Music, Emotion and Auditory Processing:

Towards New Models of Musical Expression and Cognition

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Abstract

This study represents an interdisciplinary investigation of music cognition from both theoretical and empirical perspectives drawing principally from research in neuropsychology, and philosophy. The main aim of the thesis is to produce a coherent model of music cognition, reconciling empirical findings, current accounts of musical expression, and broader cognitive models. With this aim the investigation divides into two parts: first, examining musical expression of emotion, and second, exploring music cognition as a whole and its place within global models of cognition. A particular focus is the subdivision and independence of music subsystems, notably the separation of music and language and to what extent these are functionally, and neuro-anatomically separate cognitive systems.

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Introduction

Over the last 20 years music has increasingly become a part of our everyday lives. No longer restricted to the concert hall, we have music on the buses, in supermarkets, in our cars, and even at the swimming pool. Music can accompany us wherever we go and whatever we do and it would seem a difficult task to avoid music altogether in the course of a normal day. Despite this high level of musical involvement, relatively little is known about how the brain processes music, how we subdivide musical structure and abstract emotional significance, and how music cognition varies between the naïve listener to the professional musician.

We know much about the physics of sound and the workings of the ear, but how can we tell what is going on when these signals arrive at the brain? Historically, accounts of music 'cognition' and musical emotions have been derived from experience. Musicologists and music psychologists have developed experimental methods to verify experiential models, but music has been largely neglected by experimental psychology as a whole, or has been treated as something of a novelty, not meriting rigorous investigation. Unfortunately this has also been the case within the medical sciences, with medical conditions relating to music being seen as novelty cases examined for fun rather than gaining neurological knowledge or with the aim of developing treatment for patients. Music is not an essential function, and not therefore a priority for research. This lack of interdisciplinary research has been detrimental to the development of any global understanding of music cognition as the 'functional' models developed by musicologists, psychologists and philosophers must ultimately be compatible with the physiological workings and structure of the brain.

It is perhaps the communication sciences which have done much to reverse these trends, the advent of music therapy, and the examination of music within the more general study of auditory functions have fostered conceptions of music as a serious candidate for research. Within experimental psychology and the neurosciences there is now a substantial body of research which may be contrasted with the results of conceptual approaches in aesthetics and musicology.

Recent research in Neuropsychology has been of particular significance, providing some interesting and astonishing findings regarding the independence of music cognition from other types of information processing, and its relationships with language, emotion and other functions. We want to know what happens to musical signals when they reach the brain — how are they separated from other sounds, how is music recognised, and how do we go about analysing the musical signal? Neuropsychological studies attempt to answer such problems by studying damaged cognitive systems, for example, examining impairments following a stroke, and contrasting findings with studies of normal subjects. But what can a damaged system tell us about normal cognitive function? Why not just study normal function? After all, normal function is what we want to explain.

The main problem is that normal behaviour is 'seamless', in many cases we simply cannot see the boundaries between different cognitive functions. Brain damage, however, literally seems to carve nature at the seams allowing us to see both physical and functional damage and allowing inferences as to the interaction and autonomy of cognitive subsystems. Neuropsychological studies reveal specific patterns of impairment, for example, showing that the processing of sound is divided into three areas of processing: speech, music and environmental sound and each of these processes can be damaged independently without affecting the other parts of sound processing.

This study provides an interdisciplinary investigation of music cognition, drawing principally from research in philosophy and studies of brain damage conducted in neuropsychology in an attempt to provide a general framework for music cognition, and musical expression of emotion. One might well question why neuropsychology and philosophy should be paired in this investigation, but the interrelation of philosophy and neuropsychology is not a new one. Recent work within philosophy of mind has drawn heavily on neuropsychological deficits such as aphasias and agnosias (impairments of language and recognition) in support of functional models of the mind and neuropsychological findings relate strikingly to theoretical models of mental function produced, for example, by Fodor, Gardner, and Jackendoff. In turn, neuropsychology has started to look towards functional accounts of mental architectures in an attempt to synthesise findings in terms of a whole-brain theory. Whilst empirical findings bolster functional models, philosophy contributes to neuropsychology by offering methodological criticisms, and as regards epistemological concerns being dependent on perceptual processes. Ultimately, if cognitive deficits are relevant to broader models of the mind, musical deficits seem likely to have bearing on models of music cognition.

