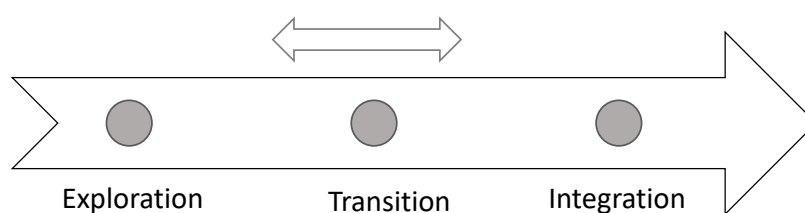


Figure 7.3 Main themes shown as bracketed time periods of exploration, transition and integration

The occurrence of critical events provided the impetus for change and adaptation, requiring the groups to agree on ways to respond and act. These events had an emotional impact, which required members to interpret and make sense of their experiences. As they spent time together, the groups were able to share knowledge and experiences, and were able to predict each other's performance style more accurately, for example in timing of entries at the start of a piece. This sharing of knowledge, which included social, technical, and artistic elements, is consistent with an increased focus on implicit, nonverbal interaction. Group members described the balance of singing and talking as variable and generally focused 'on the music', and that there was more singing nearer a recital. The shift in the balance of talking and singing happened over time, as less explicit (talk) and more implicit (singing) modes of communication were used in later rehearsals. The influence of others external to the group (such as the course director, visiting professional coaches, and peers) was also particularly critical for these groups, given the pedagogical context.

The building of shared knowledge was an important thread running through the participants' accounts. It was described by participants as creating common

understanding, consensus, and mutual trust, and enabling them to achieve their shared performance goals. Possible underlying mechanisms for this include transactive memory systems (Argote & Guo, 2016) and organisational routines (M. S. Feldman & Pentland, 2003). The organisation of tasks and activities in rehearsal, for example the sequence of 1) select piece 2) sing through 3) address issues and 4) sing through again, is an example of a routine, as is the choice of which routine to select for a given situation. On the other hand, transactive memory systems support knowledge of ‘who knows what?’ in a social unit. Indicators for their existence in an organisation – all of which may apply in an advanced music ensemble – include a high degree of knowledge specialisation, task credibility within the group (the existence of mutual trust), and task coordination (working together smoothly) (Argote & Ren, 2012). These and other possible mechanisms supporting the dynamic and adaptive capabilities of the ensemble are explored further in the discussion (Chapter 8).

## 7.5 Conclusions

This qualitative study explored the experiences of two newly formed ensembles preparing for performance, and their perceptions of how their processes changed over time. Three discrete but related phases were identified, in which early progress and familiarisation in an initial ‘exploration’ phase was followed by an abrupt shift to a more turbulent ‘transition’ phase. This shift was triggered by situational and time constraints, including periods of illness or absence, and impending recital deadlines. Having refocused the group activities based on this change, as planned recital deadlines grew closer, and as the groups shared some successes, there was more settled phase of ‘integration’ in which there was more agreement and more reliance on implicit, nonverbal communication. Similar changes over time were identified in both groups.

This study builds on the findings from Chapters 5 and 6, in which lower-level interactions were investigated, but the results of which also suggested periodic, larger-scale changes. In the following discussion (Chapter 8), findings from this and previous chapters are brought together, and considered in relation to the wider theoretical implications for temporal aspects of ensemble development.

## 8 CHAPTER EIGHT

### Discussion

*As soon as a group starts acting as a collective, it acquires direction and momentum.*

*(Arrow et al., 2000, p. 80)*

A primary focus of this thesis is to better understand the way that performance preparation evolves over time. Building on previous research in single rehearsals or shorter investigation periods, it explores perceptions, observations, and interactions in relation to ways performance is accomplished through a series of rehearsals. It advances conceptual and empirical understanding of the emergence of interactions and coordination of self-organised and newly formed music groups over time. In this chapter, the main contributions are first outlined, and then explored in depth, drawing on results reported in Chapters 4–7, and relating them to the extant literature.

This thesis contributes to two main areas of knowledge. Firstly, it advances conceptual understanding of how coordination emerges in small groups through temporal pacing and patterned interactions. Secondly, it offers new insights into the way newly formed ensembles work together over time, including structure of rehearsals and changes in explicit/implicit communication as performance approaches. It takes a process view, which enables analysis of change in “a world of forces and flows” (Hernes, Hendrup, & Schäffner, 2015, p. 117) to investigate ways that events proceed over time, and thereby understand how they relate to wider contexts of small group behaviour. It addresses a number of existing gaps in knowledge of how behavioural interactions evolve and change, and of the temporal dynamics of ensemble performance preparation. To better understand these processes, the aim was to investigate verbal utterances, their timing and content, and how group changes were perceived by group members.

The findings suggest that performance preparation involved dynamic changes in social behaviours, including incremental changes in interactions, a shift from explicit to implicit coordination, and a series of distinct temporal milestones. The main themes for discussion are presented accordingly, in relation to changes over time, and to social and musical communication. Prior research and theory from

organisational and musicological studies of groups provide further perspectives on the findings.

### 8.1 Main contribution: towards a dynamic model of performance preparation

The main contribution to theory is a new perspective on how interactions develop over time in a Western classical music ensemble preparing for performance. It brings together two strands of research. The first strand relates to ongoing, emergent interaction in ensembles. Previous studies of musical groups suggest that social and musical interactions are tightly interconnected (Brinner, 1995; McCaleb, 2014), fluid (Sawyer, 2006; Sawyer & Dezutter, 2009) and involve anticipation and reaction to events (Keller, 2008; Keller & Appel, 2010). These characteristics relate to the unique context of music-making. The second strand relates to the larger-scale structures of groups working together over time. It can be argued that a group of musicians is subject to the same interactional and temporal dynamics as groups in other contexts, in which they are subject to external influences on group working. This research explores both these perspectives – both at the level of emergent interactions and of larger-scale temporal influences – and offers a new model in which they co-exist. In doing so, it takes a socio-musical perspective, responding to a call for research that explores the construct of emergence in musical coordination (Bishop, 2018).

A number of empirical findings have contributed to the formulation of this model. As noted in the literature review, the role of time in group processes has been extensively studied, and scholars have reported methodological and theoretical challenges, avenues for investigation, and calls for further longitudinal study of groups. This research responds to this call. The main contributions are as follows:

*There is a ‘flexible framework’ for the way rehearsals are structured in self-organised, small ensembles*

In Chapter 4, survey data from a wide range of ensemble types and sizes, and at different stages of preparation for performance revealed a high degree of variability and idiosyncratic approaches to rehearsal. However, there were commonalities, too – factor analysis revealed a ‘flexible framework’ of rehearsal strategies, in which the structure and methods used in rehearsal are interchangeably

employed and adapted. This framework may be shaped by prior knowledge and experience, and be unique to each group, as it evolves in response to moment-by-moment events and interactions (rather than being pre-planned). The factors identified include an initial ‘tuning in’ period at the start of the rehearsal, followed by periods of work on two main elements of ensemble improvement – long-term (more strategic) and short-term (problem-solving) elements. Reflection and future planning happened towards the end of, or between, rehearsals. The balance and configuration of these episodes varied in relation to stage of preparation. A further finding relates to how the building blocks of tasks changes from early to later rehearsals. Results from Chapter 5 confirmed previous research showing that more ‘basic’ tasks (relating to technical skill acquisition) predominate in early rehearsals, and that these methods became less frequently adopted in later rehearsals, when tasks focussed more on ‘expressive’ and ‘interpretive’ aspects.

*Coordination was shown to be an emergent process, with less explicit and more implicit communication over time*

Implicit coordination increased over time. The survey data (Chapter 4) suggested that verbal communication varied by stage of rehearsal, with fewer spoken cues and less talk in later stages. In the first case study (Chapter 5), there was a marked shift from discussion to more singing between Weeks 3 (Rehearsal 2) and 5 (Rehearsal 3), marking a transition from verbal to nonverbal interactions as performance approached, whilst in Chapter 6 there was evidence of convergence of coordination through micro-timing and pitch cues. These findings provide support for King and Grittens' (2017) conceptualisation of the shift from mainly verbal ‘communication’ to mainly nonverbal ‘interaction’ through rehearsal to performance. The change was dynamic and evolved incrementally over the rehearsal period. Interaction pattern data from the case studies also showed that, with increasing familiarity, there was a shift from social to more task-driven interactions. It also provided evidence of short, repeated ‘cells’ of interaction around performative episodes (those including singing a passage), which became more consistent as familiarity with co-performers developed. This latter finding was an unexpected one that warrants further investigation in future study.

*Verbal interaction patterns emerged as group processes developed over time*

Pattern emergence started from first encounters and increased over time, and ensembles moved flexibly between simple and complex patterns of verbal behaviour (Chapters 5 and 6). Early patterns formed in both groups and were evident even in very short rehearsals investigated in Chapter 6. In Group 1, patterns appeared within 2 minutes, in Group 2 within 1 minute. There was an increase in pattern number and complexity over time, even though less time was spent talking. More group members were involved in patterns in later sessions. Appearance of dyadic patterns, most marked in Chapter 5 but also evident in Chapter 6, was consistent with the prediction of the emergent role compilation team model of Kozlowski et al. (1999) and provides a mechanism to support the development of longer patterns. In both Chapters 5 and 6, roles and contributions in the patterns were flexible and involved all group members. This ongoing emergence and changing of interaction patterns, happening over short time periods (seconds and minutes, as well as the larger timescale of a series of rehearsals) reflects moments of incremental as well as longer-term changes over time.

*Ensembles moved through transitional stages in working towards performance*

Evidence of temporal pacing emerged in findings from Chapters 5, 6 and 7. In Chapter 5, early encounters and calendar midpoint were shown to be formative moments. In both Chapters 5 and 6 early patterns were a mix of social and technical (task-based) interactions, enabled by pre-existing knowledge of individual members as they drew on previous experience of similar situations, for example through transactional memory systems (Argote & Ren, 2012; Austin, 2003; Lewis & Herndon, 2011; Liang, Moreland, & Argote, 1995). There was also evidence of a transition at or around the calendar midpoint (Gersick, 1988, 1989), most marked in Group 1 (Chapter 5), in which there was an increase in pattern complexity in Week 5. From Chapter 7, interviews and observations identified the key milestones that provided 'turning points' or moments of change where collective actions took on a different character and focus. (These triggers and the resultant changes are described later in this chapter.)

*A dynamic model for ensemble performance preparation is proposed*

Collectively, these contributions offer new theoretical and empirical insights into the processes at work in newly formed, self-organised groups, with a particular focus on music ensemble context. In the discussion that follows, these themes are explored further in relation to prior research and the findings reported in Chapters 4–7. A model is proposed for the processes of performance preparation identified in the findings. The main elements are summarised in Figure 8.1, and explored fully in the following discussion.

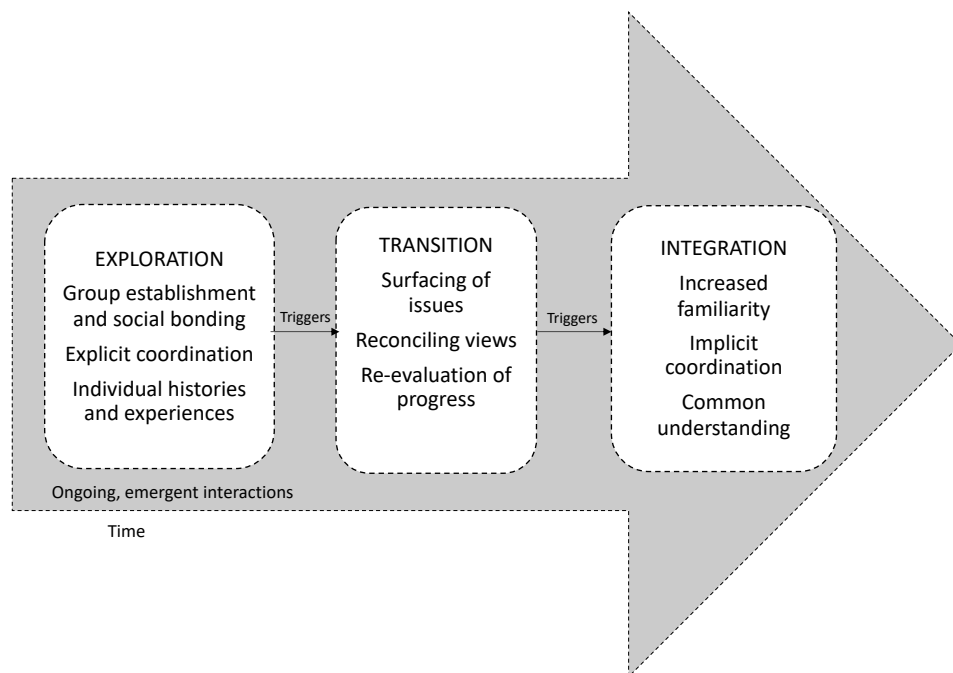


Figure 8.1 A dynamic process for groups preparing for performance

## 8.2 Musicians in transition – groups preparing for performance

The discussion is structured around the main theoretical contribution, in which a dynamic process for performance preparation is proposed, combining structured phases within a context of emergent interactions and change. The findings are discussed in relation to this model, and to the key contribution areas of formation and development of interaction patterns, temporal milestones, implicit and explicit communication, and rehearsal structure and strategies.

It was found that a series of rehearsals was subject to dynamic processes that evolved over time, arose from internal group dynamics, and were subject to

contextual, external factors. A model is advanced that places these emergent social interactions within a series of distinct stages of progression. Hence, it proposes that, in newly formed, self-organised groups, music-making and its technical accomplishment takes place within a wider context of the temporal dynamics of performance preparation.

### *8.2.1 Phases of performance preparation*

In Chapter 7, the unfolding nature of the rehearsal process was explored in relation to the organisational context of ensemble, and also to the wider implications relating to social interaction and coordination in groups. A number of cross-cutting themes were evident from the results, including familiarity, variation in speed of progress, key turning points, implicit and explicit processes, and mutual trust. These phases are summarised as follows:

***Phase 1 Exploration:*** processes of orientation, familiarisation with co-performers and goals, establishing communication, and trying out new ideas.

***Phase 2 Transition:*** experiences of disruption, openness to external influences, and emotional volatility. The start, end and duration of this phase is flexible.

***Phase 3 Integration:*** emergence of mutual trust, more direct communication, more efficient ways of working, and growth.

There was evidence of temporal pacing, which gave rise to the ‘semistructure’ of key milestones (Okhuysen & Waller, 2002). These milestones triggered the groups entering (and subsequently leaving) a transitional phase, mediated by arrival at or around the calendar midpoint, and which manifested as a ‘reality check’. Driven by time pressures and performance goals, and facilitated by accomplishment of interim achievements, the groups moved into a final stage in which they reached the state of alignment required for performance. Interaction patterns evolved from the first meeting through dyadic exchanges and longer patterns involving more group members. There was a reduction in patterned behaviour in the final phase. Communication became more implicit over time. From the musical context, the type of rehearsal methods changed from basic skill building to more expressive and interpretative endeavours. In summary, these processes were mutually shaped by individual group members in response to environmental



influences, norms and structures, such that experiences of one phase serve to influence subsequent behaviour. This interpretation, in which time periods are ‘bracketed’ into distinct periods also references structuration theory (Giddens (1984), in which actions arise from the mutual shaping of actors over time. The main findings relating to each phase are summarised in Table 8.1.

Table 8.1 Group performance preparation – summary of findings

Features	Exploration	Transition	Integration
Patterns	Early patterns Appearance of dyads	More complex patterns More dyads	Simpler patterns (Group 1)  More complex patterns (Group 2)  Fewer patterns (both)
Temporal milestones, key events and pacing	First rehearsal	Reality check (near calendar midpoint)	Shared achievements
Communication	More verbal, less nonverbal Social-focused Tentative suggestions, few differences in views	More diversity of views	Less verbal, more nonverbal Task-focused Direct, different views expressed
Rehearsal methods	Flexible framework of methods: Basic tasks to establish technical competencies	Strategic tasks for future planning	More focus on expressive and interpretative behaviour
Emerging themes	Familiarisation Communication Experimentation	Realisation Consultation Challenge	Focus Resilience Consensus

### 8.2.2 Use of metaphor

Metaphors can provide a valuable tool for theorising, and for thinking about and understanding organisations by relating to concrete examples in the real world (Cornelissen et al., 2008; Morgan, 1980). Whilst their use has limitations,

particularly where they lead to misunderstanding of concepts (Taylor & Dewsbury, 2018), they have a special role to play in interdisciplinary research where they can provide a meeting point for different perspectives and cast a new light on phenomena (Cornelissen, 2004; Tsoukas, 1991). In this thesis the metaphor of a river is used to support the following discussion and to create connections between concepts that have not previously been viewed in this way. The river metaphor has been used by researchers in theory building on strategic management (Lamberg & Parvinen, 2003) and in teaching leadership theory (Burns, 2000), but not, to my knowledge, in organisational or musicological studies.

### *8.2.3 Flow and change - the river*

The findings from this study also support the view of incremental, moment-by-moment change, referred to here as types of ‘flowing’ interaction (van Oortmerssen et al., 2015) in order to differentiate between these changes and the more sudden shifts between phases. This should also be distinguished from the widely recognised psychological construct of ‘flow’ as theorised by Csikszentmihalyi (1997), which has also been considered in the ensemble setting as ‘group flow’ (Cochrane, 2017). There is potential for future studies to explore how these constructs interrelate in the musical setting.

To further explore this, the process of performance preparation is compared to a river journey through a changing landscape. Whilst all rivers are different, they share essential qualities of flowing and changing, and journeys on a river may encounter these changes as the river flows through a changing environment from source to sea. The flow of a river creates its own internal momentum; different stages of a river have different flow qualities. The ‘long profile’ of a river (see Figure 8.2) is well-established geological construct (Mackin, 1948). At source, there is a joining of separate streams, which together provide enough critical mass for the beginning of a watercourse to form. As each stream is assimilated into the new entity of the river there may be turbulence and more rapid flow as each new stream joins and mixes, contributing to the increase in volume. Speed and turbulence of flow may also be affected by the terrain over which the river flows, for example how steep and rocky the ground is. Not only is the river flowing fast, but it may encounter restrictions to its flow, such as passing through a narrow gorge, where increased

pressure creates more turbulence as the water volume is compressed. As the river widens, the pressure is relieved and the flow is calmer and more predictable. As it flows and passes through different stages, the river goes through changes that arise from its own internal dynamics, and the environment it encounters – or as Heraclitus would have it, is both ‘the same and not the same’ river (McCabe, 2015).

This metaphor can be further extended by considering the physical properties of the river, its geometry and dynamics in relation to the laws of conservation of mass and energy, which are measurable but not readily observable. Regarding the river as an isolated system, the *law of conservation of mass* states that the amount of water in the system is constant (Young, Freedman, Sandin & Ford, 2012, p. 1247) . This law explains the dynamics of changing properties of the river as it passes through different stages and how the speed of flow varies relative the volume it occupies. The *law of conservation of energy* states that, in a system, energy cannot be created or destroyed (Young et al., 2012, p. 392). It remains constant but may be transformed or transferred from one system to another. Energy can be broadly classified as potential and kinetic energy. A river has the most potential energy (energy related to the forces of gravity, for example) at the start of its life, at the top of a hill or mountain. This potential energy reduces as the river passes over lower ground. Kinetic energy in flowing water relates to its motion: a river’s discharge (volume), gradient, and velocity all contribute to its kinetic energy, which accordingly varies over the river’s course. White water may be high gradient and appear fast moving, but inefficient in its flow due to friction. In later stages, smoother ‘laminar’ flow, combined with greater discharge, generally results in greater velocity and kinetic energy. Sudden changes in kinetic or potential energy may also happen, for example in a waterfall, often caused by ‘knickpoints’, or “step-like discontinuities in the longitudinal profile” (Wohl, 2010, p. 88). These knickpoints may give rise to a sudden change of gradient, creating a change in both potential energy (due to difference in gradient) and kinetic energy (due to difference in motion). There is a tendency for processes of erosion to drive the position of such knickpoints upstream (Foster & Kelsey, 2012) (see Figure 8.2).

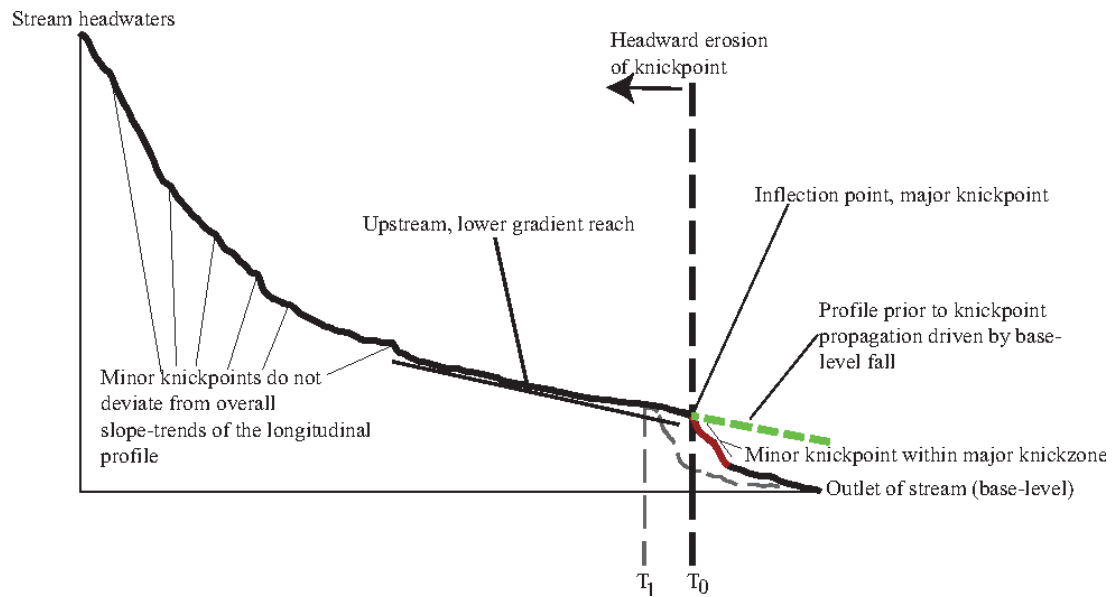


Figure 8.2 River profile showing 'knickpoints', impacting the gradient of flow (reproduced from Foster & Harvey, 2012, p.405)

These river profile features can be compared to the evolving group interactions observed in the music ensembles in this study. Rivers behave the way they do because they are dynamic systems with potential and kinetic energy, just as groups are considered to behave in certain ways because of their dynamic qualities. In the first instance, the five members coming together can be compared to five separate tributaries, in which the amount of combined potential for changes in behaviour is highest. At this early stage, there may also be uncertainty and unpredictability in the flow, resulting from the intermingling and exploring of ideas and finding common ground. Once established, sudden changes may occur, just as when the river may encounter a discontinuity, and result in a change of flow such as a waterfall. Such rapid changes in energy can be compared to the *transition points* observed in the groups, where they experience a change in behaviours, and subsequent rapid progression from one phase to the next. Later stages are more predictable, as the group is more established in its ways of working. This predictable, aligned behaviour provides momentum and stability, with a greater resistance to change and the effects of external forces.

### 8.3 A dynamic process for groups preparing for performance

Bringing these elements together, and building on the phases identified in Chapter 7, in the following discussion a framework is advanced for verbal interactions and music performance preparation. It proposes two interrelated

elements: a set of processes relating to gradual changes in patterned behaviours, within a series of connected phases. The process summary in Figure 8.3 shows how this overall pattern of phases emerged. First, groups negotiated the social processes required to come together around a shared task and environment. Communication was generally explicit and shared through discussion. Alongside this, non-conscious patterns started to form. Each member brought their own history, knowledge, and experiences, which both allowed progress to happen but in which there were inherent differences. Increasing time pressure, particularly notable around the calendar midpoint, triggered a transitional period where these differences were surfaced and confronted, and new ideas considered. Interactions became more complex as new patterns of working were tried. Compromise and pragmatism enabled choices to be made in order to meet the approaching deadlines. Finally, coming together around (and even achieving interim) performance goals provided the trigger for greater alignment. Familiarity with co-performers, and emergence of non-conscious complex interaction patterns contributed to increased adoption of implicit coordination modes, with less discussion and more nonverbal communication. In this musical context, this provided the necessary basis for performance in which nonverbal coordination was a fundamental requirement.

In summary, this study found that the process of performance preparation comprised an orientating *exploration* phase, to which individuals brought their own prior experience and energy. Increasing time pressure or other external factors contributed to a more turbulent *transition* phase from which they arrived at a final, more convergent *integration* phase. Whilst each phase had distinct characteristics, the ways the groups moved between them did not follow a clear linear progression but was rather a combination of distinct chronological phases and continuous process flow. There were gradual evolutionary changes, consistent with concepts of emergence and the ‘flow’ of time. The moment-by-moment interactions of the group members resulted in incremental changes in communication and social interactions. Overlaying this, there were also external triggers (discontinuities), which appeared to be partly driven by chronological time and approaching deadlines (Okhuysen & Waller, 2002), and in which the calendar midpoint (Gersick, 1988, 1989) may play a key role. However, this ‘midpoint’ was observed to be flexible in timing, and in which increasing urgency gathered force and resulted in gradual changes in

behaviour and patterns. The timeline of these phases and their main features is summarised in Figure 8.3.

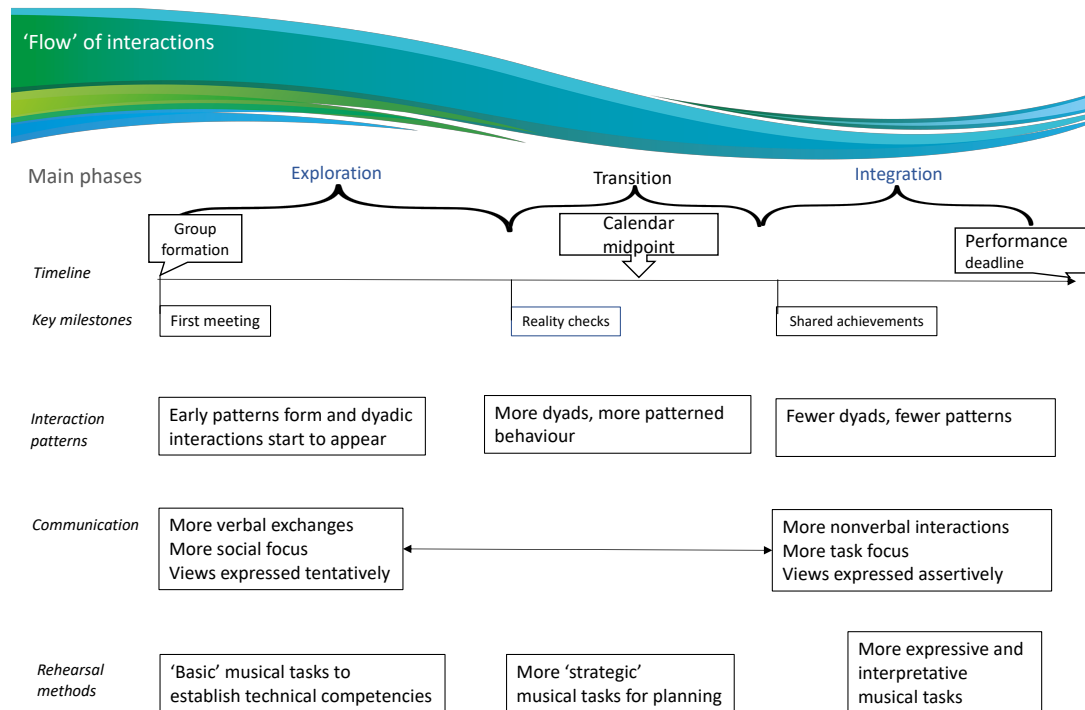


Figure 8.3 Timeline of group progression from formation to performance

The findings build on previous research to explore experiences and perceptions of how performance is accomplished through rehearsal, and whether stages are apparent. The results suggest that there are potentially two levels of temporal process in ensembles – over a series of rehearsals, and within a rehearsal.

In the following discussion, each of the interrelated elements of interaction patterns, explicit and implicit communication, and the development of rehearsal strategies are discussed. Further consideration is given to aspects of temporal milestones and pacing. General observations of each element are considered, exploring how performance preparation progresses over time.

### 8.3.1 Interaction patterns

The current research incorporated methods for behaviour pattern detection to provide deeper insights than direct observation alone allowed. Pattern detection

analysis provided a more nuanced view on the individual behavioural contributions, as it is both time-based and reveals ‘hidden’, recurrent patterns. The resulting patterned data were used to explore group behaviours over time, in two separate groups.

Short-term patterns of interaction contribute to longer-term achievement of coordination through “ongoing patterns of interaction among the group’s constituent elements as the group pursues its function” (Arrow et al., 2000, p. 55). Measuring interaction patterns provided a window into the level of change apparent in the group interactions. Both groups displayed shifts in pattern type and complexity over time, which has been suggested to denote group adaptability (Gersick & Hackman, 1990). It also provided a means to investigate the presence of standardised or routinised behaviours, which can be a useful way for teams to create opportunities for sharing of expertise, social bonding, and for planning (Chung & Jackson, 2013; Marks et al., 2001). Forming and developing these routines may involve many iterations and may appear as complex interaction patterns. In the highly interdependent setting of a musical ensemble, these patterns are likely to continuously develop as members develop more familiarity with each other (Reagans, Argote, & Brooks, 2005), rather than appear as repeated formal processes.

From the longitudinal studies (Chapters 5 and 6), patterned behaviour was identified in all rehearsals and involved a range of behaviours and group members. The presence of systematic patterns revealed a number of structural features of group interactions, and ways in which they changed over time. The number and complexity of the interaction patterns, combined with analysis of the video transcripts, provided a rich mixture of quantitative and qualitative data. In both groups there were notable changes over time.

#### 8.3.1.1 Changes in interaction patterns over time

Interaction patterns emerged and changed over time from the very first moments of the first rehearsals and continued to evolve and develop. These patterned behaviours, identified in very short time intervals (seconds and minutes), provided a way to explore the ‘flow’ of the group over time. The ensembles exhibited both simple and complex patterns, a dynamic feature of group development

(Uitdewilligen et al., 2018). The increase in pattern complexity over time may also suggest the emergence of implicit processes (Rico et al., 2008).

It has previously been recognised that, in creative groups, divergence and even separation ('de-integration') are important precursors to coordination (Harrison & Rouse, 2014). In Group 1, the pattern data suggests integration in Weeks 1 and 3, but with a period of de-integration (in Week 5) and further integration of ideas and interactions in the patterned behaviours (Week 7). This suggests that, whilst the group is subject to dynamic group development processes common to teams in other domains, the achievement of integration proceeds in a cyclical or episodic, rather than linear way (Marks et al., 2001). An episodic process of integration is also evident in Group 2. Over the five rehearsals, after an initial decrease, the patterns show increasing complexity, as measured by the number of hierarchical levels and constituent events.

The extent to which the interactions were well balanced in early rehearsals, (involving few mono-actor patterns, and all members) suggested that active exchange of information was quickly established. Such reciprocal patterns have been shown to be consistent with the existence and development of shared mental models in command and control teams (Rasker, Post, & Schraagen, 2000), in which a group of people assigned a task and roles work together towards agreed goals. Shared mental models include a 'common' model relating to the team's situation, and also a 'mutual' model about fellow team members, and hence require a degree of familiarity and predictability to develop. They are also a feature of implicit coordination processes (Entin & Serfaty, 1999; Orasanu et al., 1993).

Patterned verbal interactions were also compared during rehearsals where groups prepared two pieces of music with different musical structures. No major differences were found in pattern type and complexity with change of piece, suggesting that the level of shared knowledge was sufficient to provide resilience to a change of task (Uitdewilligen et al., 2018).

#### 8.3.1.2 Changes in interaction patterns by phase

The emerging patterns are considered by each of the three phases, Exploration, Transition and Integration.



### *Phase 1: Exploration - formation of patterns and early interactions*

Early encounters provided opportunities for the groups to self-organise and establish patterns of behaviour, and to establish social relationships. The groups sought to gain knowledge of one another to establish order, to be able to predict the behaviour of their fellow group members (Okhuysen & Bechky, 2009) and establish a flow to their interactions (van Oortmerssen et al., 2015). These early interaction patterns enable and facilitate progress in unfamiliar teams, by providing a mechanism to quickly establish a balanced communication involving multiple (although not necessarily all) members (Zijlstra et al., 2012).

Patterns of interaction arose early in both groups investigated in the case studies. In Group 1, the earliest significant patterns in Week 1 were recorded very early, the first in under two minutes after the start of the rehearsal. Compared with later weeks, Week 1 patterns were simple and short. Group 2 rehearsals were shorter than those of Group 1, but patterns were still evident very early. These early contributions and interactions appeared therefore to provide a basis on which the groups made progress, from the very first moments. The patterns are generally 'hidden' from the group members, and obscured by overt, vocal exchanges, especially from dominant personality types. However early patterns were persistent. In Group 1 early patterns involved a shared task and three group members. It is also notable that in Week 1 the most vocal member (Singer B) does not feature in the pattern, reinforcing the idea that the patterned behaviours exist at a different level of interaction. The non-conscious and unfolding patterns of interaction may therefore enable 'quieter' members to contribute earlier and for their influence to be expressed and endure through patterns in small group contexts. This is explored further below.

These early patterns can be compared to the establishment of the flow of a river. Separate tributaries coming together mix and blend, just as non-conscious patterns of behaviour enable the contributions of each members to join with others and still maintain an onward flow of progress and ideas.