The aim of the discussion as a whole is to evaluate conceptual and empirical analyses of music and emotion, with the intention of assimilating findings into a unified theory of music cognition and music-emotion processing. That is, to provide a functional account of music cognition which is consistent with, and supported by empirical findings.

An Introduction to The Neuropsychology of Music

It is easy to formulate theoretical hypotheses about which aspects of music (e.g. rhythm or melody), might be processed by specific cognitive subsystems. However, such hypotheses are extremely difficult, if not impossible, to verify experimentally (with normal subjects). Brain damaged subjects however, offer us the opportunity to hypothesise regarding processing systems and strategies, to develop tests for normal subjects, and by evidence of selective damage, to conceptually formulate whether there are indeed music specific as opposed to general-purpose auditory processing mechanisms.

To begin, there are many anecdotal stories of brain damaged musicians. A Russian composer, Shebalin lost all language abilities following a stroke but managed to continue composing works which were highly acclaimed. And perhaps the most famous case of aphasia (loss of language abilities) in a composer is that of Ravel, who lost written and verbal language abilities. Although physical difficulties prevented Ravel from performing and composing, he was still able to enjoy music, teach students and criticise compositions and performances of his contemporaries. Such anecdotes about composers with brain damage are certainly interesting, but might not be thought to reveal much about the ordinary person's musical experiences. One might be tempted to explain away such findings as a result of the exceptional musical abilities possessed by these professional musicians, and indeed this seems to have been the case until the recent flurry of investigations into neuropsychology of music. In addition, the anecdotal approach to studies of music was not conducive to rigorous scientific investigation and many early cases are lacking in this respect.

Current findings have examined both amateur musicians and non-musicians with music specific deficits or sparing. In addition to providing convergent evidence for earlier investigations, these studies also offer clues as regards the nature of processing strategies in musicians and non-musicians.

After brain injury, musical abilities may be selectively spared or impaired. Subsequently, subjects are unable to 'process' musical information, hearing music as squeaking and grating sounds despite intact physiological mechanisms for hearing, as demonstrated by their abilities to hear other sounds. Occasionally specific musical functions are impaired, for example, reading music, playing an instrument, memory for music, and even the ability to identify melodic and rhythmic aspects of music. Further empirical studies may show that music, language, and environmental sounds can all be selectively spared or impaired, suggesting that to a great extent these categories of sound are processed separately and are also 'channel specific' : This means that we can not choose how to hear a sound — instead the mind is 'programmed' to process sounds in a certain way - as speech, music or environmental sound. Not only do such findings offer clues as to how music is organised and subdivided, they also give evidence regarding the broader subdivisions of auditory processing of which music is a part.

Perhaps the most startling evidence from neuropsychology of music is the separation of music and emotion processing observed in brain-injured subjects. Subjects with musical deficits have reported being unable to recognise or interpret music, whilst they still reported feeling a sense of enjoyment from music. Such subjects could still tell if a piece of music was sad or happy, and respond well within the scope of normal subjects on tests of musical-emotion detection. These findings raise many questions for this inquiry: How is it that subjects who cannot recognise music 'as music' or discriminate between musical features, can still identify the emotion being conveyed? What is it being detected which allows emotional distinctions to be made?

From this brief overview of musical deficits, one can see the scope for neuropsychological findings in developing a music specific framework, and a general model of music's place within auditory cognition and a global cognitive architecture. Indeed one might think, in light of the wealth of findings, that neuropsychological evidence alone is a sufficient basis upon which to build a cognitive model. Neuropsychological evidence, whilst certainly enlightening, requires convergence from other disciplines and importantly evidence from normal cognition. Whilst neuropsychological evidence is revealing, it leaves us with pressing problems regarding the interaction of music with other cognitive functions — specifically language and emotion. Here philosophical accounts of musical expression, conceptual analysis of emotions, and functional models of normal cognition provide some of the convergent evidence required to develop a comprehensive model.