### *Phase 2: Transition - divergence of interactions*

After the initial emergence of simple, short patterns, further developments were apparent. In Group 1 there was a marked change in patterned behaviour in Week 5, as patterns increased in complexity, and number of actor switches,

coinciding with the calendar midpoint (Gersick, 1988, 1989). There is a vivid parallel between this increase in patterned activity and the turbulence associated with a river encountering a restriction to its flow. In Group 2 there was also an increase in complexity of patterns, although the midpoint of this group was more ambiguous due to shifting deadlines.

### *Phase 3: Integration - convergence of interactions*

The process of alignment suggests an emerging sense of ‘integration’ (Okhuysen & Bechky, 2009), which was evident in both groups in later rehearsals. In this respect, the convergence and self-similarity of patterns represents a smoother, more frictionless flow of progress and ideas, which can be compared to the smoother ‘laminar’ flow of a river in its later stages, as momentum and kinetic energy build and barriers to progress are more readily overcome.

In Group 1 there was a marked ‘convergence’ in Week 7 (Rehearsal 4). Patterns showed their strongest self-similarities – not only (as with previous patterned interactions) between group members, their timing and type of behaviour, but also in the content. The transcripts showed that not only were the event types repeated, but also the musical context. On each of three occasions Singer A asks a question to check pronunciation along the lines of, “Can I check, is it ‘*pronounces word*’?”. Singers C and then E both contribute to the answer. Singer 5 then makes a practical suggestion, (e.g. “do you want to run into that?”), which Singer A builds on, (e.g. “shall we do it again, we only did it once?”). They then all sing an agreed passage together. This entire sequence happens three times. The high degree of similarity in both interactions and musical content suggests an effect of increasing familiarity and the influence of developing predictability of contribution.

In Group 2, patterns increased in complexity throughout the study period. In addition, more group members (as measured by ‘actor switches’) were involved in the patterns over time. This also reflected the willingness among members for more involvement and created more balanced team interactions. In Group 2 it is notable that, even after the long interval between Rehearsals 4 and 5, higher levels of complex patterning were retained. This may be an effect of attunement to the task, as patterns that fit the task requirement tend to be retained (Uitdewilligen et al., 2018).

### *8.3.2 Communication*

The role of implicit and explicit dimensions have been proposed as essential building blocks for coordinating by Rico et al. (2008). Jarzabkowski et al. (2012) take a process view, in which coordination is emergent, comprising overlapping cycles of action rather than proceeding in clear steps. This view is conceptually close to organisational routines, as a source of valuable stores of organisational knowledge and meaning. The amount of verbal communication varied widely in both groups. Compared with early rehearsals, there was less talk in rehearsals nearer performance, although this did not appear to be a straightforward linear progression. This is consistent with the need to establish the implicit (rather than explicit) coordination required for the performance setting. There were qualitative changes, too, including the relative amount of social talk and task-focused talk, which varied over time. The use of humour as a type of social interaction emerged in patterned behaviours (Chapter 5) and as a mechanism for conflict resolution (Chapter 4).

Individual members found different ways of making contributions. Using Group 2 as example, a picture emerged of how members of this ‘leaderless’ ensemble exerted their influence, expressed through different modalities, whereby the Singer V and Singer Y appeared to exert their influence primarily via explicit modes (e.g. more verbal contributions), whilst both Singers W and X and Singer Z exerted their influence in implicit ways (e.g. through participating in patterned events which led to action, or by tending to be ahead in time).

#### *Verbal and nonverbal communication*

The survey study (Chapter 4) reported verbal and nonverbal communication in ensembles of different types and sizes. Previous studies have reported a wide variation in talk versus playing time, including reports of as much as 52 % and as little as 10% of rehearsal devoted to talk time in professional groups working intensively. The current study also found a wide variation, from 0–80% time spent playing, with a mean of 35%. The most important topics (as indicated by amount and perceived importance) related to interpretation and ensemble performance. No differences were found overall in amount of talk by groups at different stages, or in groups of different types and sizes. Although there were no differences in total talk across ensemble type, there were some differences in amount of ‘social’ talk – string

players engaged in more social talk than other group types. It was also apparent that groups at later stages of preparation reported less social talk, and more talk about interpretation and performance, when compared with groups without immediate performance focus. Taken together, these findings on rehearsal talk suggest that a contribution to the wide variation of talk time may include the group's instrumentation and professional status. There is a further contradiction here – whilst amateur groups are more likely to express a social goal focus, they also report less total talk time than non-amateur groups. This could be explained by a strong desire to 'just play' expressed by some respondents, and to therefore prioritise playing whole works or movements, with fewer interjections for error correction and problem solving. Members of these groups may be less focused on the 'moment-by-moment' interactions. This would be a further point to follow up in interview or observation studies.

In the studies reported in Chapters 5 and 6, the amount of talk varied over time, and in different ways. Previous research suggests that the underlying drivers for time spent singing or talking are likely to reflect the sub-goals of rehearsals and the level of development of the group (Ginsborg & King, 2012). This variation is also consistent with that reported in Chapter 4, and with prior research (Bayley, 2011; Davidson, 1997; Davidson & Good, 2002; Williamon & Davidson, 2000, 2002) in which musician interactions were shown to arise in response to moment-by-moment events in rehearsal, which in turn were often triggered by musical features or landmarks such as repeated sections. These landmarks may provide triggers for discontinuities, giving rise to divergence of views, and even disagreement and conflict.

As a type of verbal communication, conflict and its management has previously been found to be an important aspect of ensemble cohesion and even cited as an indicator of success, at least where there are effective strategies for its resolution (Murnighan & Conlon, 1991). Whilst reported levels of conflict were generally low in this study, artistic reasons (musical interpretation and repertoire choice) were most frequently cited reasons for conflict, resolved most often by playing, discussion, or through the use of humour. This supports the findings of Bayley (2011) who observed the consistent presence of humorous exchanges throughout an intensive rehearsal of a professional string quartet, including its use to

alleviate tension, and as a transition from talking to playing. When compared by stage, the amount and severity of conflict were greater in groups at later stages, and most often attributed to time constraints, and practical issues around concert programming and management.

*'Leadership', informal roles and other modes of influence*

The survey results showed that the adoption of 'shared' leadership was high, although larger groups were more likely to have a single leader. This is consistent with the work of Rasch (1988), who reported that musical groups with six or more members are more likely to benefit from a single leader. Members of both case study groups were all agreed they were 'leaderless'. In practice, there were many modes of influence from within the ensemble, which influenced the direction and decisions made by the group. Whilst leadership traits weren't assessed in this research, there was evidence of different types and levels of contribution, which could be ascribed to the presence of certain traits more usually associated with stereotypical leadership roles, such as more willingness or ability to articulate their views (Seers, Keller, & Wilkerson, 2003). Individuals seeking status initiate and talk more than those that don't, who may 'defer' to others as a result of cognitive biases, where the label or resemblance to a schema of 'leader' may create expectations and categorisation as 'leader' even when members may not have an inclination to fulfil the role.

Therefore, a further way that an individual can exert their influence is through nonverbal, auditory mechanisms. For example, from the results of the parallel study reported in Chapter 6 (Group 2), there is evidence that Singer Z had a consistent tendency to precede the other singers, and to be less consistent in pitch. This meant that others had to adjust to his discrepancies, as achievement of timing synchronisation increased in consistency over time, in line with prior research (D'Amario, Daffern, et al., 2018). In the tuning study, differences attributed to Singer 5 revealed less consistent and precise intonation compared with others in the group (D'Amario, Howard, et al., 2018). Whilst this may indicate attempts to adapt his own pitching, it also resulted in other members of the group being required to adjust their own pitch throughout the rehearsal period. These examples illustrate how an individual can, even non-consciously, be driving change and adaptation in a group.

Assignment of functional roles, either formal and informal, can be a feature of self-organised ensembles that helps to provide stability (King, 2006). In a case study of a self-organised professional vocal ensemble, Lim (2013) found that formal roles such as librarian, treasurer and concert manager were assigned. Such roles are distinct from the ‘team’ roles identified by King (2006), based on Belbin’s team-behavioural model, which suggested that stability of roles was a factor in more successful student groups. In the current study, however, findings from Chapter 4 (survey data) and case study interview and observation data (Chapter 7) suggest that formal roles were not found to be a widely used mechanism for organisation. In Chapter 4, allocation of functional roles such as responsibility for finances or concert management was not used by most groups surveyed (only 20% reported defined roles). Rather than formal roles, when making group decisions, analysis of individual contributions (Chapter 6) provided an alternative perspective. Different singers showed different ‘modes of influence’, which included not only the amount and type of verbal contributions, but also to what extent they featured in patterns, and their influence through vocal micro-timing and pitch differences.

As well as the different rankings for verbal contributions and presence in patterns, there were other ways in which the individual members made their influence felt in the group. One way they did this is by triggering key events, such as when the group rehearsed the ideas being discussed by singing through a passage. In Chapter 6 (Group 2), the influence of Singer Y was particularly evident in this respect. He was not the most verbally active, and did not appear in more patterns than others, but the timing of Singer Y’s contributions suggests that he was able to elicit joint action. In Rehearsal 1, there were 14 instances where a Clarifying contribution from Singer Y resulted in the action of ‘all singing’, the first of which occurred within 1 minute of the rehearsal start. It also appeared as the penultimate event type in the significantly recurring longer patterns. This sequence re-appeared in Rehearsals 2 and 4.

#### 8.3.2.1 Changes in communication over time

The presence of more nonverbal cues in later rehearsals (Chapter 4), an increase in amount of singing versus talking (Chapter 5), the convergence of singer synchronisation and pitch tuning (Chapter 6), and the increasing number and complexity of verbal interaction patterns (Chapters 5 and 6) suggest that, over time,

there was an increase in implicit versus explicit coordination processes. This is consistent with calls for a conceptualisation of interaction in rehearsal that is distinct from dialogic communication, and which can foster the emergent behaviour and ‘qualitative transformation’ required as performers move from rehearsal to performance (King & Gritten, 2017).

From their first meeting where social interactions began to be established mainly through verbal interactions, the groups in the case studies demonstrated shifts in focus over time. These were triggered by time pressures and the need to agree on how to work together, and by shared artistic goals. As they progressed, their interactions became more complex, as nonverbal modes of communication became established. Differences were resolved through nonverbal and verbal means (see also Figure 8.4). Members of both groups described how, with growing confidence, trust, and familiarity, they took more ownership of the performance-related elements and were able to be more adventurous with interpretation. This was expressed as the sense of a collective ‘mind’, bringing the preparation process to the fore in performance, described by one member as “... *our thoughts and rehearsal processes are recognisable and audible in what we do now.*” (Singer Z, Group 2). The findings suggest that this was achieved through a combination of verbal and nonverbal communication, in which roles and other modes of influence played a part as the groups worked together over time.

#### 8.3.2.2 Communication by phase

The types and styles of communication varied by phase over time and summarised in Figure 8.4.

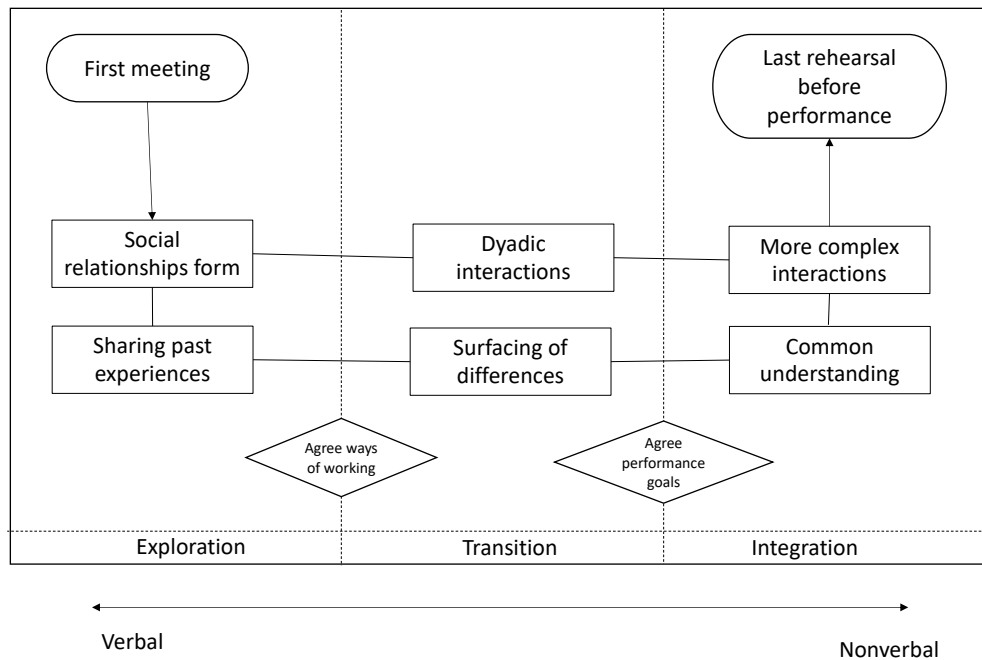


Figure 8.4 Moving from verbal to nonverbal communication

*Phase 1: Exploration - sharing and social bonding*

Verbal discourse has been shown to be not only an important facilitator of coordination but also to promote the establishment of nonverbal communication, for example through eye contact (Richardson, Dale, & Kirkham, 2007). Group 1 (Chapter 5) shared their experiences and opinions with each other through discussion and other types of verbal interaction. The task-based nature of the rehearsals was reflected in the high incidence of Clarifying behaviour, especially ‘giving task information’, which featured in the increasingly complex patterns that emerged. This is consistent with the desire for members of a new group to share their knowledge, in order to establish task boundaries and individual contributions.

*Phase 2: Transition - surfacing differences and forming dyads*

There was a change from Week 5 to more Reacting behaviours, which suggests that there was more opportunity to react and respond. This increase in Reacting behaviour was consistent with more swift-moving interaction patterns and coincides with greater urgency and increased familiarity. Over time, the amount of talk decreased, and both the total duration and the length of episodes of singing increased, consistent with a shift from explicit to implicit coordination as



performance approached. For Group 1 this shift started to be most apparent in Week 5. For performance, the ultimate goal is to coordinate nonverbally: the group was therefore starting to enact performance-type behaviour in rehearsal (longer singing episodes, more implicit coordination).

The contribution of pattern detection methods enabled exploration of implicit interactions. There was clear evidence of a change in Week 5, when rehearsal task focus shifted from basic to more expressive aspects, which was seen in both analysis of musical task codes and self-reports. Patterns were also longer, there were more actor switches, and patterns were most complex in Week 5.

### *Phase 3: Integration - developing implicit, common understanding*

In Group 1, the integration and simplification in Week 7, particularly notable after the relative complexity of Week 5, also suggested a ‘coming together’ in relation to the group’s interactions, shortly prior to the performance. An example of this arose from the interview data (Chapter 7) when Singers A and E in Group 1 described what they considered to be moments of peak performance, where their experiences in performance transcended what they had achieved in rehearsal.

... every single piece was performed better than we’ve done it before, and I would say that personally listening back everyone else had upped their game as well. (Singer E, Group 1)

In like one part, one of our pieces we started away from each other, then we stopped singing then we all came in together, all staring at the same spot in the back of the room. That was very cool. (Singer A, Group 1)

Familiarity may also cultivate a sense of psychological safety in this new group and allow all members to find opportunities to contribute (Edmondson & Lei, 2014; Harrison & Rouse, 2014). In Chapter 6, Group 2 were preparing material for the purpose of the study, rather than for their own performance goals. They focused on the task provided for the rehearsal and had short sessions in which to achieve it. In later rehearsals (Weeks 8 and 16), as they were highly familiar with the task, the group had more time to explicitly coordinate their work (hence, more talk) and through familiarity with co-performers were more able to anticipate the actions of others.

Findings from Chapter 4, 5 and 6 support the importance of implicit factors in the achievement of integration. There are also fewer spoken cues in later rehearsal stages; this is consistent with previous research suggesting that verbal modes of communication are replaced by nonverbal cues in performance (King & Gritten, 2017). The survey findings (Chapter 4) showed that, whilst more use of gestures was reported in later stages, there was less use of eye contact, although this known to be highly idiosyncratic and context-sensitive, whilst body gestures, often aligned to articulation of attack, are more standardised and related to structural landmarks in the score (Biasutti et al., 2016).

### *8.3.3 Rehearsal strategies and methods*

Ensembles prepare for performance by harnessing resources and skills in a series of rehearsals over time. This research takes the perspective that coordination between co-performers is facilitated by the sharing of knowledge and experiences, particularly in newly formed groups. This sharing is achieved in multiple ways. Based on research conducted with a wide sample of ensembles, and through longitudinal case study of newly formed groups, this thesis contributes to the understanding of ensemble working in two main ways – the rehearsal structure and process, and how ensemble members communicate and interact.

Within rehearsals both short patterned sequences and repeated structures and methods were apparent. Larger-scale structures were also evident from the survey data, from a wide sample of ensembles (Chapter 4). Analysis of interaction patterns revealed ways in which group members used a mix of social, task-related, and music-making episodes to establish an agreed interpretation. Repeated patterns arose around a singing episode in a later rehearsal, as reported in Chapter 5.

The dynamic, evolving nature of the rehearsals was also reflected in changes in rehearsal structure and content. The focus on basic, interpretive, and strategic rehearsal tasks shifted from week to week, with more interpretive and strategic and fewer basic tasks as performance approached. The model of progression from communication to interaction proposed by King and Gritten (2017) suggests that groups use rehearsals to cultivate and assimilate patterned behaviour for enactment in performance. The findings of this study provide support for this theory, as the

ensembles decrease the amount of verbal behaviour, and engage in more performance-focused musical discourse.

Previous research has shown that musicians respond to moment-by-moment events in rehearsal and performance, often triggered by musical features and landmarks (Bayley, 2011; Davidson, 1997; Davidson & Good, 2002; Williamon & Davidson, 2000, 2002). Whilst structuring and ordering of these tasks tends to be open-ended, rather than predetermined, the results suggest that a relatively limited repertoire of tasks and activities might be employed in rehearsal, which lend themselves to different configurations depending on ensemble goals. This was particularly the case in later rehearsals. Whilst there are commonly encountered building blocks from which rehearsals may be assembled, they are put together in flexible and interchangeable ways, which also vary over time.

Together, the results suggest that rehearsal tasks and structure are configured and re-configured to suit the immediate requirements, and that moment-to-moment interactions are triggered by musical landmarks, features, and ongoing feedback. Returning to the river metaphor, these triggers might be regarded as small-scale discontinuities, such as a boulder in a fast-flowing stream, which disrupts but does not essentially arrest the onward flow. On encountering a boulder, there is a temporary turbulence or change of energy, and then the flow continues around it, meeting and joining again on the other side. The amount of disruption caused varies according to stage – early on the river has greater potential energy and less kinetic energy, so there will be more disturbance to the flow. Later on, with greater momentum and smoother flow, a small discontinuity can be more easily absorbed into the general forward progress. Hence, progress in a group in an early stage of development may be more disrupted (e.g. through discussion, and trying and rejecting ideas) than in a more mature group that can deal with changing musical landmarks as a matter of course, using more nonverbal cues or focusing on more expressive elements.

The survey study reported in Chapter 4 explored a wide range of ensemble types and sizes, and at different stages. The results revealed a set of activities that are common both across and within groups. This suggests the existence of common practices for groups represented in the sample. The structure of a musical rehearsal – the tasks and their sequence – can be characterised as a type of organisational

routine; “repeated patterns of behaviour that are bound by rules and customs” (Feldman, 2000, p. 611). Such routines provide stores of knowledge and meaning, and support coordination by providing a predictable approach to tasks, which I have conceptualised as a ‘flexible framework’ for rehearsal.

#### 8.3.3.1 Rehearsal strategies and methods changes over time

In Case Study 2 (Chapter 6), the musical material being rehearsed changed both within rehearsals, and over time, as the group worked on the same two pieces, presented in different orders. More talk and more complex patterned behaviour were observed in rehearsals of the polyphonic (more complex) piece. The differences between the two pieces related to texture, rhythm, and pitch; however they were similar in style, length and level of difficulty. Even when working within limits of a specific genre or style, it is likely that ensembles will encounter much more widely varying repertoire, so this has implications for further understanding the influences on ensemble working practices and warrants investigation in a future study. It has also been found in previous studies that increased task complexity in exceptional (‘non-routine’) versus normal (‘routine’) situations was associated with increased pattern complexity (Stachowski et al., 2009; Zijlstra et al., 2012; Uitdewilligen et al., 2018). Building on the view of patterned interactions providing a mechanism enabling a team to adapt, the transitions between tasks with different levels of demand suggest that there may be an impact on amount of patterned behaviour. Uitdewilligen et al. (2018) found that a task change was followed by a reduction in pattern complexity. In Group 2, in all except Rehearsal 1 there were fewer significant patterns after the change of piece than before, regardless of the order of pieces. This may be the result of a temporary loss of adaptive capability arising from the change of task (Rico, Gibson et al., 2014), or it may be that the repetition of the task resulted in a reduced motivation for the group, which would explain why the effect was not seen in Rehearsal 1 (their first exposure to both pieces).

Investigation of the verbal utterances relating to tuning showed that singers in Group 2 allocated 19% of total time to tuning, representing a significant part of their focus. However, this reduced over time, moving from a focus on ‘basic’ to more ‘expressive’ and ‘interpretive’ tasks in later rehearsals, where work on tuning was categorised as a ‘basic’ musical dimension (Ginsborg & King, 2012). To make improvements, they used a range of strategies, including repeating a short section,

bar, chord or part of chord, and re-balancing voices. The measurement of tuning outcomes focused on thirds; indeed, chords containing minor and (especially) major thirds were most often a focus for tuning work. Thirds are known to be difficult to tune (Covey-Crump, 1992) and so it is possible that the characteristics of these chords made tuning issues more apparent, and discussions about their resolution more explicit.

### 8.3.3.2 Rehearsal strategies and methods by phase

Ensembles employ specialist knowledge, methods, and skills to navigate the process of rehearsal. The findings revealed ways in which they used different methods and strategies to negotiate the demands of rehearsal at different stages. From the survey results, the combination and focus of tasks and actions were found to be influenced by stage of rehearsal, and there were changes over time in the case studies. Some examples are given to illustrate these processes at each stage.

#### *Phase 1: Rehearsal strategies - experimentation and basic tasks*

In the case studies, the groups explored many ideas in the early weeks. For example, in the Group 1 case study, self-report rehearsal log data showed that early rehearsals (Weeks 1 and 3) involved a wide variety of methods, from basic intonation, work on technique, breaking music into sections, slow practice, and work on balance, blend, synchronisation and expression. However, there was no planning reported (or observed) during these early weeks. Speed of progress was variable in these early weeks, but generally it was recalled as slow, in part due to a lack of rehearsal strategy, although there was a point where participants reported that progress started to get faster. This can be compared to the early, turbulent flow of a river, as tributaries join and mix. At the source of a mountain river, whilst the gradient may be steep, the flow lacks momentum as it is disrupted by turbulence.

#### *Phase 2: Rehearsal strategies - bringing to the surface and managing differences*

We know from previous studies, and supported by the results of the survey, that interpersonal processes involve managing conflict and building cohesion around the task. One aspect of this repetition is the surfacing and addressing of what Harrison and Rouse (2014) refer to 'discontinuities', which may be compared to the 'knickpoints' of the river profile. O'Neill and Peluso (2014) described a dialogue for

creative resolution to conflict, which includes listening together, respecting different perspectives, suspending judgements, and ensuring individual voices are heard. This is what Group 2 did with their ‘conch’ system of rehearsal consultation. This was an effort by the group to surface and manage any differences, introduced after it became apparent during Phase 1 that they needed to ensure all members had the chance to contribute ideas. This provided a structured way to actively collaborate, and resolve any differences arising.

### *Phase 3: Rehearsal strategies - expression and convergence*

Changes in rehearsal strategies in later stages revealed more expressive and performance-based tasks. The survey found that groups in their final stage of rehearsal included more tasks related to ‘overall ensemble’ – balance, expression, performance cues, synchronisation, and blending. They were also more likely to work on sections involving multiple parts, listen to their own recordings, and engage in future planning. In the case studies, the pattern data revealed a convergence of behaviours, including around the way interactive behaviours and rehearsal tasks combined. Notably, in Group 1, Week 7 there was a recurrent pattern, comprising the elements of *social: task: performance* [run-through]: *task: social* behaviours. Not only did this represent a highly structured, non-conscious pattern of behaviour, which was repeated three times during the rehearsal, but also the topics of discussion were similar in each recurrence. This is a vivid example of convergent behaviour, equivalent to the smoother, laminar flow of the later course of a river.

## **8.4 Transitions and emergence**

Concepts of temporal milestones and pacing provide a chronology to group interactions and a means to relate behaviours to progress over time. There were examples of convergence, divergence, and sudden changes in group behaviour in this research. Just as a river flowing over a changing gradient may flow faster or slower, or even fundamentally transform as in the case of a waterfall, these sudden shifts may affect group behaviours and interactions. The way that groups negotiate these discontinuities is explored further in this section. In considering possible mechanisms, this discussion builds on previous research in this area, including the punctuated equilibrium model and concept of a ‘critical midpoint’ (Gersick, 1988,

1989, 1994), and of team pacing and entrainment (Okhuysen & Waller, 2002; Ancona & Chong, 1996).

### *Punctuated equilibrium theory and the critical midpoint*

The punctuated equilibrium theory of team development (Gersick, 1988) predicts that groups working towards an end goal undergo a ‘tipping point’ at the calendar midpoint, in which they reassess timings and priorities based on time remaining. Relating this to the river metaphor, the calendar midpoint represents a ‘knickpoint’ or change of terrain, which results in a sudden energy jump in flow, such as those observed in this research. Models of team development that have been previously applied in music rehearsal settings, such as Tuckman’s ‘forming, storming, norming, performing’ model (Tuckman, 1965; Tuckman & Jensen, 1977), do not accommodate this transitional element.

The coordinated, enduring, and regular group practices known as routines tend to align with external pacing through ‘entrainment’ (Zellmer-Bruhn et al., 2003). The primary source of external pacing in this research was the academic assessment calendar (Group 1) and the time constraints of lab-based rehearsal sessions (Group 2). Entrainment is a force that can maintain organisational routines (Gersick & Hackman, 1990; Kelly & McGrath, 1985), and can focus attention away from, or towards, certain tasks (Zellmer-Bruhn et al., 2003). In their research with groups, Kelly and McGrath (1985) also showed that tasks of different types and difficulty had different entrainment effects.

### *Emergence and group progression*

As well as the longer patterns, the additional pattern sub-types of a single person interacting with themselves (mono-actor) and repeated pairings of interaction (dyads) provided further insights into emergent behaviours. As background to this perspective, work on interaction patterns suggests that the presence of mono-actor patterns is indicative of less balanced contributions across teams, and hence lower effectiveness (Zijlstra et al., 2012). The adaptive team perspective proposed by Kozlowski et al. (1999) suggests that teams develop over time in response to changing stimuli in their environment and, as part of this adaptive process, their model predicts dyad formation as part of team development. The appearance of dyads in early rehearsals is therefore also consistent with the forming of social

bonds, facilitating the later emergence of more complex interactions. Furthermore, it may be reinforced by a ‘contagion’ effect (Bourbousson et al., 2015) in which the presence of dyads makes it easier for a third member to join and create a triad, resulting in longer patterned interactions.

Comparing the profile of interaction patterns in Groups 1 and 2 can be partly explained by applying different models of emergence (Kozlowski & Chao, 2012). Whilst Group 1 members were addressing broad and diverse artistic challenges in their rehearsals and deciding what, how, when, and for how long to rehearse given pieces, Group 2 had straightforward material, limited time available and a highly prescribed task. In Group 2, all members of the ensemble developed an agreed concept of the task (in this case, an interpretation of two given pieces). The more open-ended and complex challenge faced by Group 1 (in which they set their own agenda) can be explored in relation to the *compilation* model of shared knowledge in the form of transactive memory, which is a ‘networked’ memory system. In this case, individual contributions to knowledge may be idiosyncratic and diverse, but at team level they are meaningful in relation to the shared purpose. Development of dyadic patterns such as those observed in Group 1 was also reported by Kozlowski et al. (1999) in their model of team compilation, where an initial socialisation phase and understanding of shared purpose provided the foundation for a second phase focusing on task mastery. In relation to time, dyadic exchanges are associated most strongly with a phase of ‘role compilation’ (see Chapter 2, Figure 2.2) when group members most actively gather knowledge of fellow group members’ capabilities. The authors describe this process as a “continuous series of phases, with partial overlap at transitions” (p. 248). These behaviours have been described as ‘role identification behaviours’ and form the basis of knowledge sharing about each other, and of the group’s capabilities.

The total number of significant dyadic interactions by rehearsal for both groups is summarised in Figure 8.5.



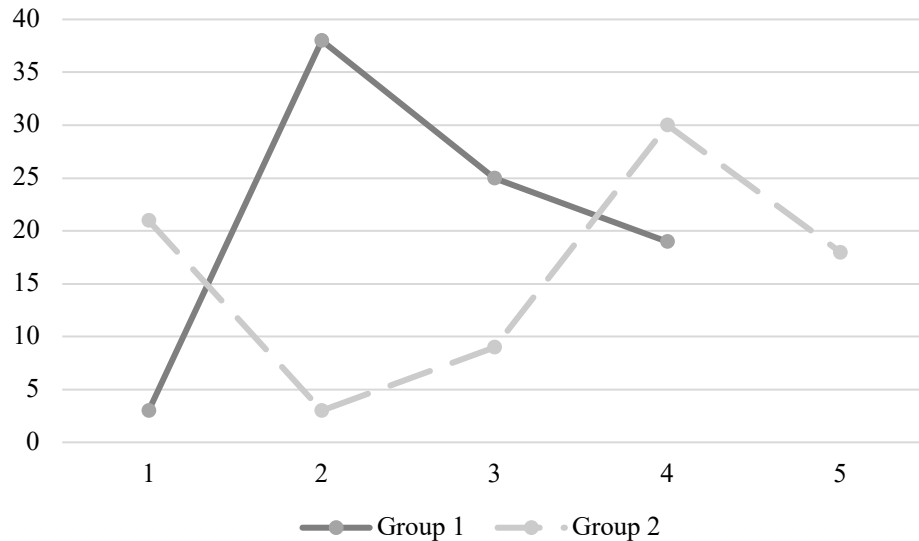


Figure 8.5 Number of dyadic interactions appearing in patterned behaviour by rehearsals, Groups 1 and 2

Regarding a musical ensemble through this lens of team compilation has implications for pedagogy and practice. For example, it suggests that optimal timing of planning activity may be around the middle of the rehearsal series when there is sufficient familiarity with both the task and with co-performers for effective coordination (Pearsall, Ellis, & Bell, 2010).

In Group 1 (Chapter 5), there was a low occurrence of mono-actor patterns. The exception was Week 5, suggesting the balance of contributions was different in this rehearsal, which may be explained by the shift in focus to be more ‘strategic’, resulting in different types and levels of contribution from different individuals. However, it may also reflect the absence of one group member as this rehearsal only had four members present. Dyadic sub-patterns appeared in Week 3 (Singers B and E, 27 occurrences) and Week 5 (Singers C and E, 19 occurrences) and may reflect the establishment of more interactions and social patterning as the group explored ways of working. In Group 2 (Chapter 6) there were no mono-actor patterns. Dyadic sub-patterns appeared throughout, and the first dyadic interaction appeared in the first minute of Week 1.

In Chapters 5 and 6 the interaction patterns revealed a mix of social and task behaviours (see Table 8.2). For Group 1 (Chapter 5), which involved longer rehearsals and a more natural setting with their own rehearsal agenda, there was an

increase of more patterned social behaviours, supported by dyadic interactions, but in the final rehearsal the patterns were solely task-focused. This may arise from entrainment effects, or “non-deliberate and non-conscious synchronisation of behaviour” (McGrath, 1990, p. 42). By contrast, Group 2 (Chapter 6) were participating in short rehearsals (2x10 minutes), to an agenda pre-defined by the researcher. Their balance of task and social behaviours followed a different trajectory, with social and dyadic interactions only emerging from Rehearsal 4 onwards. Hence, the shorter timescales imposed on Group 2 meant they had very limited time during these rehearsals to engage in group well-being behaviours but, rather, focused on the task in hand. Between the recorded rehearsals, other rehearsals and interactions allowed time for other types of interactions. However, the task-focused rehearsal pattern persisted until the emergence of dyads in Rehearsal 4. In Rehearsal 5 these patterns were still evident and social behaviours appeared in the patterns. From an entrainment perspective, it is notable that for both groups, the ‘tone’ of the first rehearsal (i.e. mix of social and task behaviours) persisted until Rehearsal 4, when for Group 1 they became task-focused, and for Group 2 the dyadic interactions first appeared.

Table 8.2 Summary of Group 1 and 2 mix of social and task behaviours appearing in patterned interactions, by rehearsal

	Rehearsal 1	Rehearsal 2	Rehearsal 3	Rehearsal 4	Rehearsal 5
Group 1	Mix of social and task	Mix of social and task, plus dyadic patterns appear	Mixed social with more task, dyads still present	Task only, fewer dyads	
Group 2	Task only	Task only	Task only	Task only but dyads appear	Mix of social and task, with dyads

The survey found that some groups reported the absence of performance goals, whilst others had very short, intense preparation periods with just one or two rehearsals. Those groups with long or no deadlines had adequate time to invest in the group – indeed, many amateur groups function this way. Conversely, it is not uncommon for a professional ‘scratch’ ensemble to have a very condensed preparation period, hence having no time (or perceived need) to spend on group-

building efforts. Trading off speed and quality is therefore a fundamental demand on groups operating within these different deadline horizons.

For Group 1, in Week 7 (Rehearsal 4) time pressures were greatest, as their first performance was imminent (Week 9). This was likely to have been the highest stress condition of all rehearsals investigated for this group. In their research on improvising jazz musicians, Canonne and Aucouturier (2016) also observed convergence of a number of dimensions, including those related to temporal interactions, ‘strategic’ dimensions (building a satisfying musical form in real time) and ‘aesthetic’ ones (creating congruency out of divergent preferences of the players). These adaptations over time can be achieved under pressure through coordination adaptations (Entin & Serfaty, 1999; Marks et al., 2001).

As well as the adaptive, continuous changes resulting from building familiarity and momentum, more rapid transitions were observed that involved fundamental reorganisation of the groups’ processes and behaviours. These happened between Phase 1 and 2, and Phase 2 and 3.

#### *Phase 1 to 2 transitions*

The developing social and task familiarity of Phase 1 and approaching deadline combined to initiate an energy ‘jump’ into Phase 2. In Group 1, the rehearsal in Week 5 coincided with their halfway point (given their plan for formal performance in Week 9). ‘De-integration’ therefore occurred around the midpoint of the performance preparation calendar. It was a subtle effect, more marked in Group 1 than Group 2. Group 2 experienced a change of deadline as their recital was postponed, which is likely to have contributed to the reduced effect.

Whilst the midpoint provides an interesting temporal marker, it is not the only factor – Gersick herself remarked that, “ultimately, the midpoint itself is not as important as the finding that groups use temporal milestones to pace their work and that the event of reaching those milestones pushes groups into a transitional state” (Gersick, 1988, p. 34). The groups in this study were enrolled on a course, under the guidance of a course director. He provided regular coaching throughout, which might be regarded as ‘formal instruction’. However, because they had this input on a regular (weekly) basis, it did not constitute an interruption, but was, rather, a continuous input. Social familiarity of the groups may also be a factor. Okhuysen

and Waller (2002) found that, when groups paused to engage in social interactions, they also used the opportunity to take stock of progress. These interruptions were often prefaced by a group member making a joke or light-hearted remark and continued by another group member on a more task-related matter. In Chapter 5, examples of similar interactions appear.

### *Phase 2 to 3 transitions*

The groups experienced a further step change in moving out of the ‘turbulent’ flow of the Phase 2 to the ‘smoother’ flow of Phase 3, as their processes and behaviours started to converge. This change was triggered by a sense of shared vision and resolution around goal achievement. An example is given in Chapter 7, where members of Group 1 described how some positive preparation provided the will and confidence to allow them to develop the resolve that they could ‘do a really good job’. This resolve was what enabled them to move into their final stages of preparation with a strong sense of collective endeavour.

## **8.5 Summary**

Whilst researchers have established multiple elements of coordination in ensembles, work continues in identifying an integrating framework which reflects the dynamic nature of a rehearsal series. Findings from this research suggest that, as performance approaches, there are dynamic changes in methods and structure (as shown in Chapters 4 and 5), behaviour and interaction patterns (Chapter 5 and 6) and performer perceptions (Chapter 7). From this discussion, it is argued that performance preparation is a complex mix of social, interactional, and contextual factors, in which interpersonal dimensions, group dynamics, and time-based changes play a part. These elements are conceptualised through a process lens: first, as a series of distinctive phases where the transitions are triggered by internal and external events, and second, as emergent coordinative behaviours that characterise ongoing interactions and decision-making of groups.

Combining data from Chapters 4, 5, 6 and 7, larger-scale structures over a series of rehearsals emerged, in which ensembles worked through three phases. An initial exploration phase established patterns of interaction and a framework for working together, shaped by pre-existing experiences of members and their new, shared goals. They then moved through a permeable and dynamic transition phase,

which was strongly influenced by their wider context including approaching deadlines and external influences. Post-transition, the final integration phase was characterised by the increased cohesion and the shared understanding needed for a performance. These larger-scale structures also support previous work on rehearsal methods that found that ensembles move from using more basic tasks in early rehearsals, to more strategic, interpretive, and expressive tasks nearer performance (e.g. Ginsborg et al., 2006). However, these phases were not strictly linear. Whilst exploration necessarily preceded the other phases, there was evidence that ensembles moved into and out of transition in a cyclic or episodic way, consistent with what has been found in other creative processes (Harrison & Rouse, 2014; Wise, James, & Rink, 2017).

In summary, there was an important contribution of both explicit and implicit communication modes, and ensembles tended to move towards more implicit communication over time. Alongside this, there was both ‘team’ and ‘task’ work communication, as advanced by Kozlowski et al. (1999). Figure 8.6 shows how combining this perspective with the observations on explicit and implicit coordination suggests clusters of activity that the ensembles engaged in to achieve shared goals.

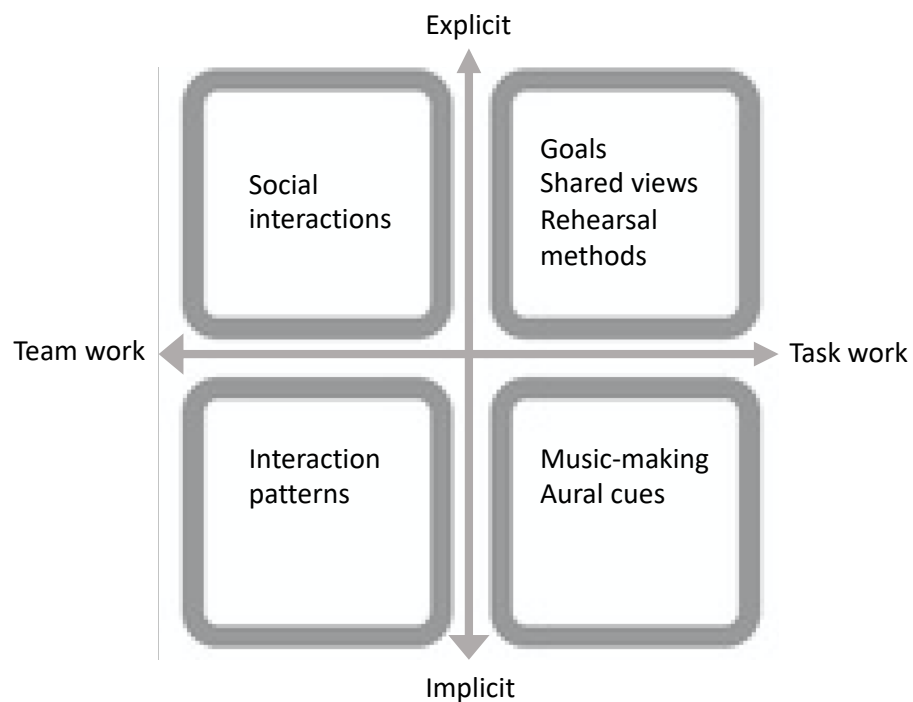


Figure 8.6 Explicit and implicit team work and task work in the ensemble

There may be other mechanisms underlying this. Implicit coordination has been proposed as the mediator of groups' understanding of their team situation (conceptualised as a Team Situation Model, or TSM), and achievement of performance. In their theoretical paper, Rico et al. (2008) advance a dynamic model in which TSM (based on longevity, trust, knowledge diversity, and group efficacy) is implicitly integrated in order to achieve coordination. The question also arises as to how rehearsal activities fit together to achieve coordination. In distributed decision-making contexts, Ching, Holsapple, and Whinston (1992) described coordination as happening in the context of ongoing and concurrent problem-solving tasks, whilst Okhuysen and Bechky (2009) view coordinating mechanisms as emergent, practical actions associated with group accountability (including roles and goals), predictability (including routines and planning), and common understanding (such as previous experience, and shared musical knowledge). Taking the findings together, evidence from the investigations of interactions, communication, rehearsal strategies and their changes over time supports the view of the ensemble as an emergent, dynamic entity.

Pattern detection and observation of behaviours revealed ways that interactions emerged over time, including early patterns and their subsequent development, the role of dyadic interactions, and individual team member contributions. Emergence has been defined at many levels: in this context coordination is focused primarily on the achievement of the alignment of activities, tasks, and ideas required for a musical performance. Okhuysen and Bechky (2009) label the fitting together required for coordination as 'integration'. Whilst the term 'emergence' is subject to a number of different conceptualisations and definitions, researchers in organisation research generally agree that 1) it comes into existence as a result of collective processes formed from individual, related parts, 2) that a degree of interaction among the individual elements gives rise to convergence 3) interactions create new patterns and higher-level phenomena, and 4) it is a dynamic process that occurs over time. (See Fulmer and Ostroff (2016) for review and for full definitions). These four dimensions highlight some ways in which the findings reported in this thesis may be regarded as emergent:

1) Performance requires the convergence of individual contributions towards collective achievement. This phenomenon has been described in different ways in

musicological research. In their work with an orchestra, Marotto, Roos, and Victor (2007) found that what they described as optimal ('peak') performance occurred when individuals made unique contributions but also perceived a holistic sense of collective performance. Overall, there was an aim for coherence in the output of the group. This was evident in the singers' perceptions ("we have a common understanding"), but also in their musical coordination. Referencing the results of the parallel studies reported in Chapter 6, by Rehearsal 5 more consistent synchronisation and tuning were achieved. Most notably, Rehearsal 4 represented a pivotal session in creating conditions for further integration in Rehearsal 5.

2) The emergence of coordination relies on the integration and retention of information, which is shared through the rehearsal process. This information forms part of a performer's memory and contributes to the shared representation of performance goals for the ensemble (Ginsborg et al., 2006; Keller, 2008). In turn, these shared representations facilitate coordination, by providing a template against which the production of parts can be compared. The challenge of achieving these tasks in real time is increased if the complexity of the musical material is greater.

3) The development of new patterns happened over time, as performance approached and as the ensembles developed greater musical and social familiarity. The 'new phenomena' that arose can be related to the perceived (by ensemble members) and measurable ways that the ensembles were able to coordinate their activities; for example in the way that improvements in synchronisation and tuning were achieved as Group 2 reached their final rehearsals.

4) The work of the groups in preparing for performance emerges as a highly dynamic and evolving process. As well as the observable and measurable changes in interaction behaviours over time, there were also changes in choice of activities and tools to facilitate the process, and parallel changes in timing and pitch synchronisation. These developments were not linear, but happened progressively from the very first encounters, with more abrupt shifts in pace as the groups responded to their changing environment.

In the following chapter, the thesis concludes with a summary of the contributions to theory, implications for practice, strengths and limitations, and areas for further study.





## 9 CHAPTER NINE

### Conclusions

*Process is fundamental: The river is not an object but an ever-changing flow; the sun is not a thing, but a flaming fire. Everything in nature is a matter of process, of activity, of change. (Rescher, 1996, p.10.)*

Whilst the real-time nature of a musical performance differentiates it from many other types of small group tasks, such as those encountered in business workplace environments, there are commonalities too. Groups, viewed as dynamic systems, seek to reconcile conflicting forces for stability and change. They share many fundamental processes of collaboration involving complex interactions with others over time - they seek to stabilise through coordination, whilst external events and other triggers ensure change is constant. Rescher (1996) describes how a river is constituted by an ever-changing flow, and that it can persist in time. In this, he references the paradoxical ‘river arguments’ of Greek philosopher Heraclitus (McCabe, 2015) whose words have been paraphrased as “it is impossible to step in the same river twice” (p. 35). He also describes how every river, whilst sharing the universal, river-like quality of *flowing* can have its own, unique, identity. Like a river, each group encounters and experiences its own currents and ebbs of action, inaction, progress and change.

The paradoxical forces for stability and change are central themes of this thesis. Viewed through this lens, group structures require repair and active work to sustain, involving constant reflection and renewal, so that even the most apparently stable groups are in a constant state of flux. External influences, critical events or time pressures can act as trigger points which result in more rapid change and transformation (Tsoukas & Chia, 2002). In the process worldview, the focus is on the unfolding of events rather than outcomes, in which group performances (of any type) become inputs for further ongoing activity. It does not mean that performance outcomes are not important, but rather leads to, ‘a less static, simplistic and linear understanding of what performance implies.’ (Langley et al., 2013, p. 10). This perspective, in the setting of a music ensemble, provides a way to interpret the interactions of group members. Individuals are immersed in the particular social

practices of the group, and decisions and actions are part of an ongoing, fluid environment in which processes unfold over time.

The implications of this research extend beyond the musical context and into the field of small group research. As set out in the introduction, this research aimed to address the following over-arching research question:

*How do behavioural interactions in self-organised music ensembles emerge and change over time?*

Exploring this question from a number of perspectives, it adopted a mixed-methods design and an abductive approach to theory, where ‘both deduction and induction are present...connecting the empirical world with theoretical ideas.’ (Gehman, Glaser, Eisenhardt, Gioia, Langley and Corley, 2018, p.297). The approaches to investigation were as follows:

*Chapter 4* was a survey study to better understand how rehearsal activities are structured in self-organised Western Art music ensembles, how this varied by different stages of preparation and ensemble type, and how verbal and nonverbal communication varied by stage of preparation.

*Chapter 5* employed pattern detection methods to explore how interaction patterns formed and impacted changing group behaviour in a newly formed ensemble. It also investigated ways that these patterns related to changes in rehearsal methods used over time.

*Chapter 6* also used pattern detection methods, to further investigate pattern formation, and their relationship to changing rehearsal context, roles and the musical organisation of performed repertoire.

*Chapter 7* reported qualitative findings relating to the question of how members of newly-formed ensembles experienced the process of preparing for performance, and how stages of rehearsal are perceived and managed.

Drawing these findings together, the prior discussion argues that the answer to this question lies in a set of related processes, in which the emergence of interactions, communication and (musical) activities are also subject to a series of transitional changes triggered by exogenous factors, including approaching deadlines, familiarity and external input.

## 9.1 Summary of contributions

The main contribution to knowledge is to offer an in-depth exploration of collaboration in ensemble rehearsal over time. This work resulted in contributions to theory, practice and methods. In this final chapter, the contributions of this thesis are considered in a wider context, including implications, strengths and limitations.

### *9.1.1 Contributions to theory*

The findings presented in this thesis provide a new perspective on collaboration in music ensembles, and also offers insights for research on small group processes and their emergence over time. In doing so, it also provides a framework for practitioners which can be further explored and developed.

For music ensemble research, it addresses a relatively under-researched area of ensemble rehearsal in relation to time. It builds on work by Kokotsaki (2007) which advanced a conceptual model to explain ways in which ensemble pianists work towards high quality performance. Among the key conditions identified in this theory were time availability or constraints. For example, the theory suggests that when sufficient time is available, preparation for rehearsal is deeper, and that the amount of time needed depends on a range of factors, such as the importance of any forthcoming performance, and the choice of repertoire. This thesis builds on the Kokotsaki (2007) theory to incorporate the changing conditions that arise as performance approaches and time becomes less available.

It also contributes to existing research which identified ways that small ensembles organise and structure their activities (e.g. Ginsborg & King, 2012; Goodman, 2000; King, 2004) by providing an over-time perspective on these behaviours, for example how ensembles integrate social interactions and focussed work on repertoire. Furthermore, it offers empirical evidence to support a recent conceptual model which incorporates a temporal aspect. King & Gritten (2017) propose that communication and interaction progress over time, as verbal discourse changes to more nonverbal, embodied interactions as performance approaches. Further, they suggest a shift towards more ‘in the moment’ interactions as patterns of behaviour become established, which they describe as the “essence of creative ensemble performance” (p. 319). These elements are reflected in the proposed

framework advanced in Chapter 8, and the changing ‘flow’ described by the river metaphor.

For researchers seeking to understand small group interactions and behaviours, it provides case study examples which strengthen the diversity of research in different workplace contexts. It also provides specific theoretical and empirical contributions to research in the areas of interaction pattern research. It provides evidence to support the emergence of early interaction patterns in the formation of small groups (e.g., Zijlstra et al., 2012) and pattern evolution and change over time (Uitdewilligen et al., 2016). Interaction pattern emergence and other aspects of temporal pacing and transitions which are identified as components of the proposed three-phase model contribute to an ongoing and active research field (Okhuysen & Waller, 2002; Wiltshire et al., 2018). Phase transitions are an ongoing and important area of study in small group research: or as Kelso (1990) described it, “around phase transitions ... the essential processes governing a behavioural pattern’s stability, change and even its selection can be uncovered” (p. 249). This study also contributes to work on phase transitions, and their relationship to shifts in patterns of behaviour and communication (Wiltshire et al., 2018), and their connection to shifts in implicit versus explicit communication (Rico et al., 2008). It also extends research on organisational change, by demonstrating how music ensembles seek to achieve coordination with a balance of stability and flexibility (Grote et al., 2018; Tsoukas & Chia, 2002).

### *9.1.2 Contributions to practice*

The dynamic processes revealed through the pattern analysis and observations were mediated by external events. Phase transitions can provide particularly important ‘windows’ for external influence and input (Butler, 2011). This provides a potential insight for ensemble players and, especially, teachers. It suggests that an understanding of the behaviour patterns associated with three phases of development could support timing of input to when it might be most effective. The initial stages are important for groups to get to know each other and to understand and agree a purpose. There is potentially a period when groups are most open to coaching, and to considering alternative approaches. The final stage is again more inward-looking as groups seek to apply and improve their practice. Timing of

interventions using the three-phase model as a framework has potential as an area for further study for music education research.

For practitioners, this research offers ways to better understand the arc of performance preparation. Whilst for many performers the experiences of the ensembles reported in the case studies may be familiar, or even commonplace, the way they are considered within a new frame may provide a tool for reflection. The processes of small group rehearsal, so often conducted *in camera*, and unobserved except by those directly involved, have been shown to be of interest for those outside the profession (D'Ausilio et al., 2015; Westelius, 2001), and also for those keen to learn from the experiences of others. Most musicians entering the profession will participate in collective music-making in some form: however, a report on higher education small group teaching and learning found that wider aspects relating to collaboration skills were not always addressed (Ginsborg & Wistreich, 2010). Whilst recognising the idiosyncrasies and variabilities which arise from differences in instrumentation, size, individual experiences, genre and style, the three-phase framework provides a tool for conceptual understanding of some of the underlying group processes that may be commonly encountered, going beyond the Tuckman (1965) model for group development (Creech & Hallam, 2017). There is hence an opportunity for this research to contribute pedagogical tools to support teaching in this area. It has the potential to improve the experience of musicians rehearsing together, by enabling them to prepare for, recognise and have strategies to respond to changing group dynamics over time, such as the encountering of barriers (or 'knickpoints' in the river metaphor).

From a teaching and learning perspective, this research offers further insights to practice relating to the roles of ensemble members. It shows that group members may exert their influence via a range of modes, including, but not restricted to, verbal contributions. Viewing the group as an emergent, dynamic system, where communication is fluid and reciprocal (Tubbs, 2012) promotes the concept of individual agency within a collective whole. It therefore supports the notion that individuals can influence group behaviours and that even what might feel (to ensemble members) like modest contributions can have a significant effect. It extends the view of group roles beyond the simple model of 'leader' and 'follower' to one where everyone has the potential to influence events and group dynamics.

In summary, some of the main implications for performers are that:

- Performance preparation unfolds over a series of rehearsals, within which there are distinct episodes and phases
- As with other groups with fixed deadlines and the need for consensus, groups may expect that:
  - First encounters set the tone for future sessions
  - After an initial settling-in period, there may be more divergent views, or a 'crisis', often around the halfway point. This is a healthy and expected part of progression
  - Later stages are characterised by increased focus and convergence of views
- Talk in rehearsal is generally more frequent at the start rather than towards the end of rehearsal series, as implicit, nonverbal communication modes become increasingly important.
- Interruptions, in the form of task change, external input, or social interactions, can provide 'ways in' for ideas and facilitate progress, especially during the middle 'transition' period
- In new groups, early formation of dyadic (two-person) interactions and social relationships are an important step in fostering wider (multi-person) group interactions
- There are many ways that individual members can influence outcomes. The term 'leadership' can be a limiting concept, with preconceptions of dominant behaviour. Other ways of influencing decisions include the timing of contributions, being engaged in a discussion from which ideas arise, or by having particular traits in instrumental or vocal performance, such as those related to rhythm or pitch.

### *9.1.3 Contributions to method*

This research used a novel combination of methods to explore interactions over time, adopting approaches from music psychology and small group research. Its contributions lie in the adoption of a method for verbal interaction (T-pattern)

analysis, applied for the first time in music ensembles, the use of a process perspective in interpreting the findings, the duration of the case studies, and the combination of multiple methods throughout.

Methods for observation and coding of ensemble rehearsal methods were based on existing research (Chaffin & Imreh, 2002; Ginsborg et al., 2006; Ginsborg & King, 2012). Use of temporal pattern analysis techniques (Magnusson, 2000) was combined with analysis of verbal behaviour, new to the study of musical ensembles. It enabled detailed study of moment-by-moment interactions, and when combined with observational and interview methods it provided the means to explore perspectives and experiences alongside quantitative analysis, and to identify larger scale time structures. This study of music ensembles using temporal pattern detection methods is of potential interest to researchers using similar methods to study sequences of behaviour over time (Herndon & Lewis, 2015). Taking a process view in the interpretation encouraged consideration of chains of events, activities, temporal ordering and change (Langley, 1999; Langley et al., 2013), which has not previously been applied in music ensemble research. Building on this process perspective, it incorporated temporal bracketing techniques to explore phases of development (Denis et al., 2011). It provided longitudinal data from ensembles, covering a time period of several months, providing the opportunity to observe changes over time, as well as reflection post-observation. The research design combined both qualitative and quantitative methods (Creswell, 2009), in which specialist software tools were selectively used to measure key variables, notably Theme (Patternvision, Ltd) for the measurement of order and time distances between behavioural events. The lab-based Case Study 2 provided additional opportunities for parallel studies capturing data on timing onsets and intonation adding further sources of data to interrogate the findings, including sound recordings from individual voices (D'Amario, Daffern, et al., 2018; D'Amario, Howard, et al., 2018). The qualitative, comparative data took a broader perspective, which also made use of visual methods to allow participants to describe their experiences (Bischof et al., 2011).

## 9.2 Limitations and strengths

This research had a number of limitations. Firstly, it was highly exploratory. It did not set out to test an existing theory, rather to explore a phenomenon in the light of existing research. As such, there is further scope for testing aspects of the framework. Secondly, whilst the use of the case study setting provided the opportunity for in-depth investigation of groups, the sample size was necessarily small. Therefore, analysis based on the assumptions of parametric statistics are not always applicable, and the results have limited generalisability. The temporal bracketing method used in Chapter 7 has some inherent limitations, with moderate generalisability and accuracy (Langley et al., 1999). The similarity of the cases (both vocal quintets in the same institution) means that any idiosyncrasies related to the particular style and culture of their practice is likely to be emphasised. Thirdly, there is some missing data, due to participant unavailability in one rehearsal in the first case study, creating an extra source of variability within the group's interactions. Fourthly, it is acknowledged that in the case studies there was lack of total access – it was not known what the groups did in between the observed periods, and indeed whether the presence of a camera changed behaviours. In the qualitative analysis, in particular, there is potential for unconscious bias in the way that participants experiences were captured and interpreted. However, this is a dilemma faced by those seeking to undertake inductive research with a theory building focus. As proposed by Gioia et al. (2013), this was mitigated by systematic data collection and analysis. The interpretation occurred in two steps – first order themes which reflect the voice of the participants, and second order themes in which there is interpretation by the researcher. These were combined to create a data structure in which the connections between source and interpretation are transparent.

Despite these limitations this research had strengths deriving in large part from the diversity and scope of its methodology. Starting with a broad approach, it compared multiple ensembles to create a context and to situate the research in the musical community of practice. Whilst there were only two case studies, they had the advantage of being independent of each other, but very similar in many ways: they were both newly formed at the start, and were comparable in genre, setting, age, gender mix, and purpose. The timeframe for study was both larger scale (weeks/months) and shorter scale (seconds/minutes): an intensive observation period



of three months, plus follow-up time, allowed consideration of the larger scale time periods of an evolving group, whilst the use of time-stamped verbal interaction data allowed detailed analysis of specific rehearsal episodes.

### 9.3 Future research

This research provides an entry point for other potential studies of this type: grounded in a process ontology, mixed-method, longitudinal case studies. In addition, each of the component studies provide possibilities for future follow-up.

A key tenet of this thesis was to explore changes over time. In doing so, it has highlighted the importance of longitudinal research in understanding the ways that members of ensembles work together. Further research could extend the timeline further: to include performances (as well as rehearsals), or across a series of rehearsal–performance–rehearsal episodes to investigate how a newly formed group assimilates performance experience. The unexpected finding reported in Chapter 5, in which ‘cells’ of interaction were revealed around discussion and singing a passage would be worthy of follow-up by focussing on the behaviours occurring in types of episodes in rehearsal.

The survey suggested that there are some differences between size and type of ensemble in communication and practice. Therefore, a next step would be to build further on the singing quintet case examples to explore the findings with different types, levels of expertise and sizes of ensembles, for example, observation studies with instrumental ensembles, larger or smaller groups, and amateur and established professional groups.

The parallel studies with two contrasting pieces revealed small but interesting differences in behaviour. This strand of research could also be developed further, with both vocal and instrumental groups, to explore the effects of more highly contrasting material, with more variation in structure and texture, and/or with greater melodic and tonal and complexity. The genre of music considered in this research was Western classical chamber music. It would be interesting to explore to what extent other small self-organised groups, such as jazz ensembles or pop/rock bands, are subject to the same processes of emergent coordination, where there may be different aesthetic demands (Doffman, 2013). Exploring the sequence of tasks over the arc of a rehearsal series, and different working practices and culture of working

without scores, compared to working with scores (as is generally the case in the Western classical tradition) would be a further way to understand this in more depth.

From a methodological perspective there are further opportunities to extend this research. Based on the experiences of using Theme for pattern detection and analysis, future studies can apply a refined and more focussed protocol. The second case study showed that sessions as short as ten minutes can reveal significant patterns. Focussing on interactions which happen at key transition points (the first few minutes, the midpoint transition) would be a further way to sharpen the focus of investigation, and reduce the time required for analysis. A new scale for explicit and implicit coordination has recently been developed and validated (Chang et al., 2017), and could be used to further explore these dimensions in music ensembles.

A related area of research which was beyond the scope of this thesis and which has been explored by scholars seeking to understand team coordination is that of shared knowledge mechanisms. Instruments for measuring team-level constructs such as shared mental models (DeChurch & Mesmer-Magnus, 2010) and transactive memory systems (Lewis, 2003) have not to my knowledge been used in music ensemble settings, and could be employed to explore further aspects of knowledge sharing in the ensemble. As part of this, exploring the way that prior individual experiences shape rehearsal strategies (for example experience as a solo performer, or with other ensembles), and the role of external coaching on the knowledge resources of the group would further build understanding of the experiences of what is it to be part of an ensemble.

Distributed, devolved decision making was highly valued by the ensembles in this study. Combined with the emergence of roles and influence in the interactions of ensemble members creates further questions relating to 'leadership' in the ensemble. Numerous studies of ensembles have addressed questions of leader-follower relations and how they related to the synchronisation of sounds. However, the emergence of 'leadership' in the self-organised ensemble remains a relatively little-researched area. Using Theme to track patterns of interaction related to key decision points in the ensemble and relating to modes of influencing which this study highlighted (e.g. type and timing of verbal contributions, inclusion in recurrent patterns) is therefore another potential area for further study. These behaviours could also be related to well-established leadership personality traits, such as those measured by the Multifactor Leadership Questionnaire (MLQ) (Avolio, Bass, &

Jung, 1999). There is also potential for the application of a ‘leader behaviour questionnaire’ similar to that developed by for sports by Chelladurai and Saleh (1980) which includes dimensions of *training and instruction, democratic and autocratic behaviour, social support* and *positive feedback*. Such a scale for ensemble musicians would provide a valuable pedagogical and professional development resource, and a way to embed the less traditional leadership behaviours identified in this research.

This research has paved the way for future investigations to consider over-time ensemble interactions in the field of ensemble performance excellence. It explored multiple strands of ensemble collaboration and coordination to examine some fundamental questions regarding how ensembles work together towards performance. It offered some new and accessible methodological approaches, which can be further used and applied by researchers in the field.

#### 9.4 Closing remarks

In conclusion, this study makes theoretical, methodological and practice contributions to knowledge. It has shown how tapping the rich seam of methods, concepts and theories from organisation studies can be applied in music-focussed research – and equally how the setting of the music ensemble can inform wider organisational questions relevant to small groups. It has the potential to offer performers and teachers of music ensembles new ways to enhance performance, through insights into how small music groups work together, interact and perform. It reinforces the value of combining prior and active research across disciplines, which can inform and enlighten many of the creative and collaborative processes experienced by musicians performing in groups. It offers new methods that can be applied in other contexts in the form of behavioural pattern detection and analysis. It also offers a new theoretical perspective on the dynamics of performance preparation over time, that can provide a departure point for further research.

## 10 References

- Aarikka-Stenroos, L., & Jaakkola, E. (2012). Value co-creation in knowledge intensive business services: A dyadic perspective on the joint problem solving process. *Industrial Marketing Management*, 41(1), 15-26.
- Adorno, T., Leppert, R., & Ritzarev, M. (2002). *Essays on music* (Vol. 11). Orlando, FL: University of California Press.
- Ancona, D., & Chong, C.-L. (1996). Entrainment: Pace, cycle, and rhythm in organizational behavior. *Research in Organizational Behavior*, 18, 251-284.
- Ancona, D., Okhuysen, G. A., & Perlow, L. A. (2001). Taking time to integrate temporal research. *Academy of Management Review*, 26(4), 512-529.
- Anon. (2001). Homorhythmic (Publication no. 10.1093/gmo/9781561592630.article.13292). Retrieved 2019-06-14, from Oxford University Press: <https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000013292>
- Anon. (2019a). Rehearsal. *Oxford English Dictionary* Retrieved 29/03/2019, 2019, from <https://en.oxforddictionaries.com/definition/rehearsal>
- Anon. (2019b). Rehearsal. *Collins Online Dictionary* Retrieved 29/03/2019, 2019, from <https://www.collinsdictionary.com/dictionary/english/rehearsal>
- Anzieu, D., & Martin, J.-Y. (1968). *La dynamique des groupes restreints*. Paris, France: Presses Universitaires de France.
- Archbold, P. (Writer) (2012). Climbing a mountain: Arditti quartet rehearse Brian Ferneyhough "String Quartet no. 6". [DVD]. In C. Still (Producer). UK: University of London: Institute of Musical Research.
- Argote, L., & Guo, J. M. (2016). Routines and transactive memory systems: Creating, coordinating, retaining, and transferring knowledge in organizations. *Research in Organizational Behavior*, 36, 65-84.
- Argote, L., & Ren, Y. (2012). Transactive memory systems: A microfoundation of dynamic capabilities. *Journal of Management Studies*, 49(8), 1375-1382.
- Aristotle. (1993). *Physics*. Oxford: Clarendon Press.
- Arrow, H., McGrath, J. E., & Berdahl, J. L. (2000). *Small groups as complex systems: Formation, coordination, development, and adaptation*: Sage Publications, Inc., Thousand Oaks.
- Austin, J. R. (2003). Transactive memory in organizational groups: The effects of content, consensus, specialization, and accuracy on group performance. *Journal of Applied Psychology*, 88(5), 866-878.
- Avolio, B. J., Bass, B. M., & Jung, D. I. (1999). Re-examining the components of transformational and transactional leadership using the Multifactor Leadership Questionnaire. *Journal of Occupational & Organizational Psychology*, 72, 441-462.
- Badino, L., D'Ausilio, A., Glowinski, D., Camurri, A., & Fadiga, L. (2014). Sensorimotor communication in professional quartets. *Neuropsychologia*, 55, 98-104.

- Bales, R. F. (1950). A set of categories for the analysis of small group interaction. *American Sociological Review*, 15(2), 257-263.
- Ballard, D. I., Tschan, F., & Waller, M. J. (2008). All in the timing: Considering time at multiple stages of group research. *Small Group Research*, 39(3), 328-351.
- Barrett, F. (1998). Creativity and improvisation in jazz and organizations: implications for organizational learning. *Organization Science*, 9(5), 605-622.
- Barth, S., Schraagen, J. M., & Schmettow, M. (2015). Network measures for characterising team adaptation processes. *Ergonomics*, 58(8), 1287-1302.
- Bashford, C. (2001). "Chamber music" in *New Grove dictionary of music and musicians* (Fifth ed.). Oxford, UK: Oxford University Press.
- Bathurst, R., & Ladkin, D. (2012). Performing leadership: Observations from the world of music. *Administrative Sciences*, 2(1), 99-119.
- Bayley, A. (2011). Ethnographic research into contemporary string quartet rehearsal. *Ethnomusicology Forum*, 20(3), 385-411.
- Bayley, A., & Lizée, N. (2016). Creative layers and continuities: A case study of Nicole Lizée and the Kronos Quartet. *Musicae Scientiae*, 20(3), 392-412.
- Biasutti, M., Concina, E., Wasley, D., & Williamon, A. (2016). Music regulators in two string quartets: A comparison of communicative behaviors between low- and high-stress performance conditions. *Frontiers in Psychology*, 7.
- Bischof, N., Comi, A., & Eppler, M. J. (2011). *Knowledge visualization in qualitative methods - or how can I see what I say?* Paper presented at the 15th International IEEE Conference on Information Visualisation, London, UK.
- Bishop, L. (2018). Collaborative musical creativity: How ensembles coordinate spontaneity. *Frontiers in Psychology*, 9(1285), 1-17.
- Blacking, J. (1974). *How musical is man?* Seattle: University of Washington Press.
- Blank, M., & Davidson, J. (2007). An exploration of the effects of musical and social factors in piano duo collaborations. *Psychology of Music*, 35(2), 231-248.
- Blickensderfer, E. L., Reynolds, R., Salas, E., & Cannon-Bowers, J. A. (2010). Shared expectations and implicit coordination in tennis doubles teams. *Journal of Applied Sport Psychology*, 22(4), 486-499.
- Blum, D. (1987). *The art of quartet playing: The Guarneri Quartet in conversation with David Blum*. New York, NY: Cornell University Press.
- Boella, G., & van der Torre, L. (2006). Coordination and organization: Definitions, examples and future research directions. *Electronic Notes in Theoretical Computer Science*, 150(3), 3-20.
- Borgo, D. (2005). *Sync or Swarm: Improvising Music in a Complex Age*. New York: Continuum.
- Borrie, A., Jonsson, G. K., & Magnusson, M. S. (2002). Temporal pattern analysis and its applicability in sport: an explanation and exemplar data. *Journal of Sports Sciences*, 20(10), 845-852.