Understandably empirical and theoretical evidence does not always converge, and in light of this I will make attempts to reconcile or reject hypotheses within the context of the interdisciplinary account proposed, that is, that any functional proposition should ultimately be compatible with neuroanatomical and neurophysiological findings. The functional 'software' is constrained by the physical 'hardware' of the system.

Part I of the discussion is concerned chiefly with explaining the musical expression of emotion and outlining different methods by which music may express emotion, in relation to different patterns of recognition and arousal in the listener. Part II is then concerned with more general issues of music cognition and how it may be incorporated within both auditory cognition and a global cognitive architecture. At various points, particularly in presenting the case for cognitivism about the emotions in Chapter 2, I rely upon *conceptual analysis*, which is necessary if the considerations that have persuaded many philosophers of mind are to be faithfully represented. But it is important to remember that there are serious questions about methodology lurking here, about what reliance we can place upon intuitions or consideration of ordinary language. We cannot keep consideration of folk psychology out of the discussion at this point. Reflection on our ordinary practice and our ordinary concepts would seem to involve simply a process of making explicit ways of thinking that are implicit within folk psychology. This is what much of conceptual analysis of emotional terms consists. A criticism here is whether this approach is legitimate, or just an armchair prejudice in favour of common-sense thinking? My position (as I have stated above in relation to functional and anatomical models), is that I reject wholesale eliminativism and accept folk psychological classifications as working hypotheses, but this provisional acceptance is tempered with the realisation that they may reflect limited interests and may turn out to be both inadequate for theoretical purposes, and also vulnerable to empirical results from psychology. Importantly though, I aim to develop an explanatory account which is compatible with the experience of music, and in this regard conceptual analyses are invaluable.

Chapter 1 offers a critical analysis of philosophical models of emotion and aesthetic accounts of musical expression, questioning their adequacy to account for musically evoked and expressed emotions in light of empirical findings. A large number of studies within aesthetics have addressed the issue of musical emotions and their expression. Yet within the wider philosophical debate on emotion, music has been largely neglected. This exclusion is problematic, as any successful theory of the emotions should yield an adequate account of the emotional potency of music without relegating musical emotions to some anomalous category. Whereas musicologists have tended to look towards music itself to explain its expressive abilities, it would be beneficial to investigate the emotions directly and to consider whether music may be integrated in existing accounts of emotion. One reason for the exclusion of music must surely be the nature of inquiry into the emotions. Until recently, emotion was not considered a subject worthy of investigation in its own right, being driven by more general psychological theorising. Consequently, theories of emotion are often tailored by the presuppositions of particular theories about the nature of the mind in general. Moreover, their assessment is to a large extent dominated by linguistic phenomena concerning the description and expression of the emotions, even though emotions existed pre-linguistically and, as the case of music shows, may well be expressed in a non-linguistic medium. Chapter 1 offers a general analysis of approaches to emotion theory and highlights some of the problems inherent in attempts to define and categorise affective states, both in terms of general theorising about the emotions and specifically in relation to the analysis of musical emotions.

This paves the way for Chapter 2 in which the limitations of cognitivism — now the dominant account within contemporary emotion theory, are considered in more detail. In light of the problems raised in Chapter 1, I raise the suggestion that cognitivism in fact fails as a comprehensive *theory* of the emotions, rather, it serves only to outline necessary cognitive prerequisites for a few specific emotion types. In reply to this critique, I provide a 'general account of emotionally affective states' which incorporates both musical emotions and empirical findings, and serves to outline the scope of affective constructs which are the concern of the enquiry.

Chapter 3 moves on to advance a revised model of musical expression encompassing both theoretical and empirical perspectives outlined in Chapters 1 and 2, and introducing the main body of neuropsychological findings. Some of the neuropsychological findings certainly undermine many past and present theories regarding musical expression, in particular questioning music's relationship with language. Further evidence that brain damage can allow subjects to determine the emotional content of a piece without being able to process musical features leaves us in the position to make a number of hypotheses about music-emotional relationships, and the independence of music cognition.