- Bourbousson, J., R'Kiouak, M., & Eccles, D. W. (2015). The dynamics of team coordination: A social network analysis as a window to shared awareness. *European Journal of Work and Organizational Psychology, 24*(5), 742-760.
- Bourbousson, J., Seve, C., & McGarry, T. (2010a). Space-time coordination dynamics in basketball: Part 1. Intra- and inter-couplings among player dyads. *Journal of Sports Sciences, 28*(3), 339-347.
- Bourbousson, J., Seve, C., & McGarry, T. (2010b). Space-time coordination dynamics in basketball: Part 2. The interaction between the two teams. *Journal of Sports Sciences, 28*(3), 349-358.
- Brauner, E., Boos, M., & Kolbe, M. (2018). *The Cambridge handbook of group interaction analysis*. Cambridge, UK: Cambridge University Press.
- Brinner, B. (1995). *Knowing music, making music: Javanese gamelan and the theory of musical competence and interaction*. Chicago: University of Chicago Press.
- Brown, R. (1988). *Group processes: Dynamics within and between groups*. Oxford, UK: Blackwell.
- Burns, J. S. (2000). A river runs through it: A metaphor for teaching leadership theory. *Journal of Leadership Studies, 7*(3), 41-55.
- Burt-Perkins, R., & Mills, J. (2009). Pitching it right? Selection and learning at a music conservatoire. *British Educational Research Journal, 35*(6), 817-835.
- Bush, J. T., Lepine, J. A., & Newton, D. W. (2017). Teams in transition: An integrative review and synthesis of research on team task transitions and propositions for future research. *Human Resource Management Review, 28*(4).
- Butler, E. A. (2011). Temporal interpersonal emotion systems: The "TIES" that form relationships. *Personality and Social Psychology Review, 15*(4), 367-393.
- Butterworth, T. (1990). Detroit String Quartet. In J. Hackman (Ed.), *Groups That Work (and Those That Don't)* (pp. 207-224). San Francisco, CA: Jossey-Bass.
- Camerino, O. F., Chaverri, J., Anguera, M. T., & Jonsson, G. K. (2012). Dynamics of the game in soccer: Detection of T-patterns. *European Journal of Sport Science, 12*(3), 216-224.
- Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81.
- Campbell, J., Flynn, J. D., & Hay, J. (2011). The group development process seen through the lens of complexity theory. *International Scientific Journal of Methods and Models of Complexity, 6*(1).
- Canonne, C., & Aucouturier, J.-J. (2016). Play together, think alike: Shared mental models in expert music improvisers. *Psychology of Music, 44*(3), 544-558.
- Carson, J. B., Tesluk, P. E., & Marrone, J. A. (2007). Shared leadership in teams: An investigation of antecedent conditions and performance. *Academy of Management Journal, 50*(5), 1217-1234.
- Casarrubea, M., Jonsson, G. K., Faulisi, F., Sorbera, F., Di Giovanni, G., Benigno, A., et al. (2015). T-pattern analysis for the study of temporal structure of

- animal and human behavior: A comprehensive review. *Journal of Neuroscience Methods*, 239, 34-46.
- Cassell, J. (1998). A framework for gesture generation and interpretation. In R. Cipolla (Ed.), *Computer vision in human-machine interaction* (pp. 248-265). Cambridge, UK: Cambridge University Press.
- Chaffin, R., & Imreh, G. (2002). Practicing perfection: Piano performance as expert memory. *Psychological Science*, 13(4), 342-349.
- Chaffin, R., Lisboa, T., Logan, T., & Begosh, K. T. (2010). Preparing for memorized cello performance: the role of performance cues. *Psychology of Music*, 38(1), 3-30.
- Chang, H.-T., Lin, C.-C., Chen, C.-H., & Ho, Y.-H. (2017). Explicit and implicit coordination: Development of a multidimensional scale. *Social Behavior and Personality*, 45(6), 915-929.
- Chelladurai, P. (1990). Leadership in sports: A review. *International Journal of Sport Psychology*(21), 328-354.
- Chelladurai, P., & Saleh, S. (1980). Dimensions of leader behavior in sports: Development of a leadership scale. *Journal of Sport Psychology*, 2(1), 34-45.
- Cherryholmes, C. H. (1992). Notes on pragmatism and scientific realism. *Educational Researcher*, 21, 13-17.
- Chew, E. (2014). Music interaction with others as conveyor of relational intent: A response to Cross (2014). *Psychology of Music*, 42(6), 826-838.
- Ching, C., Holsapple, C. W., & Whinston, A. B. (1992). Reputation, learning, and coordination in distributed decision-making contexts. *Organization Science*, 3(2), 275-297.
- Chung, Y., & Jackson, S. (2013). The internal and external networks of knowledge-intensive teams: The role of task routineness. *Journal of Management*, 39(2), 442-468.
- Clarke, E., Doffman, M., & Lim, L. (2013). Distributed creativity and ecological dynamics: A case study of Liza Lim's 'Tongue of the Invisible'. *Music and Letters*, 94(4), 628-663.
- Clarke, E., Doffman, M., & Timmers, R. (2016). Creativity, collaboration and development in Jeremy Thurlow's *Ouija* for Peter Sheppard Skærved. *Journal of the Royal Musical Association*, 141(1), 113-165.
- Cochrane, T. (2017). Group flow. In M. Lesaffre, Maes, P., & Leman, M. (Ed.), *The Routledge Companion to Embodied Music Interaction* (pp. 133-140). Oxford, UK: Routledge.
- Cooke, N. J., Salas, E., Cannon-Bowers, J. A., & Stout, R. J. (2000). Measuring team knowledge. *Human Factors*, 42(1), 151-173.
- Corley, K. G., & Gioia, D. A. (2004). Identity ambiguity and change in the wake of a corporate spin-off. *Administrative Science Quarterly*, 49(2), 173-208.
- Corley, K. G., & Gioia, D. A. (2011). Building theory about theory building: What constitutes a theoretical contribution? *Academy of Management Review*, 36(1), 12-32.

- Cornelissen, J. P. (2004). What are we playing at? Theatre, organization, and the use of metaphor. *Organization Studies*, 25(5), 705-726.
- Cornelissen, J. P., Oswick, C., Thøger Christensen, L., & Phillips, N. (2008). Metaphor in organizational research: Context, modalities and implications for research — introduction. *Organization Studies*, 29(1), 7-22.
- Corning, P. A. (2002). The re-emergence of “emergence”: A venerable concept in search of a theory. *Complexity*, 7(6), 18-30.
- Covey-Crump, R. (1992). Pythagoras at the forge: tuning in early music. *Companion to Medieval and Renaissance Music*, 317-326.
- Creech, A., & Hallam, S. (2017). Facilitating learning in small groups. In J. Rink, H. Gaunt & A. Williamon (Eds.), *Musicians in the Making: Pathways to Creative Performance* (Vol. 1, pp. 57-76). New York: Oxford University Press.
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. London: Sage Publications.
- Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage
- Creswell, J. W., & Zhang, W. (2009). The application of mixed methods designs to trauma research. *Journal of Traumatic Stress*, 22(6), 612-621.
- Cronin, M. A. (2015). Advancing the science of dynamics in groups and teams. *Organizational Psychology Review*, 5(4), 267-269.
- Cronin, M. A., Weingart, L. R., & Todorova, G. (2011). Dynamics in groups: Are we there yet? *Academy of Management Annals*, 5(1), 571-612.
- Cross, I. (2014). Music and communication in music psychology. *Psychology of Music*, 42(6), 809-819.
- Csikszentmihalyi, M. (1997). *Flow and the psychology of discovery and invention*. New York: Harper Perennial.
- D’Amario, S., Daffern, H., & Bailes, F. (2018). A longitudinal study investigating synchronization in a singing quintet. *Journal of Voice*, 10.1016/j.jvoice.2018.06.011.
- D’Amario, S., Howard, D. M., Daffern, H., & Pennill, N. (2018). A longitudinal study of intonation in an a cappella singing quintet. *Journal of Voice*, 10.1016/j.jvoice.2018.07.015.
- D’Ausilio, A., Novembre, G., Fadiga, L., & Keller, P. E. (2015). What can music tell us about social interaction? *Trends in Cognitive Sciences*, 19(3), 111-114.
- David, L., Petia, S., Robert, G., Geoff, O. B., & Safwat, M. (2015). Complex processes and social systems: A synergy of perspectives. *International Journal of Systems and Society* 2(1), 65-73.
- Davidson, J. (1997). The social in music performance. In D. J. Hargreaves & A. C. North (Eds.), *The Social Psychology of Music* (pp. 209-228). Oxford, UK: Oxford University Press.
- Davidson, J., & Good, J. M. M. (2002). Social and musical co-ordination between members of a string quartet: An exploratory study. *Psychology of Music*, 30(2), 186-201.



- Davidson, J., & King, E. (2004). Strategies for ensemble practice. In A. Williamon (Ed.), *Musical Excellence: Strategies and Techniques to Enhance Performance* (pp. 105-122). Oxford, UK: Oxford University Press.
- Davidson, J., & Salgado Correia, J. (2001). Meaningful musical performance: A bodily experience. *Research Studies in Music Education, 17*(1), 70-83.
- Day, D. V., Gronn, P., & Salas, E. (2004). Leadership capacity in teams. *The Leadership Quarterly, 15*, 857-880.
- DeChurch, L. A., & Mesmer-Magnus, J. R. (2010). Measuring shared team mental models: A meta-analysis. *Group Dynamics: Theory, Research and Practice, 14*(1), 1-14.
- Denis, J.-L., Dompierre, G., Langley, A., & Rouleau, L. (2011). Escalating indecision: between reification and strategic ambiguity. *Organization Science, 22*(1), 225-244.
- Denis, J.-L., Langley, A., & Cazale, L. (1996). Leadership and strategic change under ambiguity. *Organization Studies, 17*(4), 673-699.
- Doffman, M. (2013). Groove: Temporality, awareness and the feeling of entrainment in jazz performance. *Experience and Meaning in Music Performance, 62-85*.
- Dogantan-Dack, M. (2012). The art of research in live music performance. *Music Performance Research, 5*, 34-46.
- Dolmans, D. H. J. M., Wolfhagen, H. A. P., Scherpbier, A. J. J. A., & Van der Vleuten, C. P. M. (2003). Development of an instrument to evaluate the effectiveness of teachers in guiding small groups. *Higher Education, 46*(4), 431-446.
- Dubois, A., & Gadde, L.-E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research, 55*(7), 553-560.
- Dusinberre, E. (2016). *Beethoven for a later age: Living with the string quartets*. Chicago: University of Chicago Press.
- Edmondson, A. C., & Lei, Z. (2014). Psychological safety: The history, renaissance, and future of an interpersonal construct. *Annual Review of Organizational Psychology and Organizational Behavior, 1*, 23-43.
- Eidelson, R. J. (1997). Complex adaptive systems in the behavioral and social sciences. *Review of General Psychology, 1*(1), 42-71.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532-550.
- Ekman, P., & Friesen, W. V. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. *Semiotica, 1*(1), 49-98.
- Emery, C., Calvard, T. S., & Pierce, M. E. (2013). Leadership as an emergent group process: A social network study of personality and leadership. *Group Processes & Intergroup Relations, 16*(1), 28-45.
- Entin, E. E., & Serfaty, D. (1999). Adaptive team coordination. *Human Factors, 41*(2), 312-325.
- Ericsson, K. A., & Kintsch, W. (1995). Long-Term Working Memory. *Psychological Review, 102*(2), 211-245.

- Faraj, S., & Xiao, Y. (2006). Coordination in fast-response organizations. *Management Science*, 52(8), 1155-1169.
- Farley, S., Evison, R., Rackham, N., Nicolson, R., & Dawson, J. (2018). The Behavior Analysis Coding System. In E. Brauner, M. Boos & M. Kolbe (Eds.), *The Cambridge Handbook of Group Interaction Analysis* (pp. 584-593). Cambridge: Cambridge University Press.
- Feldman, M. S. (2000). Organizational routines as a source of continuous change. *Organization science*, 11(6), 611-629.
- Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly*, 48, 94-118.
- Field, A. P. (2009). *Discovering statistics using SPSS: (and sex and drugs and rock 'n' roll)* (3rd ed.). London: Sage.
- Fiore, S. M., & Salas, E. (2006). Team cognition and expert teams: Developing insights from cross-disciplinary analysis of exceptional teams. *International Journal of Sport and Exercise Psychology*, 4(4), 369-375.
- Fletcher, J. K., & Kaufer, K. (2003). Shared leadership. In C. L. Pearce & J. A. Conger (Eds.), *Shared Leadership: Reframing the Hows and Whys of Leadership* (pp. 21-47). Thousand Oaks, CA: Sage.
- Ford, L., & Davidson, J. (2003). An investigation of members' roles in wind quintets. *Psychology of Music*, 31(1), 53-74.
- Foster, M. A., & Kelsey, H. M. (2012). Knickpoint and knickzone formation and propagation, South Fork Eel River, Northern California. *Geosphere*, 8(2), 403-416.
- Fransen, K., Van Puyenbroeck, S., Loughhead, T. M., Vanbeselaere, N., De Cuyper, B., Broek, G. V., et al. (2015). Who takes the lead? Social network analysis as a pioneering tool to investigate shared leadership within sports teams. *Social networks*, 43, 28-38.
- Frobenius, W., Cooke, P., Bithell, C., & Zemtsovsky, I. (2001). Polyphony (Publication no. 10.1093/gmo/9781561592630.article.42927). Retrieved 2019-06-14, from Oxford University Press:  
<https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000042927>
- Fulmer, C. A., & Ostroff, C. (2016). Convergence and emergence in organizations: An integrative framework and review. *Journal of Organizational Behavior*, 37, S122-S145.
- Gehman, J., Glaser, V. L., Eisenhardt, K. M., Gioia, D., Langley, A., & Corley, K. G. (2018). Finding theory-method fit: A comparison of three qualitative approaches to theory building. *Journal of Management Inquiry*, 27(3), 284-300.
- Gersick, C. J. G. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management Journal*, 31(1), 9-41.
- Gersick, C. J. G. (1989). Marking time: Predictable transitions in task groups. *Academy of Management Journal*, 32(2), 274-309.

- Gersick, C. J. G. (1991). Revolutionary change theories: A multilevel exploration of the punctuated equilibrium paradigm. *Academy of Management. The Academy of Management Review*, 16(1), 10.
- Gersick, C. J. G. (1994). Pacing strategic change: The case of a new venture. *Academy of Management Journal*, 37(1), 9-45.
- Gersick, C. J. G., & Hackman, J. R. (1990). Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*, 47(1), 65-97.
- Gibson, W. (2010). The group ethic in the improvising jazz ensemble: A symbolic interactionist analysis of music, identity, and social context. In *Studies in Symbolic Interactionism* (Vol. 35, pp. 11-28). Bingley: Emerald Group Publishing Limited.
- Giddens, A. (1984). *The constitution of society: Outline of the structuration theory*. Cambridge, UK: Polity Press.
- Gilboa, A., & Tal-Shmotkin, M. (2012). String quartets as self-managed teams: An interdisciplinary perspective. *Psychology of Music*, 40(1), 19-41.
- Ginsborg, J. (2002). Classical singers learning and memorising a new song: An observational study. *Psychology of Music*, 30(1), 58-101.
- Ginsborg, J. (2017). Small ensembles in rehearsal. In J. Rink, H. Gaunt & A. Williamon (Eds.), *Musicians in the Making: Pathways to Creative Performance*. Oxford: Oxford University Press.
- Ginsborg, J., & Chaffin, R. (2011). Preparation and spontaneity in performance: A singer's thoughts while singing Schoenberg. *Psychomusicology: Music, Mind and Brain*, 21(1-2), 137-158.
- Ginsborg, J., Chaffin, R., & Nicholson, G. (2006). Shared performance cues in singing and conducting: A content analysis of talk during practice. *Psychology of Music*, 34(2), 167-194.
- Ginsborg, J., & King, E. (2012). Rehearsal talk: Familiarity and expertise in singer-pianist duos. *Musicae Scientiae*, 16(2), 148-167.
- Ginsborg, J., & Wistreich, R. (2010). *Promoting excellence in small group music performance: Teaching, learning and assessment*. UK: Higher Education Academy.
- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods*, 16(1), 15-31.
- Glegg, S. M. N. (2019). Facilitating interviews in qualitative research with visual tools: A typology. *Qualitative Health Research*, 29(2), 301-310.
- Glowinski, D., Bracco, F., Chiorri, C., & Grandjean, D. (2016). Music ensemble as a resilient system. Managing the unexpected through group interaction. *Frontiers in Psychology*, 7, 1-7.
- Glowinski, D., Dardard, F., Gnecco, G., Piana, S., & Camurri, A. (2015). Expressive non-verbal interaction in a string quartet: An analysis through head movements. *Journal of Multimodal User Interfaces*, 9(1), 55-68.

- Glowinski, D., Mancini, M., Cowie, R., Camurri, A., Chiorri, C., & Doherty, C. (2013). The movements made by performers in a skilled quartet: A distinctive pattern, and the function that it serves. *Frontiers in Psychology*, 4(841), 1-9.
- Godøy, R. I., & Leman, M. (2010). *Musical gestures: Sound, movement, and meaning*. Oxford: Routledge.
- Goebel, W., & Palmer, C. (2009). Synchronization of timing and motion among performing musicians. *Music Perception: An Interdisciplinary Journal*, 26, 427-438.
- Golding, W. (1954). *Lord of the Flies*. London: Penguin.
- Goldstein, J. (1999). Emergence as a construct: History and issues. *Emergence*, 1(1), 49-72.
- Goodman, E. C. (2000). *Analysing the ensemble in music rehearsal and performance: the nature and effects of interaction in cello-piano duos*. Unpublished PhD, Royal Holloway, University of London.
- Gorman, J. C., Cooke, N. J., Amazeen, P. G., & Fouse, S. (2012). Measuring patterns in team interaction sequences using a discrete recurrence approach. *Human Factors*, 54(4), 503-517.
- Greene, J. C. (2007). *Mixed methods in social inquiry*. San Francisco, CA: Jossey-Bass.
- Grote, G., Kolbe, M., & Waller, M. J. (2018). The dual nature of adaptive coordination in teams: Balancing demands for flexibility and stability. *Organizational Psychology Review*, 8(2-3), 125-148.
- Gruson, L. M. (1988). Rehearsal skill and musical competence: Does practice make perfect? In J. A. Sloboda (Ed.), *Generative Processes in Music* (pp. 91-112). Oxford: Clarendon Press, Oxford University Press.
- Gully, S. (2000). Work teams research. In *Work Teams: Past, Present and Future* (pp. 25-44). New York: Springer-Verlag.
- Hallam, S. (1995). Professional musicians' orientations to practice: Implications for teaching. *British Journal of Music Education*, 12(1), 3-19.
- Hallam, S. (2001). The development of expertise in young musicians: Strategy use, knowledge acquisition and individual diversity. *Music Education Research*, 3(1), 7-23.
- Hare, A. P. (1973). Theories of group development and categories for interaction analysis. *Small Group Behavior*, 4(3), 259-304.
- Hargadon, A. B., & Bechky, B. A. (2006). When collections of creatives become creative collectives: A field study of problem solving at work. *Organization Science*, 17(4), 484-500.
- Harrison, S. H., & Rouse, E. D. (2014). Let's dance! Elastic coordination in creative group work: a qualitative study of modern dancers. *Academy of Management Journal*, 57(5), 1256-1283.
- Hartshorne, C., Weiss, P., & Burks, A. W. (1931). *Collected Papers of Charles Sanders Peirce*. Cambridge, MA: Harvard University Press

- Häusler, U. (2015). Chamber music and group analysis, a comparison. *Group Analysis*, 48(2), 42-47.
- Havrøy, F. (2015). *Alone together. Vocal ensemble practice seen through the lens of Neue Vocalsolisten Stuttgart*. Unpublished PhD, Norges musikkhøgskole, Oslo, Norway.
- Herndon, B., & Lewis, K. (2015). Applying sequence methods to the study of team temporal dynamics. *Organizational Psychology Review*, 5(4), 318-332.
- Hernes, T., Hendrup, E., & Schäffner, B. (2015). Sensing the momentum: A process view of change in a multinational corporation. *Journal of Change Management*, 15(2), 117-141.
- Héroux, I. (2016). Understanding the creative process in the shaping of an interpretation by expert musicians: Two case studies. *Musicae Scientiae*, 20(3), 304-324.
- Himberg, T., Laroche, J., Bige, R., Buchkowski, M., & Bachrach, A. (2018). Coordinated interpersonal behaviour in collective dance improvisation: the aesthetics of kinaesthetic togetherness. *Behavioral Sciences*, 8(1-26).
- Humphreys, M., Ucbasaran, D., & Lockett, A. (2012). Sensemaking and sensegiving stories of jazz leadership. *Human Relations*, 65(1), 41-62.
- Hyer, B. (2001). Homophony (Publication no. 10.1093/gmo/9781561592630.article.13291). Retrieved 2019-06-14, from Oxford University Press: <https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000013291>
- Jarzabkowski, P. A., Le, J. K., & Feldman, M. S. (2012). Toward a theory of coordinating: Creating coordinating mechanisms in practice. *Organization Science*, 23(4), 907-927.
- Joseph, D. (2014). Interpretative phenomenological analysis. In *Research Methodologies in Music Education* (pp. 145-166). Newcastle upon Tyne, UK: Cambridge Scholars Publishing.
- Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter. *Small Group Research*, 43(2), 130-158.
- Keller, P. E. (2008). Joint action in music performance. In F. Morganti, A. Carassa & G. Riva (Eds.), *Enacting Intersubjectivity: a Cognitive and Social Perspective on the Study of Interactions* (Vol. 10, pp. 205-221).
- Keller, P. E. (2014). Ensemble performance: interpersonal alignment of musical expression. In D. Fabian, R. Timmers & E. Schubert (Eds.), *Expressiveness in Ensemble Performance* (pp. 260-282). Oxford, UK: Oxford University Press.
- Keller, P. E., & Appel, M. (2010). Individual differences, auditory imagery, and the coordination of body movements and sounds in musical ensembles. *Music Perception*, 28(1), 27-46.
- Kelly, J. R., & McGrath, J. E. (1985). Effects of time limits and task types on task performance and interaction of four-person groups. *Journal of Personality and Social Psychology*, 49(2), 395.

- Kelso, J. A. S. (1990). Phase transitions: Foundations of behavior. In H. Haken & M. Stadler (Eds.), *Synergetics of Cognition* (Vol. 45, pp. 249-268). Berlin, Heidelberg: Springer.
- King, E. (2004). *Collaboration and the study of ensemble rehearsal*. Paper presented at the Eighth International Conference on Music Perception and Cognition (ICMPC8), Northwestern University, Illinois, USA.
- King, E. (2006). The roles of student musicians in quartet rehearsals. *Psychology of Music*, 34(2), 262-282.
- King, E. (2016). Social familiarity: Styles of interaction in chamber ensemble rehearsal. In H. Prior & E. King (Eds.), *Music and Familiarity: Listening, Musicology and Performance* (pp. 253-270). Oxford, UK: Routledge.
- King, E., & Ginsborg, J. (2011). Gestures and glances: interactions in ensemble rehearsal. In A. Gritten & E. King (Eds.), *New Perspectives on Music and Gesture* (pp. 177-201). Farnham, UK: Ashgate.
- King, E., & Gritten, A. (2017). Communication and interaction in ensemble performance. In J. Rink (Ed.), *Musicians in the Making: Pathways to Creative Performance* (pp. 306-321). New York, USA: Oxford University Press.
- Klorman, E. (2016). *Mozart's music of friends: Social interplay in the chamber works*. Cambridge, UK: Cambridge University Press.
- Kneebone, R. L. (2009). Practice, rehearsal, and performance: An approach for simulation-based surgical and procedure training. *Journal of the American Medical Association*, 302(12), 1336-1338.
- Kokotsaki, D. (2007). Understanding the ensemble pianist: A theoretical framework. *Psychology of Music*, 35(4), 641-668.
- Kozlowski, S. W., & Bell, B. S. (2008). Team learning, development, and adaptation. In V. I. Sessa & M. London (Eds.), *Group Learning* (pp. 15-44). Mahwah, NJ: Lawrence Erlbaum Associates.
- Kozlowski, S. W., & Chao, G. T. (2012). The dynamics of emergence: Cognition and cohesion in work teams. *Managerial and Decision Economics*, 33(5-6), 335-354.
- Kozlowski, S. W., Gully, S. M., Nason, E. R., & Smith, E. M. (1999). Developing adaptive teams: A theory of compilation and performance across levels and time. In D. R. Ilgen & E. D. Pulakos (Eds.), *The Changing Nature of Work Performance: Implications for Staffing, Personnel Actions, and Development* (pp. 240-292). San Francisco: Jossey-Bass.
- Kozlowski, S. W., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest*, 7(3), 77-124.
- Kozlowski, S. W., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions, and New Directions* (pp. 3-90). San Francisco: Jossey-Bass.
- Lamberg, J.-A., & Parvinen, P. (2003). The river metaphor for strategic management. *European Management Journal*, 21(5), 549-557.

- Lamont, A. (2011). University students' strong experiences of music: Pleasure, engagement, and meaning. *Musicae Scientiae*, 15(2), 229-249.
- Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review*, 24(4), 691-710.
- Langley, A., Smallman, C., Tsoukas, H., & Van de Ven, A. H. (2013). Process studies of change in organization and management: Unveiling temporality, activity, and flow. *Academy of Management Journal*, 56(1), 1-13.
- Lehmann, A. C., Sloboda, J. A., & Woody, R. H. (2007). *Psychology for musicians: Understanding and acquiring the skills*. New York, NY: Oxford University Press.
- Lehmann-Willenbrock, N., Chiu, M. M., Lei, Z., & Kauffeld, S. (2017). Understanding positivity within dynamic team interactions: A statistical discourse analysis. *Group & Organization Management*, 42(1), 39-78.
- Lei, Z., Waller, M. J., Hagen, J., & Kaplan, S. (2016). Team adaptiveness in dynamic contexts: Contextualizing the roles of interaction patterns and in-process planning. *Group and Organization Management*, 41(4), 491-525.
- Lewin, R. (1993). *Complexity - life at the edge of chaos* London: J M Dent.
- Lewis, K. (2003). Measuring transactive memory systems in the field: Scale development and validation. *Journal of Applied Psychology*, 88(4), 587 - 596.
- Lewis, K., & Herndon, B. (2011). Transactive memory systems: Current issues and future research directions. *Organization Science*, 22(5), 1254-1265.
- Li, J., & Roe, R. A. (2012). Introducing an intrateam longitudinal approach to the study of team process dynamics. *European Journal of Work Organizational Psychology*, 21(5), 718-748.
- Liang, D., Moreland, R., & Argote, L. (1995). Group versus individual training and group performance: the mediating role of transactive memory. *Personality and Social Psychology Bulletin*, 21(4), 384-393.
- Lim, M. C. (2013). In pursuit of harmony: The social and organisational factors in a professional vocal ensemble. *Psychology of Music*, 42, 307-324.
- Lindh, I., & Thorgren, S. (2016). Critical event recognition: An extended view of reflective learning. *Management Learning*, 47(5), 525-542.
- Locke, K., Golden-Biddle, K., & Feldman, M. S. (2008). Perspective—Making doubt generative: Rethinking the role of doubt in the research process. *Organization Science*, 19(6), 907-918.
- Long, Y., & Siau, K. (2007). Social network structures in open source software development teams. *Journal of Database Management (JDM)*, 18(2), 25-40.
- Mackin, J. H. (1948). Concept of the graded river. *Geological Society of America Bulletin*, 59(5), 463-512.
- Macritchie, J., Herff, S. A., Procopio, A., & Keller, P. E. (2018). Negotiating between individual and joint goals in ensemble musical performance. *Quarterly Journal of Experimental Psychology*, 71(7), 1535-1551.

- Magnusson, M. S. (2000). Discovering hidden time patterns in behavior: T-patterns and their detection. *Behavior Research Methods, Instruments, & Computers*, 32(1), 93-110.
- Magnusson, M. S. (2017). Why search for hidden repeated temporal behavior patterns: T-pattern analysis with theme. *International Journal of Clinical Pharmacology & Pharmacotherapy*, 1(128), 1-7.
- Magnusson, M. S. (2018). Temporal patterns in interactions. In E. Brauner, M. Boos & M. Kolbe (Eds.), *The Cambridge Handbook of Group Interaction Analysis* (pp. 323-353). Cambridge, UK: Cambridge University Press.
- Malone, T. W., & Crowston, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys (CSUR)*, 26(1), 87-119.
- Marchetti, E., & Jensen, K. (2010). A meta-study of musicians' non-verbal interaction. *International Journal of Technology, Knowledge & Society*, 6(5), 1-11.
- Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, 26(3), 356-376.
- Marotto, M., Roos, J., & Victor, B. (2007). Collective virtuosity in organizations: a study of peak performance in an orchestra. *Journal of Management Studies*, 44(3), 388-413.
- Mathieu, J. E., Tannenbaum, S., Donsbach, J., & Alliger, G. (2014). A review and integration of team composition models: Moving toward a dynamic and temporal framework. *Journal of Management*, 40(1), 130-160.
- Maynard, M. T., Kennedy, D. M., & Sommer, S. A. (2015). Team adaptation: A fifteen-year synthesis (1998–2013) and framework for how this literature needs to “adapt” going forward. *European Journal of Work and Organizational Psychology*, 24(5), 652-677.
- McCabe, M. M. (2015). *Platonic conversations*. New York: Oxford University Press.
- McCaleb, J. M. (2014). *Embodied knowledge in ensemble performance*. London: Routledge.
- McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14): Prentice-Hall Englewood Cliffs, NJ.
- McGrath, J. E. (1990). Time matters in groups. In J. Galegher, R. E. Kraut & C. Egido (Eds.), *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work* (pp. 23-61). Hillsdale, NJ: Lawrence Erlbaum, Inc.
- McGrath, J. E. (1991). Time, interaction, and performance (TIP): A theory of groups. *Small Group Research*, 22(2), 147-174.
- Merritt, M. (2015). Thinking-is-moving: dance, agency, and a radically enactive mind. *Phenomenology and the Cognitive Sciences*, 14(1), 95-110.
- Miklaszewski, K. (1989). A case study of a pianist preparing a musical performance. *Psychology of Music*, 17(2), 95-109.
- Miklaszewski, K. (1995). Individual differences in preparing a musical composition for public performance. In M. Manturzewska, K. Miklaszewski & A.



- Bialkowski (Eds.), *Psychology of Music Today* (pp. 138-147). Warsaw: Fryderyk Chopin Academy of Music.
- Miksza, P. (2007). Effective practice: An investigation of observed practice behaviors, self-reported practice habits, and the performance achievement of high school wind players. *Journal of Research in Music Education*, 55(4), 359-375.
- Miksza, P., Prichard, S., & Sorbo, D. (2012). An observational study of intermediate band students' self-regulated practice behaviors. *Journal of Research in Music Education*, 60(3), 254-266.
- Moran, N. (2013). Music, bodies and relationships: An ethnographic contribution to embodied cognition studies. *Psychology of Music*, 41(1), 5-17.
- Moran, N. (2014). Social implications arise in embodied music cognition research which can counter musicological "individualism". *Frontiers in Psychology*, 5, 1-10.
- Morgan, G. (1980). Paradigms, metaphors, and puzzle solving in organization theory. *Administrative Science Quarterly*, 25, 605-622.
- Morgeson, F. P., Mitchell, T. R., & Dong, L. I. U. (2015). Event system theory: An event-oriented approach to the organizational sciences. *Academy of Management Review*, 40(4), 515-537.
- Muethel, M., & Hoegl, M. (2013). Shared leadership effectiveness in independent professional teams. *European Management Journal*, 31(4), 423-432.
- Müller, V., Delius, J. A. M., & Lindenberger, U. (2018). Complex networks emerging during choir singing. *Annals of the New York Academy of Sciences*, 1431(1), 85-101.
- Murnighan, J. K., & Conlon, D. E. (1991). The dynamics of intense work groups: A study of British string quartets. *Administrative Science Quarterly*, 36, 165-186.
- Nielsen, S. (1999). Regulation of learning strategies during practice: A case study of a single church organ student preparing a particular work for a concert performance. *Psychology of Music*, 27(2), 218-229.
- Noice, H., Jeffrey, J., Noice, T., & Chaffin, R. (2008). Memorization by a jazz musician: A case study. *Psychology of Music*, 36(1), 63-79.
- O'Neill, S. A., & Peluso, D. C. (2014). Using dialogue and digital media composing to enhance and develop artistic creativity, creative collaborations and multimodal practices. In P. Burnard (Ed.), *Developing creativities in higher music education: International perspectives and practices* (pp. 115-126). London: Routledge.
- Okhuysen, G. A., & Bechky, B. A. (2009). Coordination in organizations: An integrative perspective. *Academy of Management Annals*, 3, 463-502.
- Okhuysen, G. A., & Waller, M. J. (2002). Focusing on midpoint transitions: An analysis of boundary conditions. *Academy of Management Journal*, 45(5), 1056-1065.
- Orasanu, J., Salas, E., Klein, G., Orasanu, J., Calderwood, R., & Zsombok, C. E. (1993). *Decision making in action: Models and methods*. Westport, CT: Ablex Publishing.

- Oswick, C., Fleming, P., & Hanlon, G. (2011). From borrowing to blending: Rethinking the processes of organizational theory building. *Academy of Management Review*, 36(2), 318-337.
- Page-Shipp, R., Joseph, D., & van Niekerk, C. (2018). Conductorless singing group: A particular kind of self-managed team? *Team Performance Management: An International Journal*, 24(5/6), 331-346.
- Palmer, C. (1997). Music performance. *Annual Review of Psychology*, 48(1), 115-138.
- Palmer, C. (2013). *Music performance: Movement and coordination*. Amsterdam: Elsevier.
- Paparo, S. A. (2013). The Accafellows: Exploring the music making and culture of a collegiate a cappella ensemble. *Music Education Research*, 15(1), 19-38.
- Pearce, C. L., & Conger, J. A. (2002). *Shared leadership: Reframing the hows and whys of leadership*. Thousand Oaks, CA: Sage.
- Pearsall, M. J., Ellis, A. P. J., & Bell, B. S. (2010). Building the infrastructure: The effects of role identification behaviors on team cognition development and performance. *Journal of Applied Psychology*, 95(1), 192-200.
- Pennill, N., & Timmers, R. (2017). *Rehearsal processes and stage of performance preparation in chamber ensembles*. Paper presented at the 25th Anniversary Edition of the European Society for the Cognitive Sciences of Music (ESCOM).
- Peters, L. D., & Pressey, A. D. (2016). The co-ordinative practices of temporary organisations. *Journal of Business & Industrial Marketing*, 31(2), 301-311.
- Poole, M. S., Hollingshead, A. B., McGrath, J. E., Moreland, R. L., & Rohrbaugh, J. (2004). Interdisciplinary perspectives on small groups. *Small Group Research*, 35(1), 3-16.
- Potter, J. (1998). *Vocal authority: Singing style and ideology*. Cambridge: Cambridge University Press.
- Poulson, C. F., & Abraham, S. C. (1996). The Portland String Quartet. *Journal of Management Inquiry*, 5, 197-206.
- Rackham, N., Honey, P., & Colbert, M. J. (1971). *Developing interactive skills*. Clearwater, FL: Wellens Publishing.
- Rackham, N., & Morgan, T. (1977). *Behaviour analysis in training*. New York: McGraw-Hill
- Ragert, M., Schroeder, T., & Keller, P. E. (2013). Knowing too little or too much: the effects of familiarity with a co-performer's part on interpersonal coordination in musical ensembles. *Frontiers in Psychology*, 4, 368.
- Ramos-Villagrasa, P. J., Marques-Quinteiro, P., Navarro, J., & Rico, R. (2018). Teams as complex adaptive systems: Reviewing 17 years of research. *Small Group Research*, 49(2), 135-176.
- Ramos-Villagrasa, P. J., Navarro, J., & García-Izquierdo, A. L. (2012). Chaotic dynamics and team effectiveness: Evidence from professional basketball. *European Journal of Work and Organizational Psychology*, 21(5), 778-802.

- Rasch, R. A. (1988). Timing and synchronization in ensemble performance. In J. A. Sloboda (Ed.), *Generative Processes in Music*. Oxford, UK: Oxford University Press.
- Rasker, P. C., Post, W. M., & Schraagen, J. M. C. (2000). Effects of two types of intra-team feedback on developing a shared mental model in command and control teams. *Ergonomics*, *43*(8), 1167-1189.
- Reagans, R., Argote, L., & Brooks, D. (2005). Individual experience and experience working together: Predicting learning rates from knowing who knows what and knowing how to work together. *Management Science*, *51*(6), 869-881.
- Reichertz, J. (2007). Abduction: The logic of discovery of grounded theory. In *The Sage Handbook of Grounded Theory* (pp. 214-228). Thousand Oaks, CA: Sage.
- Rescher, N. (1996). *Process metaphysics: An introduction to process philosophy*. New York: SUNY Press.
- Richardson, D. C., Dale, R., & Kirkham, N. Z. (2007). The art of conversation is coordination - common ground and the coupling of eye movements during dialogue. *Psychological Science*, *18*(5), 407-413.
- Rico, R., Gibson, C., Sánchez-Manzanares, M., & Clark, M. (2014). *On the interplay of implicit and explicit team coordination: Understanding team adaptation*. Paper presented at the EAWOP Small Group Meeting Conference on Dynamics of Team Cognition and Team Adaptation, Lisbon, Portugal.
- Rico, R., Sanchez-Manzanares, M., Gil, F., & Gibson, C. (2008). Team implicit coordination processes: A team knowledge-based approach. *Academy of Management Review*, *33*(1), 163-184.
- Robson, C. (2011). *Real world research: A resource for users of social research methods in applied settings*. New York: Wiley.
- Roe, R. A. (2008). Time in applied psychology: The study of “what happens” rather than “what is”. *European Psychologist*, *13*(1), 37-52.
- Rossiter, K., Gray, J., Kontos, P., Keightley, M., Colantonio, A., & Gilbert, J. (2008). From page to stage: Dramaturgy and the art of interdisciplinary translation. *Journal of Health Psychology*, *13*(2), 277-286.
- Rounds, D. (1999). *The four and the one: In praise of string quartets*. Fort Bragg, CA: Lost Coast Press.
- Sabherwal, R., Hirschheim, R., & Goles, T. (2001). The dynamics of alignment: Insights from a punctuated equilibrium model. *Organization Science*, *12*(2), 179-197.
- Sabherwal, R., & Robey, D. (1995). Reconciling variance and process strategies for studying information system development. *Information Systems Research*, *6*(4), 303-327.
- Sameroff, A. (2009). *The transactional model of development: How children and contexts shape each other*. Washington DC: American Psychological Association.
- Sawyer, R. K. (2006). Group creativity: musical performance and collaboration. *Psychology of Music*, *34*(2), 148-165.

- Sawyer, R. K. (2012). Extending sociocultural theory to group creativity. *Studies in Vocational and Professional Education*, 5(1), 59-75.
- Sawyer, R. K., & Dezutter, S. (2009). Distributed creativity: How collective creations emerge from collaboration. *Psychology of Aesthetics, Creativity, and the Arts*, 3(2), 81-92.
- Schechner, R. (2017). *Performance studies: An introduction*. New York: Routledge.
- Schiavio, A., & Hoffding, S. (2015). Playing together without communicating? A pre-reflective and enactive account of joint musical performance. *Musicae Scientiae*, 19(4), 366-388.
- Schütz, A. (1951). Making music together: A study in social relationship. *Social Research*, 76-97.
- Seddon, F. (2005). Modes of communication during jazz improvisation. *British Journal of Music Education*, 22(1), 47-61.
- Seddon, F., & Biasutti, M. (2009). Modes of communication between members of a string quartet. *Small Group Research*, 40(2), 115-137.
- Seddon, F., & Biasutti, M. (2009a). A comparison of modes of communication between members of a string quartet and a jazz sextet. *Psychology of Music*, 37(4), 395-415.
- Seers, A., Keller, T., & Wilkerson, J. M. (2003). Can team members share leadership? In C. L. Pearce & J. A. Conger (Eds.), *Shared leadership: Reframing the hows and whys of leadership* (pp. 77-102). Thousand Oaks, California: Sage.
- Seers, A., & Woodruff, S. (1997). Temporal pacing in task forces: Group development or deadline pressure? *Journal of Management*, 23(2), 169-187.
- Selbourne, D., & Shakespeare, W. (1982). *The making of a Midsummer Night's Dream: An eye-witness account of Peter Brook's production from first rehearsal to first night*. London: Methuen Publishing.
- Sennett, R. (2012). *Together: The rituals, pleasures and politics of co-operation*. London: Allen Lane.
- Sicca, L. M. (2000). Chamber music and organization theory: some typical organizational phenomena seen under the microscope. *Studies in Cultures, Organizations and Societies*, 6(2), 145-168.
- Stachowski, A. A., Kaplan, S. A., & Waller, M. J. (2009). The benefits of flexible team interaction during crises. *Journal of Applied Psychology*, 94(6), 1536.
- Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research techniques*. Thousand Oaks, CA: Sage.
- Strawinsky, T. (1973). *Catherine & Igor Stravinsky*. London: Boosey & Hawkes Inc.
- Sundarasaradula, D., Hasan, H., Walker, D. S., & Tobias, A. M. (2005). Self-organization, evolutionary and revolutionary change in organizations. *Strategic Change*, 14(7), 367-380.
- Tal-Shmotkin, M., & Gilboa, A. (2013). Do behaviors of string quartet ensembles represent self-managed teams? *Team Performance Management*, 19(1/2), 57-71.

- Tashakkori, A., & Creswell, J. W. (2007). Exploring the nature of research questions in mixed methods research. *Journal of Mixed Methods Research, 1*, 207-211.
- Tashakkori, A., & Teddlie, C. (2016). *Sage handbook of mixed methods in social and behavioral research* (Second ed.). Thousand Oaks, California: Sage.
- Taylor, C., & Dewsbury, B. M. (2018). On the problem and promise of metaphor use in science and science communication. *Journal of Microbiology & Biology Education, 19*(1).
- Timmers, R., Endo, S., Bradbury, A., & Wing, A. M. (2014). Synchronization and leadership in string quartet performance: a case study of auditory and visual cues. *Frontiers in Psychology, 5*(645), 1-9.
- Tomes, S. (2004). *Beyond the notes: Journeys with chamber music*. Suffolk, UK: Boydell & Brewer.
- Tovstiga, G., Odenthal, S., & Goerner, S. (2005). Sense making and learning in complex organisations: the string quartet revisited. *International Journal of Management Concepts And Philosophy, 1*(3), 215-231.
- Tsoukas, H. (1991). The missing link: A transformational view of metaphors in organizational science. *Academy of Management Review, 16*(3), 566-585.
- Tsoukas, H., & Chia, R. (2002). On organizational becoming: Rethinking organizational change. *Organization Science, 13*(5), 567-582.
- Tubbs, S. L. (2012). *A systems approach to small group interaction* (11th ed.). New York: McGraw Hill.
- Tuckman, B. (1965). Developmental sequence in small groups. *Psychological Bulletin, 63*(6), 384.
- Tuckman, B., & Jensen, M. A. C. (1977). Stages of small-group development revisited. *Group Organization Studies, 2*(4), 419-427.
- Tushman, M. L., & Romanelli, E. (1985). Organizational evolution: A metamorphosis model of convergence and reorientation. In L. L. Cummings & B. L. Shaw (Eds.), *Research in Organizational Behavior* (Vol. 7, pp. 171-122). Greenwich, CT: JAI Press.
- Uitdewilligen, S., Rico, R., & Waller, M. J. (2018). Fluid and stable: Dynamics of team action patterns and adaptive outcomes. *Journal of Organizational Behavior, 39*(9), 1113-1128.
- Van de Ven, A. H., & Poole, M. S. (1990). Methods for studying innovation development in the Minnesota Innovation Research Program. *Organization Science, 1*(3), 313-335.
- Van de Ven, A. H., & Poole, M. S. (2005). Alternative approaches for studying organizational change. *Organization Studies, 26*(9), 1377-1404.
- van Oortmerssen, L. A., van Woerkum, C. M., & Aarts, N. (2015). When interaction flows: An exploration of collective creative processes on a collaborative governance board. *Group Organization Management, 40*(4), 500-528.
- Vantilborgh, T., Hofmans, J., & Judge, T. A. (2018). The time has come to study dynamics at work. *Journal of Organizational Behavior, 39*(9), 1045-1049.

- Volpe, G., D'Ausilio, A., Badino, L., Camurri, A., & Fadiga, L. (2016). Measuring social interaction in music ensembles. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 371(1693).
- Waddington, C. E. (2013). *Co-performer empathy and peak performance in expert ensemble playing*. Paper presented at the International Symposium on Performance Science, Vienna, Austria.
- Wang, D., Waldman, D. A., & Zhang, Z. (2014). A meta-analysis of shared leadership and team effectiveness. *Journal of Applied Psychology*, 99(2), 181-198.
- Weingart, L. R. (1992). Impact of group goals, task component complexity, effort, and planning on group performance. *Journal of Applied Psychology*, 77(5), 682-693.
- Weingart, L. R., Todorova, G., & Cronin, M. A. (2010). Task conflict, problem-solving, and yielding: Effects on cognition and performance in functionally diverse innovation teams. *Negotiation and Conflict Management Research*, 3(4), 312-337.
- Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, 7(2), 225-246.
- Westelius, A. (2001). On classical music and business - listening, leading, learning. *Reflections*, 2(4), 47-57.
- White, L., Currie, G., & Lockett, A. (2016). Pluralized leadership in complex organizations: Exploring the cross network effects between formal and informal leadership relations. *The Leadership Quarterly*, 27(2), 280-297.
- Williamon, A., & Davidson, J. (2000). Coordinating duo piano performance. In C. Woods, G. Luck, R. Brochard, F. Seddon & J. A. Sloboda (Eds.), *Sixth International Conference on Music Perception and Cognition*. Keele, UK: University of Keele.
- Williamon, A., & Davidson, J. (2002). Exploring co-performer communication. *Musicae Scientiae*, 6(1), 53-72.
- Williamon, A., & Valentine, E. (2002). The role of retrieval structures in memorizing music. *Cognitive Psychology*, 44(1), 1-32.
- Wilson, G. B., & Macdonald, R. A. R. (2017). The construction of meaning within free improvising groups: A qualitative psychological investigation. *Psychology of Aesthetics, Creativity, and the Arts*, 11(2), 136-146.
- Wiltshire, T. J., Butner, J. E., & Fiore, S. M. (2018). Problem-solving phase transitions during team collaboration. *Cognitive Science*, 42(1), 129-167.
- Wing, A. M., Endo, S., Bradbury, A., & Vorberg, D. (2014). Optimal feedback correction in string quartet synchronization. *Journal of The Royal Society Interface*, 11(93), 20131125.
- Wise, K., James, M., & Rink, J. (2017). Performers in the practice room. In J. Rink, H. Gaunt & A. Williamon (Eds.), *Musicians in the Making: Pathways to Creative Performance* (pp. 143-163). Oxford, UK: Oxford University Press.
- Wohl, E. E. (2010). *Mountain rivers revisited* Washington, DC: American Geophysical Union.

- Wöllner, C., & Keller, P. E. (2017). Music with others: Ensembles, conductors, and interpersonal coordination. In R. Ashley & R. Timmers (Eds.), *Routledge Companion to Music Cognition* (pp. 313-324). New York: Routledge.
- Yin, R. K. (1994). Discovering the future of the case study. Method in evaluation research. *Evaluation Practice*, 15(3), 283-290.
- Young, H. D., Freedman, R. A., Sandin, T., & Ford, A. L. (2012). *Sears and Zemansky's university physics with modern physics* (13th ed.). Reading, MA: Addison-Wesley.
- Young, V. M., & Colman, A. M. (1979). Some psychological processes in string quartets. *Psychology of Music*, 7(1), 12-18.
- Zellmer-Bruhn, M., Waller, M. J., & Ancona, D. (2003). The effect of temporal entrainment on the ability of teams to change their routines. *Research on Managing Groups and Teams*, 6, 135-158.
- Zijlstra, F. R., Waller, M. J., & Phillips, S. I. (2012). Setting the tone: Early interaction patterns in swift-starting teams as a predictor of effectiveness. *European Journal of Work and Organizational Psychology*, 21(5), 749-777.





# 11 Appendices

## 11.1 Appendix A *Settings for Theme software - effect of varying confidence interval and minimum occurrences*

Table 11.1 Confidence interval  $1 p < .005$ , minimum occurrences of patterns = 3

Week	Event types in patterns	Number of different patterns	Length mean	Length S.D.	Levels mean	Actor switches mean	Actor switches S.D.
1	25	28	2.82	0.86	1.75	1.25	0.84
3	24	53	3.21	1.26	2.02	0.77	0.72
5	23	668	5.91	2.39	3.43	1.05	1.15
7	24	36	2.50	0.88	1.42	0.53	0.74

Table 11.2 Confidence interval  $p < .05$ , minimum occurrences of patterns = 3

Week	Event types in patterns	Number of different patterns	Length mean	Length S.D.	Levels mean	Actor switches mean	Actor switches S.D.
1	25	511	5.39	1.94	3.25	1.78	1.12
3	24	3157	9.14	3.31	4.88	1.50	1.34
5	23	12019	8.81	3.42	4.68	1.05	1.19
7	24	675	7.06	2.65	4.03	0.53	1.56

Table 11.3 Confidence interval  $p < .001$ , minimum occurrences of patterns = 3

Week	Event types in patterns	Number of different patterns	Length mean	Length S.D.	Levels mean	Actor switches mean	Actor switches S.D.
1	12	10	2.40	0.70	1.3	1.1	.88
3	12	9	2.22	0.44	1.22	0.44	.53
5	15	97	4.38	1.69	2.45	1.05	1.23
7	12	16	5.90	0.45	1.25	0.38	0.5

Table 11.4 Confidence interval  $p < .005$ , minimum occurrences of patterns = 2

Week	Event types in patterns	Number of different patterns	Length mean	Length S.D.	Levels mean	Actor switches mean	Actor switches S.D.
1	21	309	7.45	3.40	4.16	3.77	1.92
3	22	512	8.77	4.19	4.82	3.11	1.77
5	21	7659	13.95	6.17	6.01	3.03	1.93
7	23	257	6.98	3.43	3.88	2.41	1.67

Table 11.5 Confidence interval  $p < .005$ , minimum occurrences of patterns = 4

Week	Event types in patterns	Number of different patterns	Length mean	Length S.D.	Levels mean	Actor switches mean	Actor switches S.D.
1	11	9	2.11	3.40	1.11	0.78	0.44
3	10	22	2.59	4.19	1.50	0.32	0.48
5	14	194	4.11	6.17	2.51	0.48	0.68
7	10	18	2.22	3.43	1.22	0.17	0.38

## 11.2 Appendix B *Survey of chamber ensembles, Chapter 4*



### About this survey

Do you play or sing in a chamber ensemble?

This research aims to explore rehearsal experiences of members of chamber ensembles, to find out more about the ways that musical groups work. So, if you are an adult singer or instrumentalist and play or sing classical music in a group of two to ten members, then we'd love to hear your experiences! The project is part of a study being run by the University of Sheffield, in partnership with the Universities of York and Leeds, on music ensemble communication.

Questions are mostly multiple or single choice, and there are opportunities for you to share more details if you wish. There are no right or wrong answers to any of the questions; we are interested in your views and experiences. The survey should take approximately 15-20 minutes to complete. All results will be confidential and data will be used and/or published anonymously. There are questions on your musical background, your experiences as a member of an ensemble, and what happens in your rehearsals. Your participation in this research is voluntary, and you may withdraw at any time if you wish. By submitting a completed questionnaire, however, you are giving your informed consent to participate in the study. You do not have to answer any question that you do not wish to answer. If you have any queries or concerns about the research, you can contact Nicola Pennill ([npennill1@sheffield.ac.uk](mailto:npennill1@sheffield.ac.uk))

Thank you for taking part in our research.

Next

---

0% completed

Nicola Pennill, University of Sheffield – 2016

First, a few questions about you and your musical background:

**1. Gender**

Select one

[Please choose] ▾

**2. Age**

Please give your age in years

Prefer not to answer

**3. What is the instrument (or voice) you are most accomplished at?**

The instrument I play best (including voice) is

**4. How many years have you engaged in regular practice of your instrument or voice?**

I engage(d) in regular practice (2 or more hours/week) of a musical instrument/voice for:

- 0       1 year       2 years       3 years       4-5 years       6-9 years       10 or more years

**5. At the peak of your interest, how many hours per day did you regularly practice?**

- Less than 0.5 hrs       0.5-1 hrs       1-2 hrs       2-3 hrs       3-4 hrs       4-5 hrs       5+ hrs

**6. How many years of formal training have you had on a musical instrument (including voice) during your lifetime?**

This may include private music lessons or study at a higher educational establishment

- 0       0.5 years       1 year       2 years       3-5 years       6-9 years       10 or more years

**7. How many years of playing or singing in music ensembles have you had during your lifetime?**

- 0       0.5 years       1 year       2 years       3-5 years       6-9 years       10 or more years

[Back](#)

[Next](#)

These questions relate to your chamber music experiences, and the main group with which you are currently most active:

**8. What type of group do you play or sing with? (If more than one, choose the most recent or regular, use the same example throughout the remainder of the questionnaire.)**

Choose from list or select 'other' to enter description

[Please choose] ▾

**Comments or description, if needed**

**9. What instrumental or vocal part do you play or sing in this group?**

**10. Are you currently a member of any other chamber ensembles?**

[Please choose] ▾

**11. In the main group you play with, how many members are there?**

Total number

Current number of females

Current number of males

**12. How long has the group been in existence?**

[Please choose] ▾

**13. Where are you based?**

Choose country

[Please choose] ▾

**14. Would you describe the nature of your group as:**

Tick all that apply

- Professional – performances by the group are paid
- Semi-professional – sometimes the group is paid but this is not a regular source of income
- Amateur – generally more for pleasure than profit
- Student – the majority of members are part of an educational institution
- Other (please specify)

**15. Overall, how important are the following goals of rehearsals of this group?**

Tick one from each row to show goals from most important, moderately important to least important.

	Least important	Moderately important	Most important
Performance focus – preparing for future performances	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Repertoire focus – exploring new repertoire	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social focus – spending time with fellow musicians	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Comments**

**16. On average, how often does your group rehearse?**

Please keep the same group in mind throughout when answering

**17. How long are your rehearsals, usually?**

**18. How many rehearsals does your group typically spend on a new piece before it is ready for performance?**

- 1     
  2 or 3     
  4 or 5     
  6 or more     
  N/A

[Back](#)

[Next](#)

**19. Thinking about your recent rehearsals, which of the following statements best describes the order in which rehearsal activities happen?**

- We always do the same things in the same order, regardless of the musical materials
- We always do the same things but the order changes at each rehearsal
- What we do depends mainly on how close we are to a performance
- It varies a lot, there's no set pattern

Other

**20. In your most recent rehearsals, how did you decide the order or allocation of time in rehearsals?**

Choose the one that fits your group best

- It's decided in advance by one person
- It's decided in advance by several group members
- We do pretty much the same each time so we all know the way it will go
- We plan collectively at the start of each rehearsal
- No plan as such, we just start and see where it leads

Other (please specify)

**21. At what time of day do you rehearse?**

	Never	Occasionally	Often	Usually	Always
Morning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Afternoon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evening	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**22. Do you think time of day affects how successful your group's rehearsals are?**

Yes (in what way? please specify)

- Somewhat
- No
- Don't know

**23. If you warm up as a group, what do you do?**

We don't warm up together

[Back](#)

[Next](#)

Please focus now on your most recent rehearsal with this group...

**24. How long ago was your last rehearsal?**

[Please choose] ▾

**25. What happened in your last rehearsal?**

For each item, please indicate when they happened, and how important you consider each to be. (Even if they don't always happen!)

						How important is this?	
	Near start	In the middle	Near end	Outside rehearsal time	Not included	Not at all important	Extremely important
Warm ups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Exercises to check intonation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparing or revising scores or parts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Segmentation or breaking music into sections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Slow practice of passages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Isolation of single instruments or voices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Isolation of several instruments or voices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work on balance and clarity of voices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuning specific chords or progressions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working out technical demands	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working on expressive aspects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Establishing cues for performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work to improve synchronisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coaching or supporting weaker players	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work to improve blending of sounds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Listening to recordings of own group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Listening to recordings of others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Planning future repertoire or performances	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**What else did you do?**

If you included other rehearsal activities not listed here please tell us what they were.



**26. Which of these statements best describes the nature of this rehearsal ?**

Tick all that apply

- First rehearsal with this group
- Trying out new repertoire
- Working to refine known repertoire
- Early stage of preparation for a performance
- Final rehearsal before performance
- Not really focussed on preparing for anything in particular
- Other (please specify)

**27. Thinking of your last rehearsal, how happy were you with it overall?**

How happy were you with the rehearsal?



Any comments on why you answered this way?

[Back](#)

[Next](#)

A few questions now around your group's organisation and roles...

**28. Who takes the lead in your rehearsals?**

Choose the option that best describes your group

- One person – always the same (please specify their instrument/vocal part)
- One person – it varies who it is
- The same two people tend to lead
- Leadership is shared equally between us all
- Other

**29. Which of these best describes your group's way of organising and managing?**

- We have clearly defined roles or responsibilities (what are they?)
- No defined roles, but everything gets done
- No defined roles, and sometimes things don't get done
- Other (please specify)

**30. What are your personal roles or responsibilities in this group, if any?**

Choose all that apply

- None
- Leader
- Co-leader
- Concert organiser
- Music organiser
- Rehearsal organiser
- Other (please specify)

[Back](#)

[Next](#)

These questions are around your group's communication style...

**31. Thinking of your last rehearsal with this group, how much time was spent talking ?**

Use the scale to show approximate percentage

0% talking 100% talking



What % of the time was talking?

**32. Tell us more about your rehearsal talk**

How much did you talk about this?

How important is each type of rehearsal talk?

Not at all

A lot

Not at all important

Extremely important

Social matters not directly related to the music

Musical interpretation or expression

Matters relating to instrument or vocal technique

Ensemble coordination or presentation

Administration such as organising future concerts and rehearsals

**Others not mentioned, or further comments if needed**

**33. Which of the following forms of communication are used in this group's rehearsals and performances?**

	In both rehearsal and performance	Just in performance	Just in rehearsal	Not in rehearsal or performance
Eye contact	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Positive facial expressions (e.g. smiling)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Negative facial expressions (e.g. frowning)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using auditory cues for timing (e.g. listening to bass)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mutually agreed gestures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spoken cues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Head nods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instrument movements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rhythmic body sway	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Foot tapping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Other types not mentioned, or further comments if needed**

[Back](#)

[Next](#)

The final section explores how you work through differences in the group...

**34. In rehearsals, what topics or issues give rise to discussions, tension and/or differences of opinion?**

Check all that apply

- Musical interpretation
- Repertoire choices
- Concert programming
- Concert management or administration
- Members not feeling recognised or respected
- Time constraints or pressures
- Differences in technical approach
- Differences in ability
- Differences in commitment
- Differences in aspirations
- Personal differences
- Frustration at lack of progress
- Factors unrelated to the ensemble
- Other (please specify)

**35. How are differences generally resolved?**

	Never	All the time			
Through playing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Through discussion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We don't generally resolve them	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have a 'cooling off' period	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
By making a joke or through laughter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Changing topic or focus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Other (please specify)**

**36. How often, and how severe, is conflict in your group?**

Use the slider to show where your group tends to fall in relation to the following statements

Very little conflict in the group \_\_\_\_\_ A lot of conflict in the group

Very mild disagreements \_\_\_\_\_ Very severe disagreements

**37. What is your personal view on conflict in your group?**

Use the slider to indicate your views on this

I think everyone should get along \_\_\_\_\_ It's OK to disagree

**38. Generally, do you consider your fellow group members as friends?**

Yes, we all socialise well

Some more than others

We're just acquaintances, it's a working relationship only

Not really friends

Other

[Back](#)

[Next](#)

Nicola Pennill, University of Sheffield – 2016

80% completed



**39. Finally, is there anything else that you'd like to add about your own experiences of rehearsing chamber music with others?**

Any comments or additional thoughts on any aspect that you think is important?

**40. Email address for follow up?**

If you are willing to participate in any follow up study or would like to hear about the results of this study when they are available, please enter your email address below. Please note, it will not be used for any other purpose and will not be used as part of the data collected for the research study.

- I am interested in the results of this study – please send me details when available
- I am happy to be contacted to follow up for later studies about the topics explored in this survey

[Back](#)

[Next](#)

Nicola Pennill, University of Sheffield – 2016

90% completed



**Thank you for completing this questionnaire!**

We would like to thank you very much for helping us. Please contact Nicola Pennill by email at [npennill1@sheffield.ac.uk](mailto:npennill1@sheffield.ac.uk) for more information or if you have questions about this research.

Your answers were transmitted, you may close the browser window or tab now.

---

Nicola Pennill, University of Sheffield – 2016





### 11.3 Appendix C *Behaviour and pattern data, Chapter 5*

#### 11.3.1 *Behaviour types by singer*

Table 11.6 Frequencies of behaviour type by singer (shown as % of total of each behaviour)

	Singer	Week 1	Week 3	Week 5	Week 7
Clarifying	A	17.6	22.4	17.5	23.6
	B	38.5	29.5		9.4
	C	18.7	12.8	31.8	32.1
	D	7.7	12.8	24.3	9.4
	E	17.6	22.4	34.6	25.5
Initiating	A	33.3	17.1	17.4	14.6
	B	22.2	17.1		12.2
	C	18.5	12.2	26.1	34.1
	D	3.7	17.1	21.7	4.9
	E	22.2	36.6	21.7	34.1
Reacting	A	4.0	23.5	12.0	15.0
	B	44.0	23.5		10.0
	C	28.0	5.9	36.0	30.0
	D	8.0	23.5	14.0	15.0
	E	16.0	23.5	26.0	30.0
Participating	A	12.5	0.0	14.1	16.7
	B	50.0	28.6		33.3
	C	12.5	14.3	28.2	0.0
	D	0.0	28.6	18.8	0.0
	E	25.0	28.6	23.5	50.0

Table 11.7 Total frequency of verbal behaviour type and subtype by week (n occurrences and % total)

Behaviour type	Subtype	Frequency	Week 1	Week 3	Week 5	Week 7	Total (mean)
Clarifying (C)	CU	n	9	11	4	10	34
		%	9.70	7.10	3.20	9.40	(7.10)
	GP	n	11	23	14	13	62
		%	11.80	14.70	11.30	12.30	(12.70)
	GT	n	47	100	82	66	299
		%	50.50	64.10	66.10	62.30	(61.60)
	SP	n	0	1	5	1	7
		%	0.00	0.60%	4.00	0.90	(1.50)
	ST	n	26	21	19	16	82
		%	28.00	13.50	15.30	15.10	(16.90)
Total	n	93	156	124	106	484	
	%	52.00	60.00	49.60	54.10	100.00	
Initiating (I)	B	n	1	0	0	0	1
		%	3.60	0.00	0.00	0.00	0.70
	PI	n	16	37	34	37	124
		%	57.10	90.20	85.00	90.20	82.70
	PP	n	11	4	6	4	25
		%	39.30	9.80	15.00	9.80	16.70
Total	n	28	41	40	41	150	
	%	15.60	15.80	16.00	20.90	100.00	
Participating (P)	BI	n	0	0	3	0	3
		%	0.00	0.00	16.70	0.00	6.30
	LM	n	8	11	15	6	40
		%	100.00	68.80	83.30	100.00	83.30
	SO	n	0	5	0	0	5
		%	0.00	31.30	0.00	0.00	10.40
Total	n	8	16	18	6	48	
	%	4.50	6.20	7.20	3.10	100.00	
Reacting (R)	D	n	6	3	4	0	13
		%	24.00	17.60	9.10	0.00	12.3
	GT	n	1	0	0	0	1
		%	4.00	0.00	0.00	0.00	0.90
	SI	n	18	14	39	20	91
		%	72.00	82.40	88.60	100.00	85.80
	SP	n	0	0	1	0	1
		%	0.00	0.00	2.30	0.00	0.90
Total	n	25	17	44	20	106	
	%	14.00	6.50	17.60	10.20	100.00	
Other		n	20	30	24	23	97
(Music-making or unassigned)		%	11.20	11.50	9.60	11.80	100.00

### 11.3.2 Airtime by singer

Table 11.8 Airtime (% total time) by member of Group 1: by week, and mean (S.D.)