In light of the model outlined in Chapter 3, and the empirical findings, Chapter 4 then offers a critical analysis of an expression theory advanced recently within aesthetics to demonstrate the implications and relevance of empirical findings for such accounts. The aim of the discussion is not only to refute the specific account in question, but also to highlight the wider implications of empirical evidence in relation to aesthetic investigations of music and musical expression. This is not to say that aesthetic accounts are to be rejected indiscriminately, for in many cases they converge well with empirical findings and offer an accurate account of musical experience. However, the discussion within this chapter serves to highlight the necessity of considering underlying perceptual processes, and the errors which can arise through failure to make sufficient distinctions between the varieties of expression and reception involved. To conclude Part One, I re-iterate the view that aesthetic accounts need not be rejected but that many can be incorporated within a general account of expression. To consolidate this point I offer such a broad construct by means of a 'response-dependent' account of musical expression.

Part II of the thesis is concerned with music cognition as a whole, its subdivisions, and place within broader theories of mind. Chapter 5 introduces a detailed neuropsychological case study, which allows me to challenge some current assumptions within neuropsychology of music and adds support to the hypotheses advanced in Part I. The study examines MR, a musician with severe aphasia following damage to the left hemisphere, but with spared musical abilities. MR shows remarkable sparing of highly complex musical abilities in the presence of severe language deficits. Whilst MR is severely impaired for sentence reading, he has no problems following a complex orchestral score and detecting errors in performance, continuing to perform complex musical tasks with ease. Not only does it appear that music and language function to a large degree independently, but that there seem to be highly complex perceptual music skills, music reading and seemingly musical memory which are independent of language processing and even other musical functions. Case MR sheds light on hypothesised neurological differences between musicians and non-musicians, and allows me to challenge some existing hypotheses, and the assimilation of findings from Chapter 3 and Chapter 5 gives a conceptually and empirically sound basis upon which to begin developing a model of music cognition.

The findings presented suggest a highly fractionated system involving many autonomous subdivisions in processing. In light of this, Chapters 6 considers music in relation to a modular hypothesis, which matches the patterns of neurological and functional impairment seen. Chapter 6 gives a general overview of the modular hypothesis and considers critiques in relation to its application in the neurosciences. It seems that in general terms a modular hypothesis may be an appropriate architecture on which to develop a model. Chapter 7 then has the task of assessing the degrees of processing autonomy exhibited by musical functions, and the patterns of organisation demonstrated by findings. Music is assessed as a candidate for modularity and associated possibilities for modular hypotheses are considered: whether music is innate or developed, whether it is neurally as well as functionally distinct, and whether modularity applies to all or only parts of the system. I am particularly concerned here to offer an account of *receptive* musical processing which is also compatible with the account of expression proposed in Part I. Having proposed a receptive model, I then go on to consider this in relation to auditory processing and in relation to other cognitive functions. I am not uncritical of empirical findings or indeed methodologies and Chapter 7 provides a forum for raising these issues in relation to the model developed, particularly the unequivocal neglect to account for initial auditory perception within neuropsychological studies.

Throughout the discussion I aim to maintain a critical stance on the plausibility of the developing model in relation to evolutionary concerns, neuroanatomical constraints and importantly how the account relates to our actual perceptions of music and the musical expression of emotion.

Part I

Musical Expression of Emotion

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Chapter 1

What are Emotions?

1.1 Introduction

It would be imprudent to attempt an explanation of musical expression of emotion without first offering some discussion of the emotions in question. Chapter 1 provides some preliminary discussion of emotion theory, highlighting some of the more wide-ranging problems for analyses of emotion, many of which are seen to cut across methodological divides: attempts to categorise types of affective state, the reliance upon language as an accurate reflection of *psychological* states, the cultural diversity of emotions and the *actual* relationships of cognitive and physiological affective components. In light of these issues further discussion examines problems specific to the analysis of musical emotions (1.4), paving the way for Chapter 2 in which more detailed critical discussion of existing accounts will attempt to reconcile the diverse analyses presented here.