Singer	Week 1	Week 3	Week 5	Week 7	Mean	S.D.
A Soprano	16.2	19.6	18.0	18.4	18.1	1.41
B Mezzo	34.6	24.6	-	10.7	23.3	12.00
C Alto	17.9	11.9	29.6	28.6	22.0	8.57
D Tenor	7.3	14.6	19.2	9.7	12.7	5.29
E Bass	17.9	23.8	27.6	28.6	24.5	4.85

### 11.3.3 Event types by rehearsal

Table 11.9 Weekly summaries of event types

Event type	Week 1	Week 3	Week 5	Week 7
A,C	20	38	27	25
A,I	4	7	8	5
A,N	0	5	1	2
A,P	0	0	3	1
A,R	5	0	6	3
ALL,M	6	11	6	8
ALL,N	5	0	4	0
ALL,R	0	2	0	0
B,C	37	47	0	10
B,I	11	7	0	5
B,N	3	4	0	2
B,P	1	4	0	2
B,R	10	3	0	2
C,C	14	21	34	33
C,I	6	5	12	14
C,N	3	2	4	2
C,P	1	2	6	0
C,R	7	1	18	7
D,C	6	24	26	10
D,I	1	7	11	2
D,N	1	3	1	4
D,P	3	4	3	0
D,R	2	0	7	3
E,C	14	39	37	27
E,I	7	15	12	15
E,N	3	4	4	5
E,P	2	4	3	3
E,R	6	0	13	6

### 11.3.4 Verbal exchanges during patterns: Weeks 1, 3, 5 and 7

Table 11.10 Week 1 verbal exchanges during patterned behaviours

Pattern	Time (secs)	Speaker, code	Activity	Description
1	68	ALL,N	All look through scores	All look through score
	98	A,I	“We need to invest in music stands for this house”	Practical suggestion (about stands)
	109	C,R	“I have strong negative feelings about pitch pipes”	Opinion (negative)
	322	D,P	“Oh my gosh please say that again”	Joke/light-hearted comment
2	920	ALL,N	Laughter	All laughing
	943	A,I	“Well we could do *name* first?”	Practical suggestion (about order)
	956	C,R	“Ugh”	Opinion (negative)
	1297	D,P	“Ah s**t happens” [joking]	Joke/light-hearted comment
3	1627	ALL,N	Laughter and excited chatter	All laughing
	1663	A,I	“OK, here we go”	Practical suggestion (about getting started)
	1685	C,R	“We should have language ...”	Opinion (about what to do)
	1981	D,P	“Wow! Could that be any more French?”	Joke/light hearted comment

Table 11.11 Week 3 verbal exchanges during patterned behaviours

Pattern occurrence	Time (secs)	Speaker, code	Activity	Description
1	73	D,P	“It’s basically a big party”	Joke/risqué comment
	273	E,C	“It sounds kind of [indistinct]”	Opinion on how music sounds
	274	B,C	“Yes, it does”	Agreement with opinion
	278	D,C	“It’s really hard to get over the ‘sings extract’”	Opinion on expression
	282	E,I	“I think it needs to go quite a bit faster “	Opinion on tempo
	323	E,C	“Like ‘names other song’”	Comparison with other song
2	324	B,C	“I think it should be mainly 'ng', so it rings”	Opinion about pronunciation
	657	D,P	“Maybe it’s an orgy”	Joke/risqué comment
	892	E,C	“yes bar 50”	Opinion where to start
	893	B,C	“bar 50”	Agreement with opinion
	896	D,C	“I like the going quiet”	Opinion on expression
	898	E,I	“just little bits like ‘she laughed’”	Opinion on text
3	929	E,C	“ ‘should I let her refusal get dropped’?”	Question about pronunciation
	930	B,C	“yeah, ‘should I let it go’? ”	Opinion about pronunciation
	1547	D,P	“ha-ha 'slide into the pousse’”	Joke/risqué comment
	1806	E,C	“ <i>pousher</i> ”	Opinion on pronunciation
	1811	B,C	“that was good, that was fun”	Opinion on enjoyment
	1816	D,C	“that’s so bad, I can’t do fast French”	Opinion on tempo
	1824	E,I	<i>suggests piece</i>	Suggestion of piece
	1843	E,C	“Oh, it’s this one! This is crazy”	Opinion/surprise about choice of piece
1846	B,C	“Ah, I’ve just noticed something (in room)”	Off topic comment about room	

Table 11.12 Week 5 verbal exchanges during patterned behaviours

Pattern occurrence	Time (secs)	Speaker, code	Activity	Description	
1	183	D,P	“Yes, shall we just play the recording on loud!?” [joking]	Joke	
	293	C,C	“Yes, the <i>*names song</i> was really good”	Opinion about music	
	302	C,C	“That was probably in second place”		
	326	E,C	“What’s this [one]?”	Checking what to work on	
	333	C,C	<i>*names song</i>		
	346	ALL,M	All sing	Singing	
	721	A,C	“I think we timed that”	Opinion about music	
	762	A,C	“Up a tone, probably”	Pitch	
	782	C,R	“Yeah, that’s true”	Agreement	
	852	D,C	“K.V.!”	Checking a marking on the score	
	854	C,C	“K.V.?”		
	859	E,C	“Yeah it’s just what people say”	Explaining and discussing a marking on the score	
	860	C,C	“Ah, I’ve never come across that”		
	862	D,C	“I’ve come across it a few times”		
	865	D,C	“What’s V.S.?”	Checking a marking on the score	
	2	906	D,P	“Well weird, we could do things in English, but we do them in Latin instead”	Joke
		943	C,C	“We are up a tone”	Opinion about music
946		C,C	“I don’t think we did this up a tone”	Pitch	
947		E,C	“We didn’t ”	Agreement	
949		C,C	“Were you talking about the previous piece when you said up a tone?”	Checking which piece was being discussed	
969		ALL,M	All sing	Singing	
1239		A,C	“That last page! I’m holding a G forever”	Opinion about music	
1242		A,C	“Until everyone else comes off”		
1264		C,R	“Yes ... and let’s see if there any of those we like better”	Agreement	
1281		D,C	<i>drops music</i> “ah literally everything has fallen out”	Drops music	
1293		C,C	“keep it in order”		
1294		E,C	“mademoiselle?” <i>hands out music</i>	Giving out music	
1295		C,C	“I have mine, actually!”		
1298		D,C	“ah thanks mate”		
1301	D,C	“this is so infuriating”	Sorting out music		

---

3	1307	D,P	“I’m ‘infurious’ ha-ha”	Joke
	1341	C,C	“This looks fun”	Opinion about music
	1342	C,C	<i>*Gives pitch on piano</i>	Gives pitch
	1368	E,C	“Using the same ...”	Checking what to work on
	1371	C,C	“Such a good piece!”	Opinion
	1379	ALL,M	<i>All sing</i>	Singing
	1751	A,C	“That sounds so sh*t without the other part”	Opinion about music
	1758	A,C	“It’s very long”	
	1779	C,R	“ ‘It would be fine’! Let’s see if we can do better than fine”	Agreement and building
	1789	D,C	“Yeah, how is it range- wise?”	Checking vocal range
	1790	C,C	“It’s OK, it’s probably good for (Singer B)”	
	1801	E,C	“It does look like ...”	Explaining and discussing text on the score
	1809	C,C	“Yeah, there’s also something cut out”	
	1824	D,C	“Oh yeah, “****” isn’t a word, is it?”	Checking text
	1827	D,C	“Or “****”!”	

---

Table 11.13 Week 7 verbal exchanges during patterned behaviours

Pattern occurrence	Time (secs)	Speaker, code	Activity	Description
1	497	B,C	“Did we, is it “*pronounces text”?”	Checking pronunciation
	504	C,C	“Me grave “*pronounces text”	
	508	E,C	“Sospiro – ‘breathy and quiet”	Picking up on composer’s marking, for interpretation
	516	E,I	“Do you want to run into that? Might be worth overdoing ”	Making a suggestion of expression
	702	A,I	“Shall we see how it goes this time? We only did it once”	Suggestion
2	346	ALL,M	<i>All sing</i>	All sing
	1226	B,C	“Can I check, is it “*pronounces text”?”	Checking pronunciation
	1237	C,C	“Whereabouts?”	
	1370	E,C	“Ah, that was nice and ‘speranza’ was really nice”	Comment on interpretation
	1375	E,I	“I think this would be a good one to do with I Fag, there’s lots of interesting... ”	Making a suggestion for future coaching
3	1464	A,I	“Shall we do *names song?”	Suggestion
	1483	ALL,M	<i>All sing</i>	All sing
	1718	B,C	“Can I check, is it “*pronounces text”?”	Checking pronunciation
	1731	C,C	“reiterates pronunciation”. Fear is fierce, so it can be quite, you know...”	
	1851	E,C	*Explains which bit is <i>softening</i>	Picking up on composer’s marking, for interpretation
	1855	E,I	“100, and yeah, if you do your bit very quietly, we’ll do ours loudly”	Making a suggestion of expression
	1923	A,I	“Again?”	Suggestion
1936	ALL,M	<i>All sing</i>	All sing	



## 11.4 Appendix D *Pattern and questionnaire data, Chapter 6*

### 11.4.1 *Patterns from rehearsal of two pieces*

Table 11.14 Summary of pattern statistics from rehearsals of homophonic and polyphonic pieces

	Structure of piece	Mean Number	Mean Length	Mean Actors	Mean Switches	Mean Level
Rehearsal 1	H	4.75	2.17	2.00	1.00	1.17
	P	3.33	2.40	2.13	1.27	1.33
		4.04	2.29	2.07	1.14	1.25
Rehearsal 2	H	3.00	2.00	2.00	1.00	1.00
	P	3.20	2.20	2.00	1.00	1.20
		3.10	2.10	2.00	1.00	1.10
Rehearsal 3	H	4.45	2.36	2.05	1.05	1.36
	P	4.00	2.11	1.78	0.78	1.11
		4.23	2.24	1.92	0.92	1.24
Rehearsal 4	H	4.75	2.58	2.33	1.33	1.58
	P	4.00	2.33	2.33	1.33	1.33
		4.38	2.46	2.33	1.33	1.46
Rehearsal 5	H	4.62	2.15	1.77	0.77	1.15
	P	3.63	2.94	2.34	1.66	1.72
		4.13	2.55	2.06	1.22	1.44

Table 11.15 Correlations of pattern statistics and rehearsal

		Rehearsal	Length patt	Level	Actor switch
Rehearsal	Pearson Correlation	1	.883*	.865	.791
	Sig. (2-tailed)		.047	.058	.111
	N	5	5	5	5
Length_patt	Pearson Correlation	.883*	1	.998**	.963**
	Sig. (2-tailed)	.047		.000	.009
	N	5	5	5	5
Level_patt	Pearson Correlation	.865	.998**	1	.971**
	Sig. (2-tailed)	.058	.000		.006
	N	5	5	5	5
Actor_switch	Pearson Correlation	.791	.963**	.971**	1
	Sig. (2-tailed)	.111	.009	.006	
	N	5	5	5	5

\*. Correlation is significant at the 0.05 level (2-tailed). \*\*. Correlation is significant at the 0.01 level (2-tailed).

### 11.4.2 Reflective questionnaire responses

Table 11.16 Responses from reflective questionnaires – Group 2

	How would you describe leadership in the group?	How have the group have worked together on this task?	Reasons given for improvements
Singer V	Everybody contributes. Different people offer different things. Singer Y often comments on tuning/ensemble balance. I often give interpretational ideas I think. Singer X gives some technique stuff etc., but everyone gives a bit of everything.	I think we have developed a real identity for the pieces. We have, however, been distract-able and sometimes silly in the sessions.	Better knowledge of piece(s). After break we were out of habit of breathing together.
Singer W	I would say that we don't really have a 'leader'. We all contribute ideas and opinions and make decisions collaboratively.		Practice. Being aware of movement in other parts.
Singer X	Initially the three who also conduct (Singers Z, Y and V) very much had all the ideas and talking time at the start. It is now <u>much</u> more balanced, with input and confident suggestions and constructive criticism from all.	Had a great time – especially giving the pieces character of the lullaby and national anthem. It really helped us bond and perform together well!	Definitely improved as we grew and bonded as a group – easier to suggest ideas, on same 'wavelength' etc.
Singer Y	Communal. Very much a group equally led.		Worked on breathing together and listening to other parts with smaller note values. Also got better as we just spent more time together as a group as the term went on.

Contd....

	How would you describe leadership in the group?	How have the group have worked together on this task?	Reasons given for improvements
Singer Z	Hopefully, pretty even-handed. Everyone has a say and we rarely disagree in a way that can't be solved by trying both suggestions and letting the music decide. Singers V and Y probably emerge as the initiators of the vision for the group, with the Singers Z joining V and Y to lead in performance.	It has been a very useful to sing in a 'laboratory' situation. Not performing works from a 'canon' or tradition, but able to focus on pure sound production and synchronicity, with no hiding behind the reputation and difficulty of a piece performed by many other choirs.	I feel that our conception of the piece converged as time went on. The longer spent together as a group the more we listen to each other's parts in polyphony.

## 11.5 Appendix E *Parallel studies*

### 11.5.1 *Overview of parallel study 1: A longitudinal study investigating synchronisation in a singing quintet*

D'Amario, Daffern, et al. (2018)

This study investigated the musical (temporal) coordination of the ensemble. The synchronisation of individual parts in ensemble singing is a fundamental skill, and in experienced groups is generally achieved with high level of consistency. Previous research has established a typical asynchrony of 30-50 milliseconds in small ensembles (Rasch, 1979), achieved through continuous temporal adjustments of co-performers (Repp & Keller, 2004). These adjustments can also be subject to the internal dynamics of the ensemble, in which members adopt 'leader' or 'follower' roles, in which there may be a tendency to precede or lag compared with others. These roles may be consciously or deliberately assigned (Goebel & Palmer, 2009), or emerge spontaneously (Timmers et al., 2014; Wing et al., 2015), and be influenced by the degree of shared knowledge among co-performers (Badino et al., 2014). Familiarity with co-performers and their likely expressive interpretations have been shown to improve temporal coordination in rehearsal settings (Ginsborg et al., 2006; Ginsborg & King, 2012).

Laryngography (Lx) and audio recordings from head-mounted microphones were used for each of the five singers in each rehearsal. Lx is a widely used, non-invasive method for measuring the singing voice. Three repeated performances of Pieces 1 and 2 were recorded before and after every rehearsal session. A specially developed algorithm was used to determine asynchronies between pairs of singers from the data generated from both recording sources. The tendency to precede/lag co-performers was analysed to provide a temporal rank order for all singers, giving a rank from position 1 to 5.

### *11.5.2 Overview of parallel study 2: A longitudinal study of intonation in an a cappella singing quintet*

D'Amario, Howard, et al. (2018)

In a second parallel study, adjustment of tuning over time, and agreement between individual singers, was investigated. Being 'in tune' is both an essential and complex component of choral singing. Not only do singers need to match their intonation with fellow singers, but in unaccompanied (*a cappella*) singing, the group need to agree on a tuning system, and the degree to which they adjust their relative tuning from pure intervals known as 'just' temperament, to conventions associated with the modified 'equal' temperament associated with most modern Western music. As well as agreeing on the system, how groups work on refining tuning is an important topic in rehearsals of professional ensembles (Havrøy, 2015). However, there is little research on ways that ensembles evolve their strategies for tuning over time.

As with Parallel Study 1, Lx and head-mounted audio recordings were used to capture repeated performances of Pieces 1 and 2 during the five rehearsals. Investigations of tuning focused on the homophonic piece (Piece 1), which more easily allowed clear identification of chords. Measurement of tuning was based on the deviation versus expected (just and equal temperament), for both horizontal (note by note) and vertical (within chord) for major and minor thirds. Three metrics were incorporated into multilevel linear models used to investigate horizontal and vertical tuning: 'pitch drift', which gives an index of the deviation from target; consistency, using pooled S.D. of measured deviations of multiple takes; and dispersion, using the range of these deviations across notes or chords for each take. Verbal utterances related to tuning strategies were identified and classified according to their purpose and to the note(s), chord(s) or bar(s) to which they related.

Full text of article follows.

### *11.5.3 Full text of article: A Longitudinal Study of Intonation in an a cappella Singing Quintet*

*Sara D'Amario, David M. Howard, Helena Daffern, and Nicola Pennill.*

#### **Abstract**

##### Objective

The skill to control pitch accurately is an important feature of performance in singing ensembles as it boosts musical excellence. Previous studies analyzing single performance sessions provide inconclusive and contrasting results on whether singers in ensembles tend to use a tuning system which deviates from equal temperament for their intonation. The present study observes the evolution of intonation in a newly formed student singing quintet during their first term of study.

##### Methods/Design

A semi-professional singing quintet was recorded using head-worn microphones and electrolaryngograph electrodes to allow fundamental frequency ( $f_0$ ) evaluation of the individual voices. In addition, a camcorder was used to record verbal interactions between singers. The ensemble rehearsed a homophonic piece arranged for the study during five rehearsal sessions over four months. Singers practiced the piece for 10 minutes in each rehearsal, and performed three repetitions of the same pieces pre-rehearsal and post-rehearsal. Audio and electrolaryngograph data of the repeated performances, and video recordings of the rehearsals were analysed. Aspects of intonation were then measured by extracting the  $f_0$  values from the electrolaryngograph and acoustic signal, and compared within rehearsals (pre and post) and between rehearsals (rehearsals 1 to 5), and across repetitions (take 1 to 3). Time-stamped transcriptions of rehearsal discussions were used to identify verbal interactions related to tuning, the tuning strategies adopted, and their location (bar or chord) within the piece.

##### Results/Discussion

Tuning of each singer was closer to equal temperament than just intonation, but the size of major thirds was slightly closer to just intonation, and minor thirds closer to equal temperament. These findings were consistent within and between rehearsals, and across repetitions. Tuning was highlighted as an important feature of rehearsal during the study term, and a range of strategies were adopted to solve tuning related issues. This study provides a novel holistic assessment of tuning strategies within a singing ensemble, furthering understanding of performance practices as well as revealing the complex approach needed for future research in this area. These findings are particularly important for directors and singers to tailor rehearsal

strategies that address tuning in singing ensembles, showing that approaches need to be context driven rather than based on theoretical ideal.

## Key words

Intonation

Pitch drift

Tuning

Singing ensemble

Ensemble communication

## Introduction

Tuning is an essential characteristic of good choral singing practice, at the forefront of critical reviews, director's manuals, and singing tutors.<sup>1</sup> Beyond the importance of pitch matching, whereby singers produce accurate unison singing within their respective parts, in a *cappella* part singing there is the additional issue of which tuning systems and temperaments should and are employed for a group to be “in tune.” There are different ways to consider tuning in singing ensembles and pitch drift is a topic of common interest to researchers and practitioners alike (see Havrøy<sup>2</sup> for a discussion of the complex tuning issues for a *cappella* singing groups).

Empirical research in this area, whilst sparse, has focused on different perspectives of choral tuning including predictions of pitch drift, pitch drift in performance, and perception preferences for different intonation systems.<sup>3</sup> Investigating tuning practices in a *cappella* part singing, Devaney et al<sup>4</sup> found no evidence of pitch drift in an exercise written by Benedetti in the sixteenth century to illustrate potential pitch drift associated with “pure tuning,” when performed by four expert 3-part ensembles. They hypothesized that this was due to the shortness of the exercise and the likelihood of retaining a pitch memory for the start of the piece throughout the eight-bar excerpt.

Exploring predicted pitch drift in three especially composed pieces, Howard<sup>5</sup> found that when modulation occurred even over a very short piece, in a single performance by one quartet, the singers had a tendency to drift in pitch. He also found that an exercise composed for the study, named “Exercise 3”, was most suitable for measuring pitch drift as it avoided use of a seventh chord. In two performances of the same piece from the prior study, sung by a different quartet comprising music students, it was found that the singers drifted beyond the just intonation prediction and a long way far from equal temperament.<sup>6</sup>

Using the choral synthesis system described in Howard et al,<sup>7</sup> the tuning of student singers was analyzed as they replaced either the alto or soprano line of “Exercise 3” when listening to the other three parts tuned either in equal temperament or just intonation over headphones.<sup>8</sup> Singers produced less stable pitches across tones and were more “out of tune” when tuning with the justly tuned rather than the equally tempered version of the synthesis, implying that the singers in this study tended towards equal temperament.

Devaney and Ellis<sup>8</sup> highlighted the importance of considering both vertical and horizontal tuning, proposing an approach to account for both, which utilizes automated  $f_0$  extraction and machine learning combining theories of sensory consonance and tonal attraction respectively.

Analyzing interval sizes performed by four expert 3-part vocal ensembles, Devaney et al<sup>4</sup> found that whilst most vertical and horizontal tuning was in line with equal temperament both minor and major thirds varied in tuning with examples of intonation close to equal temperament, just intonation and Pythagorean tuning. Major 6ths were found to be consistently tuned to equal temperament.

The interval of a third has received particular scrutiny in research from a performance and perception perspective due to the large discrepancies between tuning systems (particularly equal temperament and just tuning) for these intervals, with a general understanding amongst trained *a cappella* ensembles to narrow major thirds and widen minor thirds to be more in keeping with just intonation (Potter<sup>9</sup> p. 160). Mayer<sup>10</sup> in describing how choirs can aspire to just tuning asserts that it is “certainly the most difficult of all intervals to sing in tune” (p. 110).

Focusing on the tuning of thirds but from the perspective of the listener, Ternström and Nordmark<sup>11</sup> conducted a study on tuning perception whereby expert listeners (mainly choral musicians but some orchestral) tuned synthesized dyads into major thirds. The mean results were closer to equal temperament than just intonation; however, the spread of results within subjects suggested no preference to a particular tuning system. Listeners distinguished between equal temperament and just intonation in another perceptual study, which used synthesized sounds to consider pitch drift in short chord progressions, however preference to tuning system was found to be individual.<sup>12</sup>

The results emerging from empirical research which reveal ambiguous perception preferences towards specific tuning systems/temperaments are also reflected in literature discussing best practice, in which the issue of tuning and temperament in *a cappella* singing continues to be highly topical and often contentious. In “A Performer's Guide to Renaissance Music” Planchart<sup>13</sup> asserts that, “Given the tenacity of the resistance of modern singers to just intonation,” singers will find it difficult to deviate from equal temperament but “directors



should ultimately neither give up or let up” (p. 38). In the same book, Blachly,<sup>14</sup> also extolling the importance of just intonation as producing “a more satisfying in-tune result,” acknowledges that “training a small choir or vocal ensemble to sing in tune can be the most difficult challenge facing the director of the early music ensemble” (p. 25).

The application of just intonation as common practice has been an area of dispute for some time, although it is often purported to be the ideal practice for *a cappella* singing ensembles, especially when performing early music. Barbour<sup>15</sup> insists that “there is no system of tuning that has the virtues popularly ascribed to just intonation. Neither singers nor violinists use just intonation” (p. 48) whilst Timm<sup>16</sup> comments that “A Cappella choirs and string quartets [...] often boast of the use of just, or true, intonation instead of the tempered scale” (p. 19).

More recently, it has become commonly reported as a trait of “good ensemble singing” for professional groups to employ just tuning: “Performances by vocal groups such as The Hilliard Ensemble, The Tallis Scholars, and Gothic Voices have made it apparent that approaching perfection in tuning is not an impossible dream” (Duffin,<sup>17</sup> p. 287).

In addition to the theories and practice of the tuning of *a cappella* performances is the issue of intent and the extent to which groups actively work towards a specific tuning system and how they go about achieving their goal. Work on tuning has been observed to be a consistent feature of rehearsals of professional *a cappella* vocal ensembles<sup>18</sup>; however, there has been little research which focusses on specific ensemble rehearsal strategies for tuning and their evolution over a series of sessions.

Observational studies of small ensembles have demonstrated ways in which preparation for performance requires musical and social coordination, generally achieved through a framework of rehearsals and performance goals, with variation between groups of different type, size and familiarity.<sup>19, 20, 21, 22</sup> As part of a study of ensemble rehearsal approaches, Chaffin and Imreh<sup>23</sup> categorized rehearsal tasks as “basic,” “interpretive,” “expressive,” and “strategic.” This framework was later adapted and applied in studies of ensemble rehearsals, including that of Ginsborg et al,<sup>24</sup> a longitudinal study of rehearsal of a professional voice and piano duo. Using verbal utterances to track the focus of the rehearsals, they characterized work on pitch and intonation as “basic” musical dimensions. Over the course of the study they observed a shift from these more “basic” tasks in early rehearsals to a greater emphasis on “interpretive” tasks (such as expressive intentions) in later sessions. This framework was also used to explore differences in rehearsal approaches in a small-scale study (four duos) of newly-formed and established student and professional ensembles.<sup>25</sup> There were no differences found in verbal utterances referring to “basic” musical dimensions relating to expertise or familiarity, although all participants mentioned pitch.

Studies of rehearsal techniques and performance practices addressing the issue of tuning in a *cappella* singing groups are scarce. The limited studies employing empirical methods have so far been inconclusive and, when investigating performance trends, have generally been based on single performance sessions rather than repeated takes. This paper provides a novel contribution to research in this area by introducing a mixed method repeated measures design across several rehearsal sessions in a newly formed *a cappella* vocal quintet ensemble. It combines quantitative performance data with observational frameworks of the verbal interactions of the group during rehearsals to allow for analysis of tuning in relation to practice sessions, addressing the following research questions:

1. Horizontal tuning: Does the singing quintet produce a pitch drift representative of just intonation predictions or maintain horizontal tuning in equal temperament?

a. Do these horizontal tuning trends change pre-rehearsal and post-rehearsal?

b. Do these horizontal tuning trends change longitudinally over rehearsal sessions spanning four months?

2. Vertical Tuning: Does the singing quintet tune thirds within chords towards just intonation or equal temperament?

a. Do these vertical tuning trends change pre-rehearsal and post-rehearsal?

b. Do these vertical tuning trends change longitudinally over rehearsal sessions spanning four months?

3. How do group members address tuning issues in rehearsals, as observed in their verbal interactions?

## Method

### Participants

Ethical approval for the study (with reference D'Amario070817) was obtained from the Physical Sciences Ethics Committee (PSEC) at the University of York (UK). A newly formed soprano, mezzo, mezzo, tenor, and bass singing quintet was recruited for the study (3 females, age Mdn = 23, Range = 6). Singers were postgraduate students in ensemble singing at the Department of Music of the University of York. The ensemble became established as a regular quintet working towards performances and Masters exams. They had formal coached rehearsals once a week, and additional regular rehearsals throughout the duration of the study in preparation for their final exams. All musicians had extensive experience performing in choir (Mdn = 10.8,

Range = 11) and formal singing training with a professional singing teacher (Mdn = 8, Range = 13). They reported that none of the singers had absolute pitch.

## Materials

The chorale “Jes, mein Hort und Erretter” from the Cantata BWV 154 “Mein liebster Jesus ist verloren” composed by Johann Sebastian Bach, and arranged for the singing ensemble in the study by the first author, was used for the analysis of the evolution of tuning across rehearsal. This piece was also used in a parallel study investigating the developmental aspects of synchronization in the same singing quintet.<sup>26</sup> The original Bach chorale was arranged avoiding repeated notes and limiting semitones, to facilitate tuning analysis based on  $f_0$  tracking (see Section Analysis). Tuning for each note can be potentially difficult to calculate in the  $f_0$  signal when melodies move chromatically, since the expected *vibrato* range for classical singers might span a semitone and therefore it would be difficult to detect each note. Similarly, tuning in repeated notes during *legato* singing can be difficult to analyze, if singers do not produce a noticeable pause in phonation between notes. A piece with such attributes, maximizing tuning analysis, was difficult to find, and arrangement of the piece was preferred. The arranged piece features 6 *legato* phrases performed to the vowel /i/. The piece presents a clear homophonic structure with a stable rhythm, and simultaneous entries and breaths, as shown in Figure 1. Expressive markings were not given in order to investigate aspects of rehearsal, including tuning that might emerge spontaneously.

J. S. Bach (arr. S. D'Amario)

The figure shows a musical score for Soprano, Mezzo-soprano, Tenor, and Bass. The score is divided into three systems of four measures each. The first system (measures 1-4) shows major thirds (e.g., notes 1-2, 3-4) and minor thirds (e.g., notes 5-6, 7-8). The second system (measures 5-8) shows major thirds (e.g., notes 15-16, 17-18) and minor thirds (e.g., notes 19-20, 21-22). The third system (measures 9-12) shows major thirds (e.g., notes 29-30, 31-32) and minor thirds (e.g., notes 33-34, 35-36). The score is in 4/4 time and features a key signature of one flat (B-flat).

Figure 1. Piece from a previous study<sup>26</sup>, showing the major and minor thirds, highlighted with arrows and brackets respectively, that were selected for the analysis of vertical tuning. The full data set of notes was used for the analysis of horizontal tuning.

The figure is ©the authors, licensed CC-BY

## Apparatus

Singers wore head-mounted close proximity microphones (DPA 4065) placed on the cheek of the singer at approximately 2.5cm from the lips. Stereo recordings of the repeated performances were collected using a stereo condenser microphone (Rode NT4). The latter was placed at equal distance in front of the singer at approximately 1.5m from the lips. Singers also wore electrolaryngograph electrodes (Lx) from Laryngograph Ltd. ([www.laryngograph.com](http://www.laryngograph.com)), placed on the neck at the level of the larynx, and kept in place with an adjustable strap. Lx is a non-invasive, widely used method for the analysis of the singing voice.<sup>27</sup> It has been recently used to investigate several aspects of singing ensemble performances, such as synchronization<sup>26, 28, 29</sup> blending,<sup>30</sup> and tuning,<sup>5, 6</sup> as it allows the identification of the individual

contribution of each singer. Each Lx was attached to a preamplifier (ART CleanBox Pro) to reduce noise and interference over long cable runs. The 12 outputs (5 Lx with preamplifiers, 5 head-mounted microphones, and the stereo microphone with right and left channel) were connected to a multi-channel audio interface (Focusrite Liquid Saffire 56) connected to a PC. The 12 outputs were then recorded in synchrony using a digital audio workstation (Reaper 5.40), set at 24-bit depth and 44.1kHz sampling frequency. Rehearsals were video-recorded with a tripod-mounted video camera (Sony MV1 Music Video recorder), with a unidirectional 120 degree XY stereo microphone. The experiment took place in a recording studio of the Department of Electronic Engineering at the University of York; the room was treated with absorptive acoustic material.

## Design

This investigation is a longitudinal study consisting of five rehearsal sessions based in laboratory. The above piece was practiced for approximately 10 minutes during each rehearsal. Three repeated performances of the pieces were recorded pre-rehearsal and post-rehearsal. The Lx and audio recordings of a total of 30 repeated performances of the clearly homophonic piece were collected across the five rehearsals. The entire laboratory sessions were video recorded, to minimize the attention on the camera.

An additional piece, mostly contrasting in rhythmical content compared with the previous clearly homophonic piece, was also used for the study to investigate interpersonal synchronization between musicians in relation to the complexity of the piece rehearsed. Synchronization is out of the scope of this paper, and the results are reported in D'Amario et al.<sup>26</sup> Singers were invited to rehearse the more complex piece for 10 minutes, and performed three repetitions pre-rehearsal and post-rehearsal, as with the clear homophonic piece. The order of recording and rehearsing the two pieces was randomized within rehearsals.

## Procedure

The five laboratory sessions took place over a four-month period, from September 2017 to January 2018. Prior to the first session, participants filled in a background questionnaire and gave written consent form. The first four sessions were approximately 2.5 weeks apart from each other, as shown in Table 1. The fifth lab session was originally planned three weeks after the fourth session, which was two days before their Masters exam. Due to illness and Christmas break, the exam was postponed until eight weeks after the fourth rehearsal, and the fifth lab session took place two days before the public performance. During the lab session, the quintet

stood in a semi-circle of approximately 3m in diameter, in the sequence soprano, mezzo, mezzo, tenor, and bass. Each laboratory session lasted approximately 1 hour.

Table 1. Rehearsal Sessions Across a 16-Week Period and Allocation of Time to Tuning

						Total
Rehearsal number	1	2	3	4	5	
Week	1	3	5	8	16	
Rehearsal duration (sec)	712	315	770	618	778	3193

Singers were not aware of the purpose of the study. In order to encourage a natural approach to rehearsal, the group were asked to create an “expressive performance” of the pieces, which had no performance directions. During the rehearsal periods the researchers left the room, and the singers were asked to work freely on the piece however they chose. Singers only rehearsed the pieces during the five lab rehearsals, and for this reason the score was retained by the first author at the end of each lab session. This was implemented so the authors could record changes in the tuning of the given piece that evolved during the first term of study. A reference pitch A3 was given on a diapason before the three repeated performances recorded pre-rehearsal and post-rehearsal. The quintet was free to set their own tempo.

### Analysis

Three aspects of tuning were analyzed: i) horizontal tuning, ii) vertical tuning, and iii) rehearsal strategies used during the lab rehearsal in relation to tuning, as shown in Table 2. In order to investigate horizontal and vertical tuning, the  $f_0$  estimates in Hertz and the corresponding timestamps with a time step of 1 millisecond were extracted from the Lx and audio recordings based on the head-mounted microphone, using Praat.<sup>31</sup> The two sets of data of each recording were imported into Excel as a tabular list of data. An automated peak-picking algorithm, TIMEX,<sup>28</sup> was used to extract the note beginnings and endings of each note from the acoustic and Lx data imported in Excel, and a macro was then implemented to compute the average frequency in Hertz of each note. This algorithm, tested on a set of singing duo recordings, proved to be a valuable and successful method for onset and offset detection in ensemble singing.<sup>28</sup> The data extraction automated through TIMEX was then visually cross-validated by the first two authors (SD and DMH). Notes at which pitch errors occurred, due to signal processing issues (ie, weak signal) or the singers performing wrong notes (ie., featuring a measured deviation from the expected ET value greater than 130 cents), were 1.9% of the full data set. They were identified comparing Lx and audio recordings with the notated scores, and were excluded from the analysis.