The chief divergence in analyses of emotion is between, on the one hand conceptions of emotions as primarily cognitive and, on the other, as primarily physiological phenomena. This divergence underlies different methodological approaches for the investigation of affective states, (corresponding roughly to a divide between theoretical and empirical investigations), and features heavily in the history of emotion theory. The thought of Aristotle for example, can be seen to anticipate contemporary cognitivism, (explaining emotions in terms of beliefs and desires). However, the widespread adoption of cognitivism as a theory of emotion, is a relatively recent conversion, reflecting the rise of cognitivism in philosophy of mind. Physiological or feeling-centred theories have intermittently held sway for the past two millennia, regarding emotions as essentially non-cognitive states and suggesting a conflict between 'reason' and the emotions as 'passions'. The 17th century saw the rise of new 'scientific' methods, based on observation and experiment and the study of emotion was soon redeveloped as a truly 'scientific' endeavour. Emotions were explained in terms of observable, and felt physiological arousal, our conscious recognition of these bodily states constituting emotions. It was a natural progression, then, for feeling-centred theorists to categorise emotions in terms of their patterns of physiological arousal, (James 1884, 1890). These 'Feeling-centred' studies of emotion focused on descriptions of one's own bodily sensations, and little progress was made apart from an ever increasing catalogue of first-person accounts describing emotional experiences, which did little to extend understanding of emotion as a general concept. Introspection was widely accepted as the primary method of looking at the mind. Nonetheless, we can see clearly by looking at introspectionist accounts (e.g., those of James 1884 1890, and Lange, 1887), that these are heavily influenced by their preconceptions of emotion within the subtext of broader concepts of mind, noticeably the dominant Cartesian account.[1] Personal reportage on emotion completely left out causes of emotions, concentrating on the physical

effects and feelings, to the exclusion of any relationship emotions have to the external world or even to cognitive states.
The twentieth century, and the rise of psychology as an independent field saw widespread adoption of behaviourist accounts, explaining emotions in terms of their behavioural characteristics (Watson, 1913, 1919, 1930, Skinner, 1938, 1953). Philosophy however, was soon to reject behaviourist accounts for their failure to account for mental processes - being subject to the same critiques surrounding feeling-centred accounts. The move then was back to the Aristotelian (cognitivist) account of emotions explained in terms of beliefs and desires. The advantage of cognitivist accounts is that we may readily assess emotions as rational or irrational in light of their cognitive content and this allows type-differentiation of emotions, by reference to their characteristic causes and objects. The ability of cognitivism to distinguish clearly between individual emotions was a distinct advance on the lack of specificity available to feeling-centred accounts. The divide between cognitive and feeling-centred (or the contemporary 'physiological') accounts, remains in place, despite acknowledgement that both cognitive and physiological aspects play a role in the explanation of emotion in general. Cognitive accounts having been offered by Gordon, 1987; Solomon, 1976; and Lyons, 1980; and physiological accounts by Panksepp, 1982; Zajonc, 1980; LeDoux, 1989. However, we will see in Chapter 2 that hybrid accounts are becoming more widely acknowledged and I will consider the compatibility of cognitive and physiological/perceptual accounts of emotion. Investigation of the physiological aspects of emotion has flourished in the last few years, and I will consider some specific empirical findings below (1.3).

1.2 The Rise of Cognitivism

Three main criticisms are directed at feeling-centred accounts. First, they fail to account for the intentionality of emotions. Second, they are unable to account for the extent to which emotions are assessed in terms of rationality. Lastly - and this is perhaps widely regarded as their main weakness - they are unable to provide any fine-grained distinctions of emotions by type. Let us look at these shortcomings in a little more detail (bearing in mind the methodological remarks about reliance on introspectionism in the general introduction).

Emotions typically have the property of intentionality, being directed at or towards something. For example, we are saddened *that you had that accident*, but are relieved *that the chances of a complete recovery are so high*. I am disappointed at *not getting that article accepted for publication*. The passengers are afraid *that the plane is going to crash*. And so on. Feeling-centred accounts fail here in that we cannot attribute this complex property to emotions *and* maintain that they are simply bodily sensations. Reflection on ordinary language reveals important and systematic distinctions between intentional and non-intentional states. Typically, if someone declares they are angry, we might legitimately ask what they are angry *about*. Although we might ask for a *causal* explanation of bodily sensations — 'Why are you in pain?', 'What can have made you feel nauseous?', etc. — we do not ask what such sensations are directed towards. It would not make sense to say 'What are you hungry/warm about?' Bodily sensations simply do not have intentionality, we cannot describe toothache or feelings of warmth as *directed at* or *about* anything.[2]