Table 2. Aspects and Parameters of Tuning Investigated and Corresponding Recordings and Dataset

Aspect	Parameter	Recordings	Dataset
Horizontal deviation	Pitch drift, and tuning consistency and dispersion	Lx and audio	Deviation for each note/singer/repetition
Vertical deviation	Tuning stability, consistency and dispersion	Lx and audio	Deviation for major and minor thirds
Rehearsal strategies	Time spent on tuning and approaches to tuning	Video	Rehearsal episodes

In order to analyze the pitch drift during each of the performances, a reference set of  $f_0$  is required for the tuning systems of interest; in this case, equal temperament and just temperament.<sup>5, 6</sup> These reference  $f_0$  were calculated as frequency multipliers to the tonic of the key of the chorale (see Figure 1), which is F as it is in F major, and the starting note of the tenor part (F3) was selected. The procedure for calculating the equal temperament ratios involved multiplication (division) by the twelfth root of two to move up (down) by a semitone. The procedure for calculating the just ratios has two steps: (a) within a chord the intervals are calculated using integer harmonic ratios depending on the interval (eg, a fifth is 3/2, a major third is 5/4, a minor third is 6/5, etc.), and (b) chord to chord where a search is carried out to find the nearest harmonic ratio between one of the notes of each of the chords in the following order: unison, octave, fifth, fourth, major third, minor third, etc. Further details on tuning systems and frequency ratios can be found in Howard and Angus.<sup>32</sup> The measured  $f_0$  values are entered into the spreadsheet, and the  $f_0$  of each sung note is divided by the measured  $f_0$  value for the first note (F3) of the tenor part which is the reference note for the analysis as indicated above. To establish how close the sung notes were to equal temperament or just temperament, the measured frequency ratios are divided by the equal (just) tempered ratios. For the analyses presented below, the results have been converted to cents (1 cent is one hundredth of a semitone) to enable comparisons to be made.

The horizontal analysis was based on the whole set of notes (ie, 42 notes) included in the piece. A total of 15 major thirds and 23 minor thirds across parts were selected for the vertical analysis, as shown in Figure 1. The thirds were simple intervals, except for one compound major third, between bass and tenor in note n 42, which was also selected for the analysis. This interval was considered relevant to the analysis of thirds, being the last chord of the piece. Three metrics of horizontal and vertical tuning were measured as follows:

- Pitch drift, as indexed by the pitch deviation from ET and just intonation

- Tuning consistency, as indexed by the SD of measured deviations computed for each repetition (ie, take) pooling the 42 notes or the selected thirds to analyze horizontal or vertical consistency, respectively

- Tuning dispersion, as indexed by the range of measured deviation computed across notes or selected thirds for each repetition, similarly to the procedure implemented for tuning consistency analysis

Multilevel linear-models of the response variables (ie,  $f_0$  deviation from predicted values, SD and range of measured deviation) were then implemented to test the primary fixed effects of rehearsal, and the fixed effects of rehearsal stage (ie, pre-rehearsal and post-rehearsal) nested within rehearsal. Take, note and singer number were also entered as random variables in the models investigating the horizontal tuning across all notes. Take, interval and pair number were inputted as random variables in the models analyzing the major and minor thirds.

A Bonferroni correction was implemented for multiple multilevel linear modelling, and a  $p$  value threshold was set at  $p = 0.0055$ , based on a total of 9 tests (see Table 3).

Table 3. Multilevel Linear Models Implemented in the Study

Response Variable	Primary Fixed Effects	Nested Fixed Effects	Random Effect	Data Set
Drift	Rehearsal number	Stage	Take, note and singer number	All notes
Consistency	Rehearsal number	Stage	Take and singer number	All notes
Dispersion	Rehearsal number	Stage	Take and singer number	All notes
Drift	Rehearsal number	Stage	Take and interval number, singer pair	Major thirds
Consistency	Rehearsal number	Stage	Take number	Major thirds
Dispersion	Rehearsal number	Stage	Take number	Major thirds
Drift	Rehearsal number	Stage	Take and interval number, singer pair	Minor thirds
Consistency	Rehearsal number	Stage	Take number	Minor thirds
Dispersion	Rehearsal number	Stage	Take number	Minor thirds

In order to analyze the verbal interaction between singers during rehearsal in relation to tuning, the total amount of time allocated to each rehearsal was recorded and video recordings of the rehearsal episodes were extracted and uploaded into NVivo (QSR International). The data was transcribed by the fourth author (NP) to produce time-stamped line-by-line verbal utterances of the rehearsal episodes. Episodes of singing were also noted. The length of time allocated to



each speech unit or singing episode was recorded in NVivo during the transcription process. Further analysis was performed to identify the points at which singers worked on tuning during their rehearsals. From this data, the amount of time spent on tuning (overall, and by bar/chord), and the nature of the discussion and methods used to address each tuning “problem” were explored.

## Results

### Horizontal tuning

Visual inspection of the horizontal analysis of tuning clearly demonstrates that each singer was closer to equal temperament than just intonation, and this distinctive behavior was consistent and repeatable during and across rehearsals. This is illustrated in Figure 2 and Figure 3, showing the  $f_0$  deviations computed against equal temperament and just intonation for the soprano calculated for each take in rehearsal 1 and rehearsal 5, respectively. The analysis demonstrates that the soprano tended towards equal temperament in both rehearsals and across repetitions within each rehearsal. Complete pitch-drift analysis for each singer/note/take/rehearsal is reported in Appendices. Based on these results, the inferential analysis of tuning during and across rehearsal was based on deviation from equal temperament, rather than just intonation.

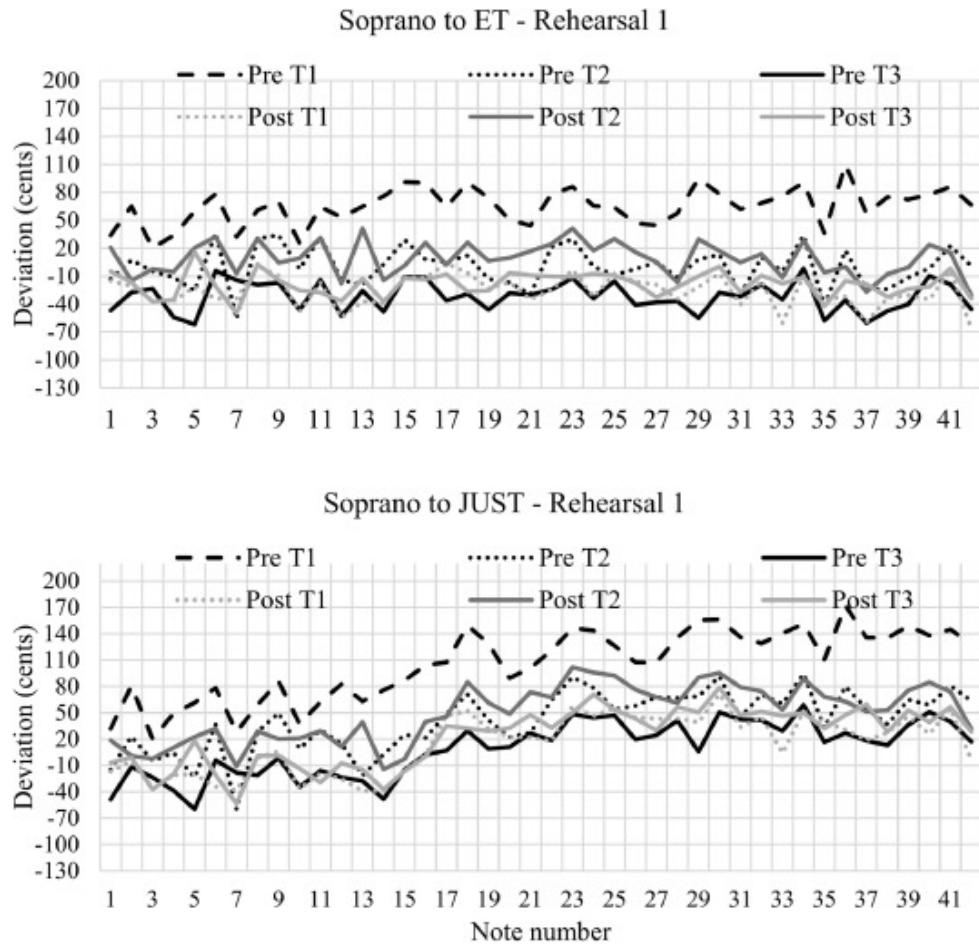


Figure 3. Measured deviation from equal temperament (ET, top row) and just intonation (JUST, bottom) of the soprano computed for each note (note 1 to 42), stage (pre-rehearsal and post-rehearsal), and take (T1-T3) during the last rehearsal, R5. Notes are normalized to the first tenor note, F3, which is the tonic of the piece used in the study. Maximum and minimum values on the y-axis have been fixed to allow comparison between the two graphs.

Results from the multilevel linear modelling show that, compared with rehearsal 1, the measured deviation from ET was slightly sharper in rehearsal 2 ( $\beta = 4.8$ ,  $t(6120) = 3.1$ ,  $p < 0.01$ ), and flatter in rehearsal 4 ( $\beta = -19.8$ ,  $t(6120) = -12.6$ ,  $p < 0.001$ ) and rehearsal 5 ( $\beta = -12.2$ ,  $t(6120) = -7.8$ ,  $p < 0.001$ ), as shown in Figure 4A. The  $\beta$  – fixed effect coefficients – indicate that for each 1 unit increase in the predictor being considered, the effect of the given predictor changes by the amount specified by the  $\beta$  coefficient. For example, for each 1 unit increase in the tuning of rehearsal 1, tuning computed in rehearsal 2 increased by 4.8 units. Deviation from equal temperament tended to be flatter post-rehearsal in rehearsals 1 to 4 (see Figure 4B), but there was no significant difference pre-rehearsal and post-rehearsal in rehearsal 5. The variance partition coefficient (VPC) among singers and notes was 0.0206 and 0.0248, which demonstrates that only 2% and 2.5% of the variability of tuning can be attributed to singers and notes, respectively. The variability among takes was 16.2%, which indicated that the measured

deviation from ET might have changed during repetitions. For this reason, an ANOVA test was run to test the effect of take. Results show that the take order had a significant effect,  $F(2, 6173) = 340.8, p < 0.001$ , and that the deviation tended to be slightly flatter across repetitions though still closer to ET, as demonstrated by the *post hoc* comparisons using the Bonferroni correction (see Figure 4C).

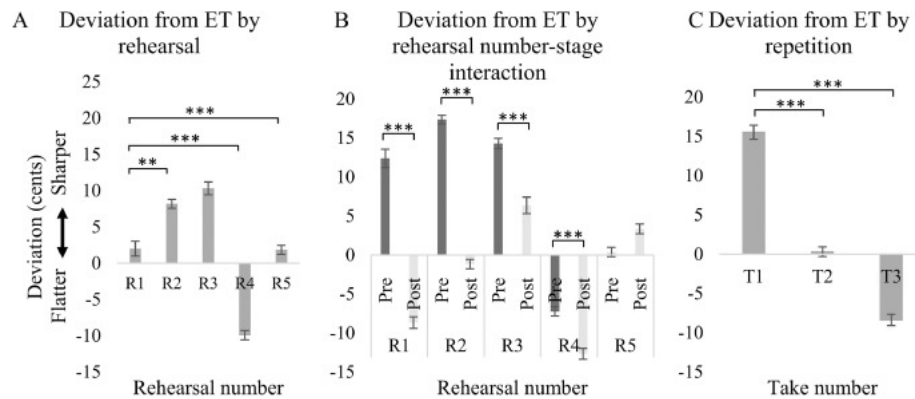


Figure 4. Deviation of tuning from equal temperament (ET): A) by rehearsal number (R1-R5); B) by interaction between rehearsal number (R1-R5) and rehearsal stage (pre-rehearsal and post-rehearsal); and, C) by repetition from take 1 to take 3 (T1-T3). Error bars represent 95% CI of the mean. \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .

Results from the multilinear modelling based on the SD of measured deviation from ET show that, compared with the first rehearsal, tuning deviation was more consistent in rehearsal 2 ( $\beta = -5.5, t(134) = -3.5, p < 0.001$ ), rehearsal 3 ( $\beta = -8.1, t(134) = -5.2, p < 0.001$ ), rehearsal 4 ( $\beta = -5.3, t(134) = -3.3, p < 0.01$ ), and rehearsal 5 ( $\beta = -4.6, t(134) = -2.9, p < 0.01$ ). Tuning was gradually more consistent during the first three rehearsals, but it did not change significantly pre-rehearsal and post-rehearsal, as shown in Figure 5A and Figure 5B. The VRP among takes and singers was 6.2% and 54.5% respectively, suggesting that the consistency of tuning across rehearsals might vary with the ensemble rehearsing. An ANOVA was run to further investigate the role of the singer on the consistency and, as expected, results confirmed a significant effect of singer  $t(4, 145) = 29.73, p < 0.001$ , which was significantly associated with the consistency of singer 5. Tuning of singer 5 was less consistent than that of the other singers, as shown in Figure 5C.

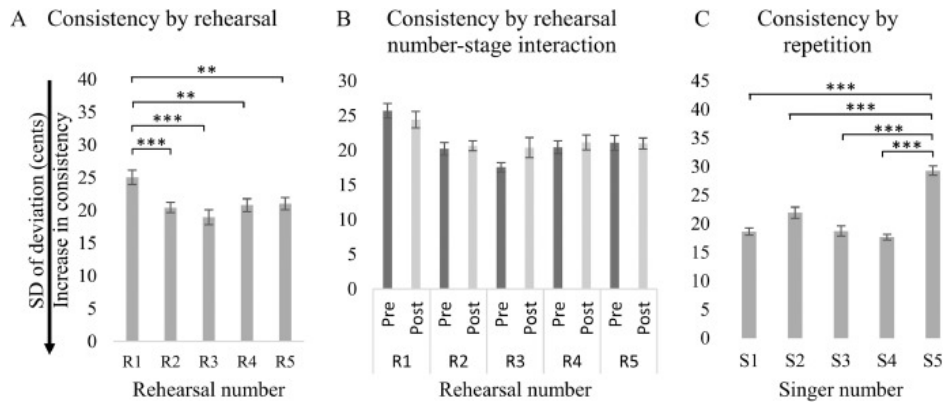


Figure 5. Consistency of tuning: A) by rehearsal number (R1-R5); B) by interaction between rehearsal number (R1-R5) and rehearsal stage (pre-rehearsal and post-rehearsal); and, C) by singer (S1-S5). Error bars represent 95% CI of the mean. \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

The analysis of the dispersion of tuning across rehearsals shows that the range of tuning deviation from ET was narrower in the third rehearsal compared with the first,  $\beta = -33.0$ ,  $t(134) = -3.7$ ,  $P < 0.001$ , as shown in Figure 6A. Tuning range did not differ significantly pre-rehearsal and post-rehearsal, as shown in Figure 6B. The variability of the primary effects of rehearsal among take and singers was 8.8% and 38.5% respectively, suggesting that these results might change if different singers were to take part in the study. An ANOVA was conducted to investigate further the effect of singer, and results confirmed that the dispersion differed significantly according to the singer  $t(4, 145) = 16.1$ ,  $P < 0.001$ . The spread of tuning was wider in singer 5 compared with the other singers, as shown by Bonferroni *post hoc* comparisons (see Figure 6C).

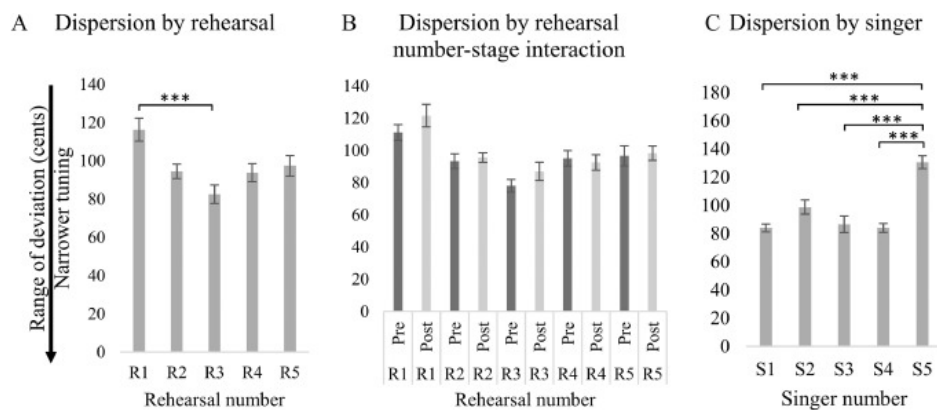


Figure 6. Dispersion of tuning: A) by rehearsal number (R1-R5); B) by interaction between rehearsal number (R1-R5) and rehearsal stage (pre-rehearsal and post-rehearsal); and, C) by singer (S1-S5). Error bars represent 95% CI of the mean. \*\*\* $P < 0.001$ .

## Vertical tuning

The average size of the major thirds was 392.17 cents with a standard deviation of 27.56 cents. This is slightly closer to just intonation (386 cents) than ET (400 cents), and, together with the wide spread, indicates examples of both ET and just intonation, as shown in Figure 7A. The stability of the thirds did not change significantly across rehearsals or pre-rehearsal and post-rehearsal. The variability among interval number, pair and take was 5.2%, 5.9%, and less than 0.1%, respectively. Considering the significant effect of singer on the horizontal tuning, an ANOVA was conducted to test whether tuning of the thirds changed according to the singers performing. Results demonstrate a significant effect of the pair of singers,  $t(3, 438) = 9.0$ ,  $p < 0.001$ , which was associated with the pair S3-S2 and S1-S2, as shown by Bonferroni *post hoc* comparisons (see Figure 7B). Singers 1 and 2 tuned the major thirds closer to just intonation, but singers 2 and 3 tuned closer to ET. Another ANOVA was also conducted to test the effect of note number, and results show the major thirds tuning changed significantly based on the interval considered,  $t(14, 427) = 4.1$ ,  $p < 0.001$ .

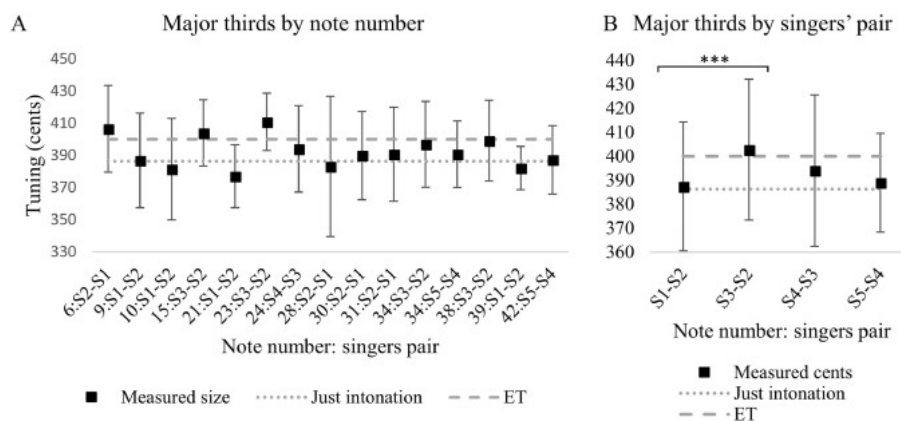


Figure 7. Tuning of major thirds: A) by note number, and B) by singers' pair. Error bars represent SD of the mean. \*\*\* $p < 0.001$ .

The consistency and range of the major thirds did not differ across rehearsals or pre-rehearsal and post-rehearsal, and the variance partition coefficient among repetitions was 8% in relation to the consistency and 15.2% for the range of major thirds. Further tests were then conducted to investigate the role of take, and ANOVAs show that the consistency and dispersion of tuning of the major thirds did not differ across repetitions.

The average size of the minor thirds was 299.13 cents, with a standard deviation of 29.28 cents, indicating that the tuning of the minor thirds was closer to ET (300 cents), than just intonation (315.6 cents), as shown in Figure 8. The tuning stability, as indexed by the size of interval, did not differ pre-rehearsal and post-rehearsal, or across rehearsals. The variability among minor thirds, pair and take was 15.4%, 1.3% and less than 0.1%, respectively. An

ANOVA on the minor thirds number confirmed a significant effect of the interval number on the tuning of the minor thirds,  $t(22, 646) = 6.4, p < 0.001$ . The consistency and range of the minor thirds did not change across the five-rehearsal sessions or pre-rehearsal and post-rehearsal, and the variance partition coefficient among take 1 to 3 was less than 0.1% in relation to both consistency and range.

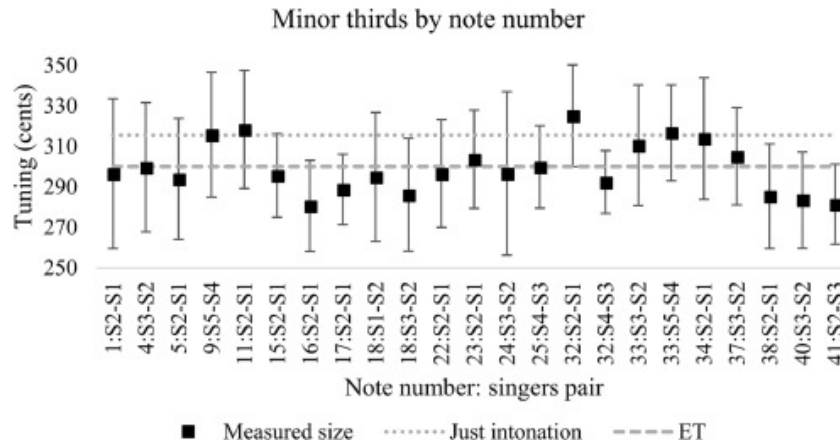


Figure 8. Tuning of minor thirds by note number.

## Verbal interactions during rehearsal

### Duration and frequency of verbal utterances relating to tuning

Based on the transcribed verbal utterances, the amount of time dedicated to tuning was summarized as a percentage of the total duration of rehearsal time in each session. Table 1 shows the total rehearsal time and time spent on tuning for the whole study period.

No verbal utterances on tuning topics were observed in rehearsal 2, which was shortened due to one member being indisposed for a time. For this reason, it was not included in the following analyses. Over the entire 5 rehearsal sessions the singers allocated 19% of their rehearsal time to tuning; however, a reduction in time allocated to tuning was apparent across the study period (Figure 9).

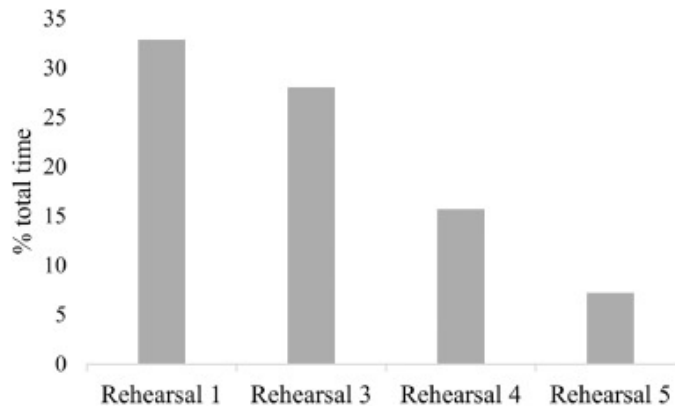


Figure 9. Allocation of time to tuning tasks as percentage of total rehearsal time.

From rehearsals 1, 3, 4 and 5, work on specific bars and chords were identified using the verbal interaction data, and is summarized in Figure 10.

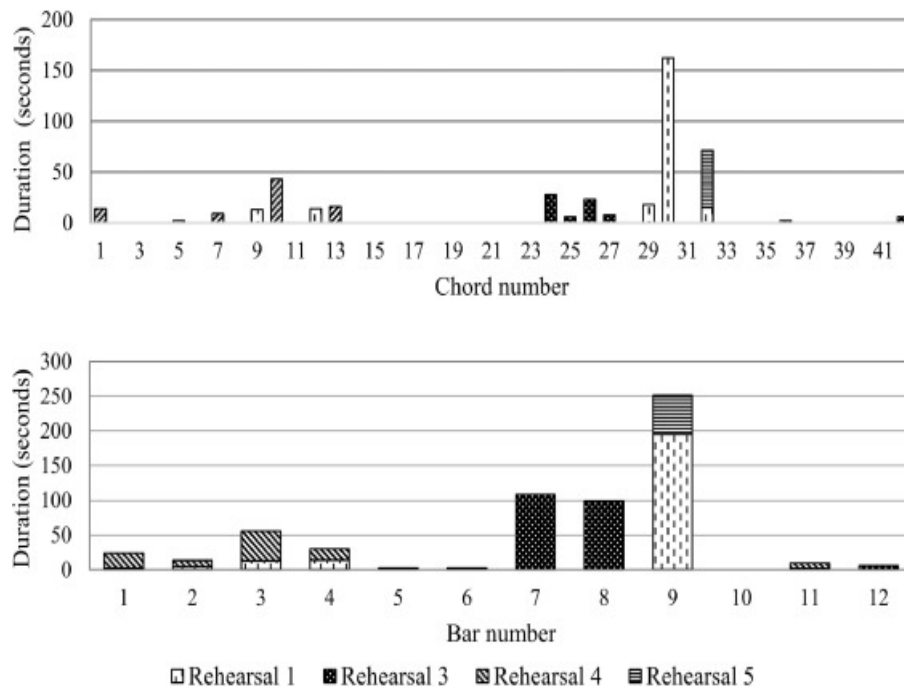


Figure 10. Time spent on tuning by bar (top row) and chord (bottom row) for rehearsals 1, 3, 4, and 5.

Chords on which the group spent most time tuning is reported in Figure 11. Chords of interest were identified as chords 30, 32, 10, 24, and 26, each of which the group dedicated at least 20 seconds of rehearsal time.

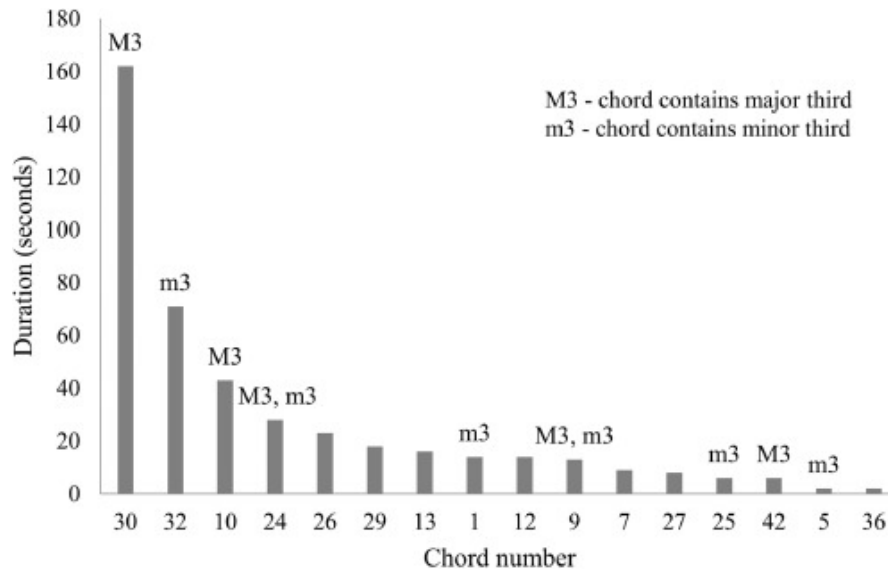


Figure 11. Amount of time allocated to tuning, by chord number.

### Rehearsal strategies for tuning

The verbal interaction data also revealed the strategies used by the group for tuning. These included the identification of problem areas, and proposed ways of dealing with tuning issues. Methods of identification included drawing attention to problem bars, “fuzzy” chords, specific intervals that were hard to tune, or problem notes in a chord, such as where notes were doubled, or where they created unusual harmonies. A range of strategies were adopted for solving tuning problems as they were identified. These included: i) running or repeating a short section, single bar or chord; ii) separating out parts so that just two or three voices could be isolated; iii) singing a progression more slowly, encouraging each other to listen in a more focused way; and, iv) rebalancing chords so that certain voices could be stronger. In some instances, individuals explicitly stated how they were planning to adjust their tuning within the context of a chord. For example, Singer 3 describes how she is deliberately lowering a minor third, and advises Singer 2 to lower her minor second;

“I was trying to pull the F down, then”, (Singer 3, chords 23, 25 and 27, rehearsal 3)

“I think it might settle if you really make that semitone close, so you can sit down lower.” (Singer 3 to Singer 2, chord 30, rehearsal 1).

In addition, Singer 4 made direct reference to the tuning system he was adopting for a specific chord;

“I’m going to do an equal tempered third at the end this time” (Singer 4, chord 42, rehearsal 5)



There was no other discussion or direct reference to tuning systems during the remainder of the rehearsals. Aside from this one example where a tuning system was explicitly mentioned, tuning strategies for chords containing thirds were primarily focused on balance, matching intonation of specific pitches in unison or octaves, or tuning a whole chord which included thirds (see Table 4). However, there were some examples where singers referred to tuning of specific melodic or harmonic thirds. Singer 2 expresses difficulty with tuning of melodic major thirds in bars 1 and 11:

“I’m very conscious of my falling major thirds in bar 1 and bar 11, I’m finding them quite hard to tune, I don’t know why.” (Singer 2, rehearsal 4, chords 1 to 4 and 36 to 39).

Table 4. Tuning Strategies for Minor and Major Thirds

Tuning Strategies	Minor Thirds Chord Number (Voices)	Major Thirds Chord Number (Voices)
Tuning "doubled" notes	9 (S5, S4)	9 (S1, S2)
	24 (S3, S2)	10 (S1, S2)
	25 (S4, S3)	24 (S3, S4)
	32 (S4, S3)	42 (S4, S3/S2)
Balancing voices	5 (S2, S1)	30 (S1, S2)
	32 (S2, S1)	
Tuning of whole chord	1 (S2, S1)	9 (S1, S2)
	32 (S4, S3)	10 (S1, S2)
		30 (S1, S2)
Tuning melodic intervals	1 (to 2) (S2)	
	24 and 25 (S3, S5)	
Aiming for equal temperament		42 (S4, S5)

In rehearsal 3, singer 4 draws attention to a harmonic minor third, which prompts singers 3 and 5 to work on tuning of chord 24:

“I think I’m hearing the minor third between the F and the D, [singer 3 and singer 5] as too wide...in other words the D on the third beat of the bar as too low.” (Singer 4, chord 24, rehearsal 3).

## Discussion

This study investigated the evolution of tuning across five rehearsal sessions in a newly formed, semi-professional singing quintet during a first term of study. The analysis of tuning was based on a mixed method that combined the physical measurement of tuning and the

investigation of the verbal interactions between singers during rehearsals. The physical measurement was based on the analysis of the  $f_0$  deviation computed against the expected equal temperament and just intonation, and measured horizontally (i.e., for each note/take/singer/rehearsal) and vertically (ie, in relation to the major and minor thirds of the piece). The verbal interactions between singers were investigated through time-stamped transcriptions of rehearsal discussions, to identify verbal interactions related to tuning, the tuning strategies adopted, and their location (bar or chord) within the piece.

Each singer in this study consistently tended towards equal temperament during and across rehearsals, as demonstrated by the pitch drift analysis. These results corroborate previous investigations conducted by Devaney et al<sup>4</sup>, showing no evidence of pitch drift in a Benedetti's three-part exercise, and contrast the findings from Howard<sup>5,6</sup> observing pitch drift in a four-part piece, in which the chords were linked via a tied note in each case, composed for the study. These findings suggest that tuning in singing ensemble might depend on the specific melodic/harmonic characteristics of the piece performed as well as the individual singers and combination of singers performing.

Furthermore, compared with the first rehearsal, intonation computed against ET was significantly flatter in rehearsal 4 and 5, ie towards the end of the first term of study. It was also flatter with repeated performances, and, in most rehearsals, post-rehearsal. Tuning deviation from ET was less consistent in the first rehearsal, compared with the rest of the rehearsals, as shown by the SD of the measured deviation. This is not surprising, as the singers did not know each other before the first rehearsal, and did not practice the piece before. The consistency did not change pre-rehearsal and post-rehearsal, but gradually improved in the first three rehearsals. The tuning of singer 5 was significantly less consistent and wider compared with the other singers, as quantified by the SD and range of measured deviation, respectively, but still highly accurate.

Tuning deviation from ET was more consistent and narrower in the third rehearsal, which was the anticipated midpoint of the first term of study, although, due to some last-minute issues, the final rehearsal date was moved, and consequently the anticipated and actual midpoint were different. Therefore, rehearsal 3 was at the time the anticipated midpoint, and played a crucial role in the consistency and dispersion of tuning. The role of this rehearsal is consistent with the group development theory advanced by Gersick,<sup>33</sup> suggesting a turning point in the development, halfway through the process of working towards a shared goal, in which there is a transition from exploration mode to action planning mode.

The size of the major thirds was slightly closer to just intonation, with examples of both just and ET system across the piece. This did not change within (ie, pre-rehearsal and post-

rehearsal) and across rehearsals (R1-R5), and repetitions (T1-T3). Chord number and pair, however, did significantly affect the size of the major thirds. The pair singer 1 and 2 (S1-S2) tuned their major thirds closer to just intonation, but the pair singer 2 and 3 (S2-S3) closer to ET. These results suggest that the tuning of major thirds might change with singer and the harmonic/melodic content of the piece. The highly variable size of the major thirds across pair of singers measured in this study also corroborates the results from perception studies, showing different subjective preferences for the size of major third dyads.<sup>11</sup>

Intonation of the minor thirds was clearly closer to ET; this did not change across repetitions and rehearsals, or pre-rehearsal and post-rehearsal. Chord number significantly affected the tuning, suggesting, similar to the finding with the major thirds, that intonation of the minor thirds might be context-specific. The variability of the minor and major thirds based on the chord number, including examples of intonation close to both ET and just intonation, is in line with previous results found by Devaney et al<sup>4</sup> when investigating minor and major thirds in a three-part progression written by Benedetti. The consistency and distribution of the major and minor thirds' tuning, as quantified by the SD and range of the thirds' size respectively, did not differ pre-rehearsal and post-rehearsal, and across rehearsals and repetitions, suggesting that this tuning behavior was highly repeatable in relation to the minor and major thirds and typified the ensemble.