Similarly, we cannot describe headaches or pangs of hunger as unreasonable or irrational. So the assimilation of emotions to bodily sensations would mean that one cannot account for emotions as open to rational assessment. But it is commonplace to acknowledge, for example, that one was wrong to get so angry, because so much anger was not justified in the circumstances; or that you ought to feel gratitude towards one's benefactor *because that would* *be an appropriate response* given the fact that she has done so much for your sake. Notice further that, if you were subsequently to learn that what that supposed benefactor had done had not been undertaken for your sake, but for quite other and self-interested motives, then it would no longer be appropriate to continue feeling grateful towards her. One can multiply examples of the appropriateness, suitable adjustment, justification, and rationality of emotional states at will, (and, by contrast, cases of inappropriate, unsuitable, unjustified, and irrational emotion). However, it should be acknowledged that there are certain emotions which do not fit the standard pattern of rational assessment. For example, it is not clear that endogenous (objectless) depression (unlike, say, disappointment) is ever *appropriate* or *justified*, even though there are circumstances in which reactive depression (e.g. in response to bereavement) is accepted as an understandable and properly human reaction. Also there are certain emotions which may have basic conditions for rational comprehensibility (e.g., concerning what *sort of thing* you envy or are jealous of), but which are so strongly negative that it is questionable whether an emotionally well-adjusted person would ever be fully justified in feeling them (e.g., *hate*). Whatever the verdict on those complications, it is clear that in general emotions allow a form of assessment (as rational or appropriate) which is simply inapplicable to bodily sensations.

This brings us to the third main critique of feeling-centred accounts. We can clearly distinguish between object-directed *emotions* and mere bodily sensations. But feeling-centred accounts have no means of distinguishing between these, or between specific emotions, other than to summarise how they feel. In terms of feeling, some fears and some joyous excitements may be very similar, or even indistinguishable. What distinguishes indignation from other forms of anger is not how it feels (as if there were some distinctive *indignation quale*), but rather the fact that in order for someone to feel indignant they must think that they have been treated unworthily. In other words, for a whole range of emotional types, there are necessary conditions for being in just that particular kind of emotional state which must be expressed in cognitive terms. One cannot feel *grief* unless one thinks one has suffered a loss. One cannot feel *remorse* unless one believes that one has acted wrongly. One cannot feel *hope* without believing that there is at least some possibility of a happier future state. And so on. That cognitive prerequisites (or components) are built into our ordinary concepts of emotional states seems to be one of the least contestable results of conceptual analysis.

The case for cognitivism, and its limitations, will be reviewed more thoroughly in Chapter 2. But here I would just like to draw attention to the following point. In so far as cognitivism about the emotions is based upon the above considerations, it is doubtful whether it amounts to a full theory of the emotions, even though one does quite frequently encounter references to "The Cognitivist Theory of the Emotions". For what the arguments establish is that there are *necessary conditions*, of a cognitive kind, for being in various emotional states. This falls some way short of telling us what emotions *are*. For it does not even settle the question of whether those cognitive aspects of the emotions are *parts* of the emotional state, whether they are necessary *causal antecedents* of the emotional state, or whether they are conceptually required *accompaniments* of the emotion in question.

1.3 What are Emotions?

Before turning our attention specifically to musical emotions, we need to clarify which affective states fall within the scope of this investigation. For ease of discussion I will refer to 'affective states', as a broad category, to encompass, emotions, moods, feelings, and any physiological and cognitive states that might be referred to in affective terms. As they are already prevalent in the discussion of affective states, I will refer to 'emotions', and 'moods' as used in the ordinary description of affective categories (moods used typically to describe unfocused, long-term affective states and emotions to describe focused short term affective states). I feel that use of the term 'feelings' requires further comment as it is used ambiguously to describe both 'emotions' and bodily sensations. Here I will take 'feelings' to be a blanket term for any affective state involving self-awareness of one's bodily state and also to include bodily feelings such as pains and aches. I take affect as the broadest category, referring to chiefly physiological responses of which one may or may not be aware and importantly which *underlie* other more complex affective states. The idea I propose here (and which will be developed in Chapter 2) is that these varieties of affective state may be variously combined. Emotive 'episodes' which might be described as 'sadness', 'happiness' etc., may in fact involve a transition through one or more of these affective states. The following discussion will in fact, serve to reveal some of the difficulties in any attempt to classify affective states in terms of distinct categories, and will consider existing methods of classification.

For the musical case, many theorists talk of the musical expression of emotion, feeling or mood without explaining what their notion of 'emotion', 'feeling' or 'mood' amounts to. How for example, might one effectively distinguish emotions from moods, feelings and affect? Current emotional vocabulary seems to presuppose that 'emotions' are a distinct and easily identifiable category of affective state. Yet despite the ease with which we might be able to compile a *list* of 'emotions' (as opposed to what we might call moods, feelings and bodily sensations), we are still in no better position as regards identifying emotions as a distinct *kind* of mental states. Indeed, it is by no means obvious that we should acknowledge the existence of a *distinct psychological kind*, all instances of which can be appropriately labelled as emotions. Robert Gordon raises this issue in *The Structure of Emotions*, making the important point that the classification of 'emotions' as a single psychological category is only a recent addition to our discussion of emotional life and, rather than being a useful addition, it invites confusion in any attempt to identify and classify affective mental states.[3]

Some examples may illustrate the difficulties in attempting to distinguish between categories of affective state. The fact that we have a word, which is commonly taken to name an emotion, does not preclude that same word from being used in connection with other types of affective state. *Fear* is typically taken to be an emotion, as opposed to a mood or other affective state. Yet fears seem to be a pretty mixed bag. There are purely cognitive fears, physiological aversive responses, phobic responses, and both long and short-term episodes of fear. Thus, you may be afraid that your seedlings will be killed by the overnight frost. (A *purely cognitive fear*: it's something that you think might happen and you would rather it didn't, but it is unlikely to cause trembling. One often says 'I am afraid that ...', meaning not much more than 'I think that...' with an associated attitude of something less than satisfaction.) The startle response, triggered by sudden, unexpected sound or movement, may make you jump in the air and reduce you, at least momentarily, to a quivering wreck. But it doesn't make you *think* anything in particular (it is a *physiological aversive response*, behaviourally rather a dramatic example of fear). Children are liable to be afraid of the dark, although one does not expect them to be able to explain what threat or danger there is in the absence of light. (Perhaps this is not a clear example of a *phobia* — like claustrophobia or arachnophobia — but something of a further category). An explanatory account capable of incorporating all of these variations would necessarily include states we may not want to class as emotions proper at all.

One might think, however, it would be possible to distinguish at least between broader categories such as *mood* and *emotion*, which are typically taken to denote different kinds of mental states. Perhaps the most common distinction made here is in terms of duration. Emotions are seen as episodic states, whilst moods are taken to be of longer duration.

Exceptions though, immediately spring to mind. Love is considered an emotion but is not necessarily episodic, and depression seems to fall awkwardly on the boundary between moods and emotions. Others have suggested distinguishing between affective states in terms of their modes of production. After all, it is common to explain emotions by referring to their causes.[4] Emotions are usually attributed to a definite set of events, that is, determinate antecedent events can usually be identified for each instance of emotion. Moods however, do not typically have such identifiable causes (or at least not causes that are readily open to introspection). People are usually unable to cite a distinct *cause* of their moods, which are often the result of a cumulative series of events. Indeed, the same event might variously evoke affect, mood or emotion dependent upon the emoter, so problems would be invoked in attempting to distinguish categories of affective state principally in terms of causal antecedents. The cause of a mood does not become its intentional object as is often (but not necessarily) the case with emotion. Rather it is the case that moods are directed towards 'events in general' and lack determinate cognitive content.