The analysis of the verbal interactions in relation to aspects of tuning that emerge spontaneously during rehearsal demonstrates that singers allocated 19% of the total time rehearsing to aspects of tuning. This indicates that tuning was a consistent feature of rehearsal in this ensemble, in line with previous research conducted among professional *a cappella* vocal ensembles.<sup>18</sup> The time spent on tuning decreased during the study period, and this might be understood in light of previous investigations showing a shift from “basic” tasks, such as work on intonation, in early rehearsals to “interpretative” tasks, such as expressive intentions, in later rehearsals.<sup>24</sup> The ensemble made use of a range of strategies to improve the overall tuning, such as repeating a short section, single bar, chord, tuning “doubled” notes, and isolating and rebalancing two or three voices, so certain voices could be stronger. These strategies were also applied specifically to chords containing major and minor thirds, and indeed a number of these chords (eg, chords 30, 32, 10, and 24) were the focus of the most time in solving tuning issues. Most tuning time was allocated to major thirds, but this did not appear to be deliberate strategy on their part, as there was little explicit discussion of chord type. The reasons for this are not clear, although it may be that these chords had characteristics that meant the tuning issues were easier to detect, for example, with the presence of doubled notes or octaves. In general, the verbal interactions revealed that methods used for tuning thirds was rather indirect, as the group

found ways to identify problems and generally improve the tuning of these chords, rather than focusing on tuning of harmonic intervals or aiming explicitly for adherence to equal temperament or just intonation tuning systems.

The combination of measured intonation horizontally and for vertical thirds with analysis of the verbal interaction reveals a complex picture of the tuning strategies of this quintet. The increased consistency in horizontal tuning with rehearsal, peaking in rehearsal 3, is an expected result, in that as the singers practice they establish their tuning of the piece. This is most probably related to other performance goals including blend and expression, and reflects the findings of the verbal interaction data that they spend less time discussing tuning throughout the term. That the increased consistency is in parallel with overall flatter horizontal intonation is unexpected but suggests that the group are satisfied with these intonation outcomes, also implied by the reduced discussion on tuning in the later sessions. This ensemble overwhelming tune to ET horizontally, avoiding pitch drift, and also present features of just intonation occurring frequently in the tuning of major thirds. The varied but repeated tuning of thirds suggests either context and/or singer specific practice, however this seems to be a spontaneously emerging characteristic based on the absence of specific work to tune thirds, rather the group worked to tune an overall chord or match octaves. A notable increase in time spent on tuning of chords with major thirds is in line with experience reported in the literature that thirds are difficult to tune,<sup>34</sup> but without explicit reference to the thirds within those discussions this data supports the hypothesis that tuning is highly context driven based on a complex number of factors rather than a simple aim to tune thirds within a specific system.

### **Limitation and future works**

This study was based on a single ensemble performing a five-part piece featuring a simple harmonic context and a homophonic structure. Future investigations should use other ensembles and pieces with greater tonal and rhythmical complexity, to test the replicability of the above findings in more musically complex pieces. The stimulus used in this study was a Bach chorale arranged to facilitate and maximize the accuracy in the analysis of tuning by limiting semitone progressions in any part, but still challenging the singers during the five rehearsal sessions across a first-term of study. The resulting stimulus was a medium-length piece without repeated notes and with few semitones. Parallel octaves and fifths are present in the arrangement, which were strictly forbidden in Bach's harmonies but not uncommon to other kinds of music, such as jazz, popular and folk music. Further investigations could analyze the approach to tuning in an untouched Bach composition, addressing the effect of parallel octaves and fifths on tuning

using an untouched Bach's composition in addition to a manipulated piece with some consecutive octaves and fifths.

Singers performed the pieces to the vowel /i/ for consistency with previous investigations analyzing repeated performances in singing ensembles.<sup>26, 28, 29</sup> It is common to observe slight sharpening in ascending passages when the text makes use of this vowel, although this was not the case in the present study. It would be of interest for further studies to investigate the effect of the chosen vowel on tuning, through repeated performances of a shorter piece sung each time to a different vowel.

This study focused on five lab-based rehearsal sessions, representing five snapshots captured across a first term of study. The ensemble continued to rehearse outside of the study in order to work on other pieces, and was coached between lab-based rehearsals; these extra events were not considered in this study but will have contributed to the development of the group's performance traits. Further research should analyze all rehearsal and coached sessions of a specific and shorter study period to investigate the development of tuning with controlled practice, and in relation to coaching.

The intent of the current investigation was to analyze aspects of tuning that emerged spontaneously with practice. For this reason, singers were not aware of the scope of this study, but were asked to work on producing an expressive performance. Another avenue of research should consider the evolution of tuning when singers are explicitly asked to master tuning. This may shed some more light on the rehearsal strategies that singers consciously apply to excel tuning during singing ensemble performances, as well as determine which tuning systems they are aspiring to.

Finally, singers were invited to master the expressive performance of the piece across rehearsals, pretending that they would have had to perform the piece in form of a concert. Further studies should consider a more realistic situation, with an ensemble working on a piece that will be then also performed on stage.

## Conclusions

This study investigated the evolution of tuning in a newly-formed advanced singing quintet during five rehearsal sessions across a first term of study. Each singer performed closer to ET, avoiding pitch drift based on just intonation predictions, during and between rehearsals and across repetitions. Deviation from equal temperament was flatter towards the ending of the first term compared with the initial rehearsal, and was more consistent and narrower in the third rehearsal. The ensemble tuned the major thirds slightly closer to just intonation, and the minor

thirds closer to equal temperament, and these results were consistent within and between rehearsals, but changed based on chord number and singers' pair.

Tuning was an important dimension of rehearsal in this ensemble with 19% of the total time of rehearsal dedicated to tuning, and which showed a decrease over time from rehearsals 1 (33%) to 5 (7%). Singers adopted a range of strategies to solve tuning related issues, including tuning doubled notes, whole chords, specific melodic intervals, and balancing voices.

The above findings contribute to understanding the developmental aspects of tuning in advanced singing ensemble. This study provides an evidenced base and context from which choir directors and coaches can develop their rehearsal strategies and performance goals.

### Acknowledgments

The authors would like to thank the singers who took part in the study, and the White Rose College of the Arts and Humanities (WRoCAH) for funding this investigation.

### References

- 1 C Hansen *Tuning the choir* Music Educ J, 51 (1964), pp. 85-89
- 2 F Havrøy 'You cannot just say: "I am singing the right note"'. *Discussing intonation issues with Neue Vocalsolisten Stuttgart*, Music Pract (2013). Available at:<http://www.musicandpractice.org/volume-1/intonation-neue-vocalsolisten-stuttgart/> Accessed March 21, 2015
- 3 S Ternström *Choir acoustics—an overview of scientific research published to date* Int J Res Choral Sing, 43 (2003), pp. 1-8
- 4 J Devaney, MI Mandel, DP Ellis, *et al.* *Automatically extracting performance data from recordings of trained singers* Psychomusicol Music Mind Brain, 21 (2011), pp. 108-136
- 5 DM Howard *Intonation drift in a capella soprano, alto, tenor, bass quartet singing with key modulation* J Voice, 21 (2007), pp. 300-315
- 6 DM Howard *Equal or non-equal temperament in a capella SATB singing* Logoped Phoniatr Vocol, 32 (2007), pp. 87-94
- 7 DM Howard, J Brereton, GF Welch, *et al.* *Are real-time displays of benefit in the singing studio? An exploratory study* J Voice, 21 (2007), pp. 20-34
- 8 J Devaney, DP Ellis *An empirical approach to studying intonation tendencies in polyphonic vocal performances* J Interdiscip Music Stud, 2 (2008), pp. 141-156

- 9 J Potter *Ensemble singing* J Potter (Ed.), *The Cambridge Companion to Singing*, Cambridge University Press (2000), pp. 158-164
- 10 F Mayer *The relationship of blend and intonation in the choral art* *Music Educ J*, 51 (1964), pp. 109-110
- 11 S Ternström, J Nordmark *Intonation preferences for major thirds with non-beating ensemble sounds*. In: *Nordic Acoustical Meeting*, Helsinki, 12–14 June 1996-; 1996:359–365.
- 12 H Terasawa *Pitch drift in choral music* Music 221A final paper; Center for Computer Research in Music and Acoustic, at Stanford University, CA (2004) Available at: <https://ccrma-standford-edu.sheffield.idm.oclc.org/~hiroko/pitchdrift/paper221A.pdf> Accessed June 5, 2014
- 13 A Planchart *On singing and the vocal ensemble I* J Kite-Powell (Ed.), *The Performer's Guide to Renaissance Music* (2nd ed ), Indiana University Press, Bloomington, IN, USA (2007), pp. 28-41
- 14 A Blachly *On singing and the vocal ensemble II* J Kite-Powell (Ed.), *The Performer's Guide to Renaissance Music* (2nd ed ), Indiana University Press, Bloomington, IN, USA (2007), pp. 14-27
- 15 J Murray Barbour *Just intonation confuted* *Music Lett*, 1 (1938), pp. 48-60
- 16 E Timm *Intonation facts* *Music Educ J*, 29 (1943), pp. 19-20
- 17 R Duffin *Tuning and temperament* J Kite-Powell (Ed.), *The Performer's Guide to Renaissance Music* (2nd ed), Indiana University Press, Bloomington, IN, USA (2007), pp. 279-298
- 18 F Havrøy *Alone Together. Vocal Ensemble Practice Seen through the Lens of Neue Vocalsolisten* Stuttgart Norges musikkhøgskole (2015)
- 19 M Blank, J Davidson *An exploration of the effects of musical and social factors in piano duo collaborations* *Psychol Music*, 35 (2007), pp. 231-248
- 20 J Davidson, EC King *Strategies for ensemble practice* In: *A Williamon (Ed), Musical Excellence: Strategies and Techniques to Enhance Performance* , Oxford University Press, Oxford, UK (2004), pp. 105-122
- 21 EC Goodman *Ensemble Performance* *Musical Performance: A Guide to Understanding*, Cambridge University Press, Cambridge, UK (2002), pp. 153-167
- 22 A Williamon, JW Davidson *Exploring co-performer communication* *Music Sci*, 6 (2002), pp. 53-72
- 23 R Chaffin, G Imreh *Practicing perfection: Piano performance as expert memory* *Psychol Sci*, 13 (2002), pp. 342-349
- 24 J Ginsborg, R Chaffin, G Nicholson *Shared performance cues in singing and conducting: A content analysis of talk during practice* *Psychol Music*, 34 (2006), pp. 167-194

- 25 J Ginsborg, E King *Rehearsal talk: familiarity and expertise in singer-pianist duos* Music Sci, 16 (2012), pp. 148-167
- 26 S D'Amario, H Daffern, F Bailes *A longitudinal study investigating synchronization in a singing quintet*. J Voice (2018)
- 27 S D'Amario, H Daffern *Using electrolaryngography and electroglottography to assess the singing voice: a systematic review* Psychomusicology Music Mind Brain, 27 (2017), pp. 229-243
- 28 S D'Amario, H Daffern, F Bailes *A new method of onset and offset detection in ensemble singing* Logop Phoniatr Vocology (2018)
- 29 S D'Amario, H Daffern, F Bailes *Synchronization in singing duo performances: The roles of visual contact and leadership instruction* Front Psychol 9, (2018)
- 30 H Daffern *Blend in singing ensemble performance: vibrato production in a vocal quartet* J Voice, 31 (2017), pp. 385
- 31 P Boersma *Praat: a system for doing phonetics by computer*. Glot Int 5, 2001, 341–347
- 32 DM Howard, JAS Angus *Acoustics and Psychoacoustics* (5th ed ), Focal Press, Oxford, UK (2017)
- 33 CJG Gersick *Time and transition in work teams: toward a new model of group development* Acad Manag J, 31 (1988), pp. 9-41
- 34 R Covey-Crump *Vocal consort style and tuning* J Paynter (Ed.), Companion to Contemporary Musical Thought, 2, Routledge Reference, London and New York (1992), pp. 1020-1050



## 11.6 Appendix F Trajectory drawings

The trajectory drawings created by Group 2 are reproduced below. They were used as a way to prompt reflection as the participants described their experiences, and also to identify what were perceived as key milestones in the process.

Green boxes – events perceived as positive to progress

Orange boxes – events perceived as negative to progress

Blue box – period without rehearsals due to Christmas break

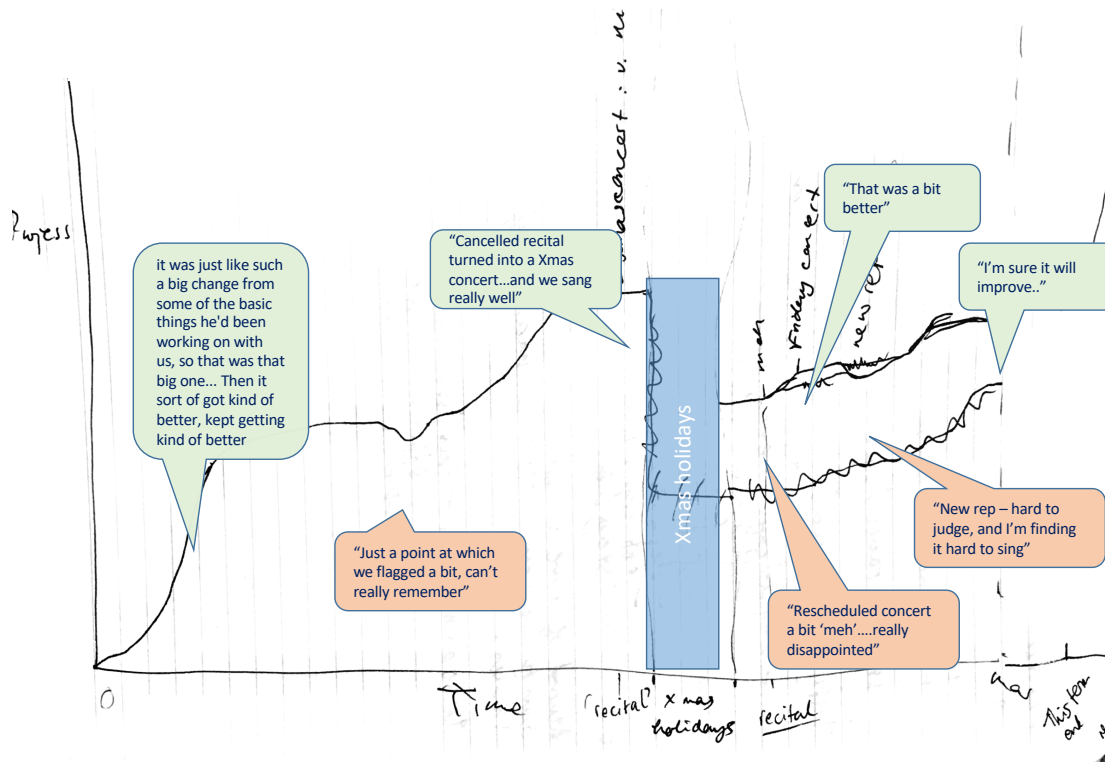


Figure 11.1 Trajectory drawing – Singer V

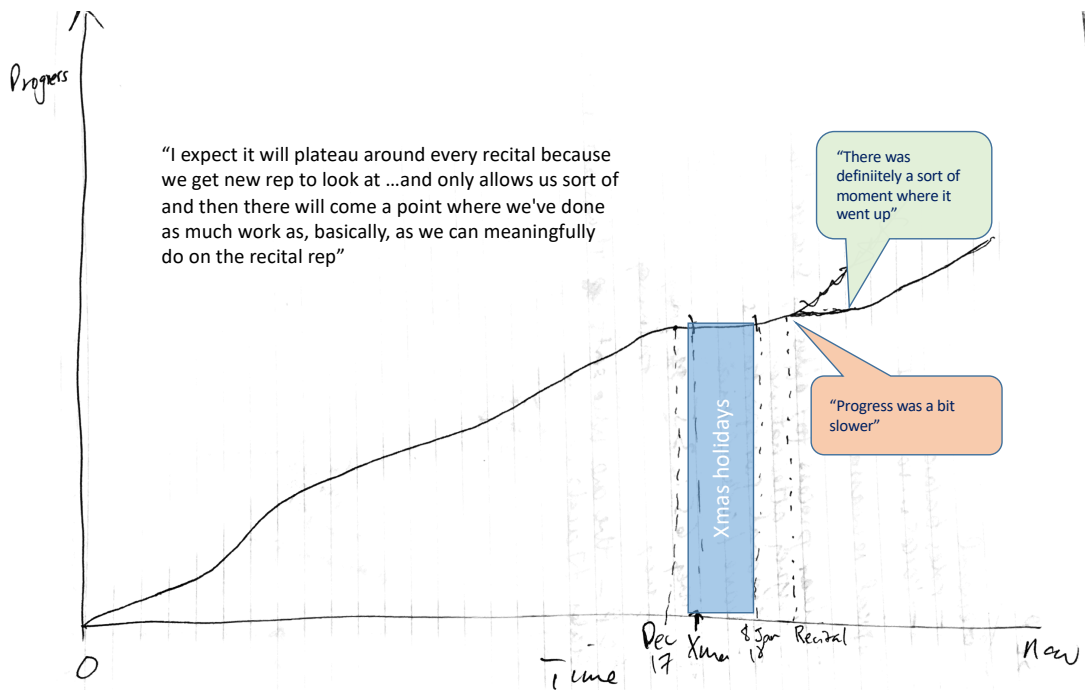


Figure 11.2 Trajectory drawing – Singer W

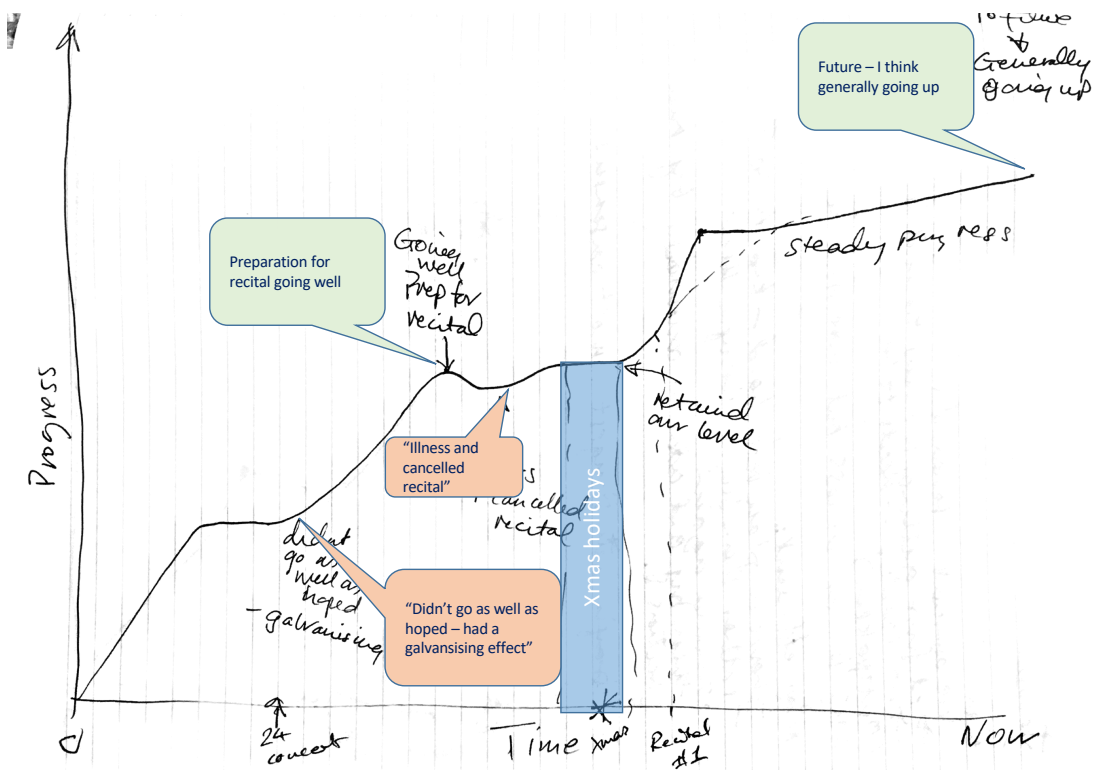


Figure 11.3 Trajectory drawing – Singer X

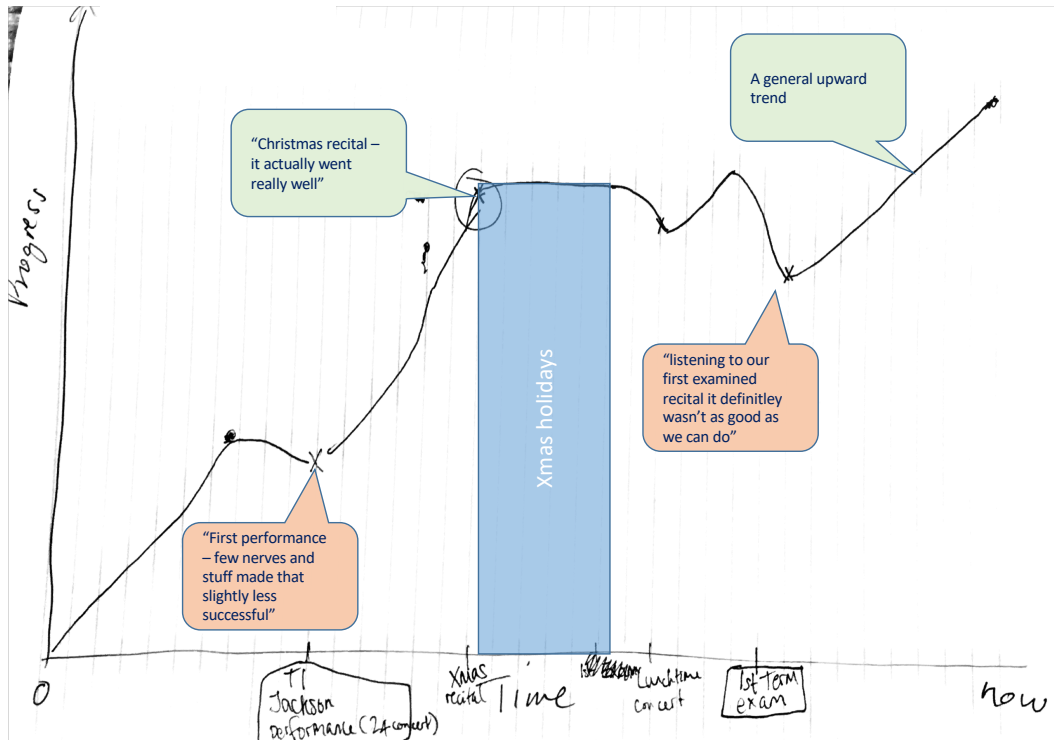


Figure 11.4 Trajectory drawing – Singer Y

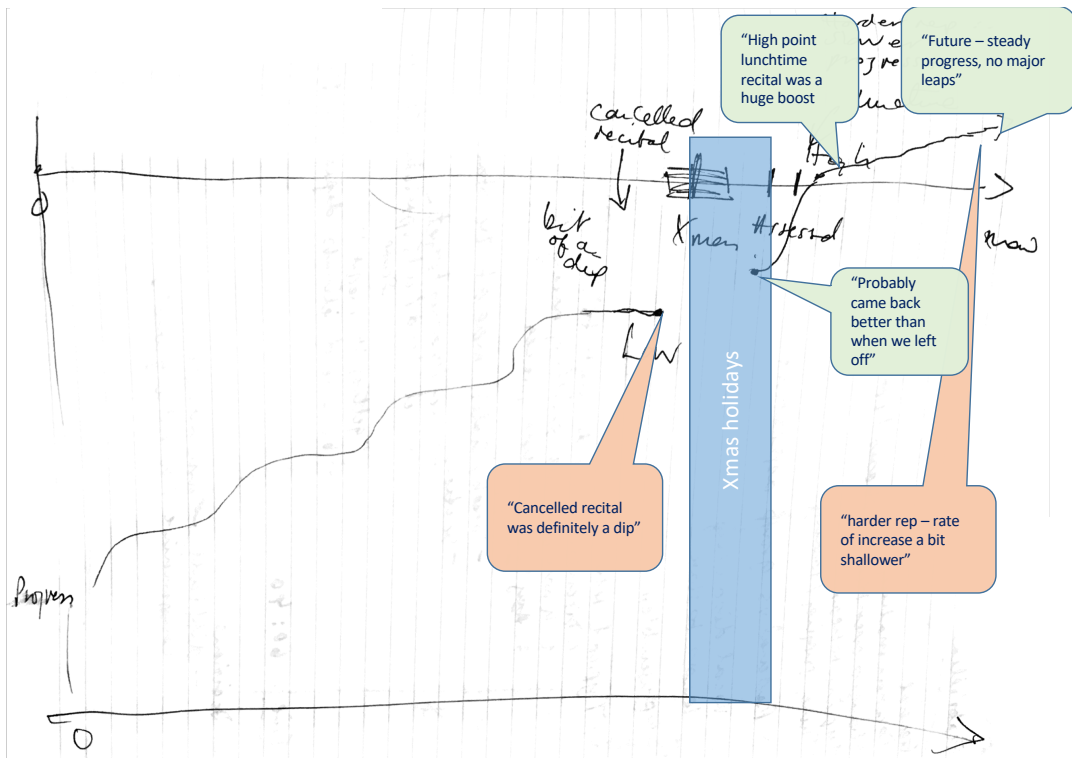


Figure 11.5 Trajectory drawing – Singer Z

## 11.7 Appendix G *Interview guide and assessment criteria*

### *11.7.1 Semi-structured interviews - guide questions*

General: Overall, what's your experience so far with the group? What's gone well/highlights? Or low points? What made it work well? Or not so well?

Goals: What were your own goals? The group's goals? To what extent were they achieved? What were the contributing factors?

Decision making: Who makes decisions about what to work on, and how? Does this change during the rehearsal? What is/was your role? Others' roles? Do you ever disagree? If so, how do you resolve differences?

Development: What has changed over time so far? How have things changed this term compared to last term? What about off-camera interactions? Relationships before? During? How well did your rehearsals prepare you for performances?

Other: Follow up/other points to mention, drawing of timelines (Group 1) and development trajectories (Group 2)

### *11.7.2 MA Music (Solo Voice Ensemble Singing) assessment criteria*

“Work with industry experts: This course is directly beneficial to students wishing to break in to the commercial world of classical singing. You'll gain vital skills for performing your repertoire professionally, enabling you to be competitive within the professional solo and choral worlds.” (from Course Description on York University web site). <https://www.york.ac.uk/study/postgraduate-taught/courses/ma-music-solo-voice-ensemble-singing/#careers>, accessed 4th February 2019)

Performance assessment criteria: All MA Music programmes, University of York

90% - 100%: Work which has reached not only a professional standard, but a professional standard of excellence. The performance will show a degree of insight and/or interpretation which challenges current work in its field, as well as being at least of a standard acceptable for a commercial recording or performance at a major public venue. The music chosen for performance will also contain a level of interpretative and/or technical challenge commensurate with the highest professional standards.

80% - 89%: High Distinction. Work whose quality bears comparison with professional standards, and which therefore shows technical and interpretative command of the chosen repertoire as well as interpretative (and in some cases, technical) challenges.

70% - 79%: Distinction. Work which has reached a clear standard of excellence. The performance will display a high degree of interpretative attainment, and will also show technical accomplishment commensurate with the communication of such musical ideas. Work marked in this band may, however, not have attained full, professional-level technical achievement; to give two examples, a singer of a relatively young age, or a string player using, for instance, a baroque instrument which is new to them, may not fully have mastered some of their technical problems.

60% - 69%: Merit. Very good work that shows a high degree of achievement in terms of understanding of musical ideas and text (where appropriate), and clear evidence of an ability to make convincing interpretative decisions. Technical command will be of a standard good enough to communicate musical ideas.

50% - 59%: Pass. Satisfactory work. The performance will show understanding of the music and text (where appropriate) and there will be evidence of interpretative decisions, but the performance may be lacking in full technical command.

40% - 49%: Marginal Fail. There will be evidence of musical understanding, and some interpretation, but technique may be flawed and breakdowns may feature in the performance. Work marked in this band does, however, show the potential to reach a Pass standard with further work.

0% - 39%: The work is unsatisfactory, with very limited evidence of musical understanding as well as flawed technique (evidenced by poor intonation and quality of sound).

## 11.8 Appendix H *Main themes and quotes from qualitative analysis*

Table 11.17 Summary of the main themes with illustrative quotes  
Group 1: Singers A, B, C, D, E, and Group 2: Singers V, W, X, Y, Z

Aggregated theme	Second-order theme	First-order concept	Examples from data
Exploration	Familiarisation	Building social bonds	We sort of had a chat quite early on when we realised just how much we would be working like together and how quickly we would get to know one another and stuff like that. (Y)  ... the first couple of rehearsals we just didn't really get much done because we didn't have a strategy. (Y)  so progress was a bit slower towards the start ... I'm not sure you'd have a necessarily a date or a time when it sort of picked up a bit but there was definitely a sort of moment where it went [up]. (B)  I remember our reaction was a bit like oh not sure if I like this. Speaking for myself it took a while to get into it and sink our teeth into it. But that requires quite a few weeks I think, a few weeks into a term. (E)
		Orientation	
	Communication	Testing responses	Yes. Also, I, how, what do you guys feel 9, I feel it's leading into it, to the final phrase, or ...? (V)
		Agreeing shared goals	We seem to be pretty goal orientated as individuals but I think in terms of what we want for the group that seems to be pretty similar. (Y)
Exploration	Experimentation	Trying new ideas	We had our first session or two yeah and loads of stuff kicked in and we did like loads of work on our own (V)
		Early successes	Someone ... had a bit of a slip [in performance] and the other the remaining four of us did sort of move to catch them. (Z)
Transition	Realisation	Recognising gaps	First off we don't know it, it's not in our voices, we don't know what's coming up next ... then we can start working out things like tuning, where we're going to speed up and slow down. (C)  ... early on we did loads of work on discovering the rep, and then we started our recital preparation about 2 or 3 weeks before. Then we had a practice recital ... and then we were like OK, we've got to start! (D) ... we had a practice recital which is the closest we got to tricky, to be honest. There were some differences of opinions in what we

Aggregated theme	Second-order theme	First-order concept	Examples from data
		Facing time pressures	should do, because we were on a very tight schedule for getting the music ready ... (D)
	Consultation	Reconciling differences	So, you know it's not just been us agreeing with each other ... (Z)  Yeah interpretation of text is usually, well to be honest, I think it's usually a compromise usually a vote in the end - whether it's three against two or whatever. (Z)  ... at the start of the year we had everyone singing in the way they were totally used to ...and we've now broken it down (Z)
		External influences	Amazing to learn from [touring with professional group] (A)  ... and by the end of term when we had the session with the professional group we all knew our notes, so we were asking how to make this into a piece of music (C)
	Challenges	Overcoming problems	... when we're in a room together it's been great but sometimes it's been really hard to find time to get together ... (C)
		Emotional highs and lows	... It was the only day we actually had any verbal conflict and it was just because of all the energy that everyone put in all term suddenly had to be diverted. (Z)
		Turning points	... performance was a turning point – based on the feedback and feeling like a group (E)  Then we had a practice recital ... and then we were like OK we've got to start. Yeah, we've got to seriously get on with it. (D)
Integration	Focus	Sustained improvements	... where we've improved is that we're more acutely trained. So like language and that is one I've improved on a lot since ... (D)
		Deeper preparation	... working very intensively on limited repertoire on a half an hour programme really makes a difference in the end, it gives a performance which is very rare in this setting, indeed professionally. (E)
	Efficiency	Faster progress	I think we've developed a nice way of doing things, quicker to apply things, understanding composers ... (C)



Aggregated theme	Second-order theme	First-order concept	Examples from data
		Smoother process	I think where we are now we've got a really good sort of rehearsal [process], like understanding of what we want. (Z)
		More direct communication	We're getting pretty big on high notes; we need to come back or we won't hear anything of [Singer A]. (C)
	Consensus	Mutual trust	<p>One of our pieces we started away from each other, then we stopped singing then we all came in together, all staring at the same spot in the back of the room. That was very cool. (A)</p> <p>... [now] we are a bit more daring. We've spent a lot longer trying the less obvious option of ... interpretive or expressive or whatever and saying dare we do this, how does that sound? And previously we would have dismissed it out of hand or not considered it. (E)</p>
		Common understanding	<p>Our thoughts and rehearsal processes are recognisable and audible in what we do now. (Z)</p> <p>... but there's no leader in this group, so you just have to go on a sort of unspoken democracy, where you just discuss it and then it just happens. (D)</p> <p>I'd say the first term was getting to that level in the consort, all understanding the concepts. Whereas this ... it's all under our belts and we think more about, well I think more about personally, how to get the dramatic aspects across, so the technical things are all happening together without having to think about them. (E)</p> <p>Anybody can learn the notes given enough time, you have [to] get through that in order to get to the point where you're actually engaging brain and like having meaningful thoughts about things and improving your general musicianship. And I think that's where we're at now is a stage of growth. (W)</p>
	Achievement	<p>Last term it was like 'so much singing, so much music' and this term was like, 'we achieved something really good'. (A)</p> <p>A high point would probably be the recital ... every single piece was performed better than we've done it before. (E)</p>	