In light of this last point perhaps the most obvious distinction to make concerns intentionality, with emotions having identifiable intentional objects, and moods interpreted as 'objectless' mental states. Yet, identification of an affective state as belonging to a particular category does not account for its intentionality. Fridja notes,

> "It is natural that that the domain of "non-intentional affective states" coincides with that of states called "moods" only roughly because natural-language words like "mood" never are used in a fully consistent fashion and do not correspond to a particular necessary feature" (Fridja, 1994, p.60).

Whilst I do not want to endorse Frijda's rather grand claims about consistency of language use, he nonetheless makes a valid point. In addition to linguistic inconsistencies, intentionality is not a sufficient measure for identifying categories of affective state. As I will discuss below (1.4), emotions *can* be produced without conscious awareness of an object (Gazzaniga, 1988) but one would not want to call these states 'moods' purely because the emoter can not identify the relevant cause or object. The relationship of emotion, cause and object is far from straightforward. Similar problems arise for distinguishing emotions and moods from more basic affective responses. Even empirical measurements of physiological responses are not sufficient for type differentiation (See p.412, Ekman & Davidson 1994). Indeed, even if it were possible to identify different neural circuitries subserving 'moods' and 'emotions', this would not solve problems of *reference* to affective states, nor *interaction* between these affective constructs. The more general issue is that a wide range of affective concepts would be redundant if we could offer such simplistic definitions.

1.3.1 Emotional States and Emotional Vocabulary

An underlying problem is the confusion between emotive language itself and the emotional states referred to. A variety of terms exist for describing emotional states, and at first glance, it might seem that we have a highly specific lexicon for discussing emotional states. On closer investigation, terms such as moods, feelings, emotion and affect have no definite ranges of application and may be loosely (and perhaps incorrectly) applied to many affective states, actions, or thoughts. As noted above (p.4) one often remarks 'I'm afraid that,' without referring or intending to refer to an affective state, but rather to an unsatisfactory state of affairs. Emotion names themselves invariably have different modes of application, to both observable behavioural states and felt psychological states. Ordinary names for emotions cannot therefore be regarded as providing a satisfactory, fully articulated taxonomy for the emotions. Ultimately the range of phenomena identified by the ordinary language word 'emotion' does not exclusively define the category of mental states to be addressed in this inquiry. It seems implausible to suggest that such a limited vocabulary of emotion might be able to distinguish between (and fully describe) every instance of an emotion, and to equate emotional states themselves with their lexicalised forms is certainly restrictive. The case of the German emotion term *Schadenfreude* provides a good illustration of this. We have no English equivalent for this emotion term but this is not to say we cannot and do not experience this state.[5] Typically though, theorists have assumed emotive language to offer a fairly accurate reflection of the emotions. Shibbles states that "An examination of the relationship between emotion and language shows what emotions are and also suggests why and how we may control and change them." (Shibbles, 1974, p.118). However, vocabularies of emotion are *not* theoretically substantial, the recognition and naming of emotion types are areas in which we see cultural diversity in folk psychology.

Referring back to my comments on methodology in the general introduction, two distinct problems concern me here. First, what we consider to be the function of emotion names and terminology in any particular emotional lexicon and second, cultural diversity exhibited in the naming and recognition of emotions. Turning our attention to the first issue, use of emotive language would suggest there to be a distinct feeling corresponding to each emotion term. Errol Bedford comments quite extensively on this problem, arguing against the misconception of emotion words as names and the misinterpretation of their function which ensues. In Bedford's view "it would be a mistake to imagine that the primary function of these statements is to communicate psychological facts."[6] Rather, we should consider such terms may be used as reports, judgements and explanations of behaviour, varying in relation to social context and not to be given primarily as a description of a qualitatively distinct experience which is the emotion itself. Bedford's point put simply is that emotive language fails to distinguish between the feel or experience of emotions, and their outward expression or behavioural characteristics. Ultimately the descriptive functions of emotion terms cannot be separated from their more general usage.[7] Bedford comments,

> "does the truth of such a statement as 'He is afraid' logically require the existence of a specific feeling? I imagine that it would nowadays be generally conceded that emotion words are commonly used without any implication that the person they refer to is having a particular experience at any given time." (Bedford, 1957, p283).

Importantly then 'being angry' does not entail 'feeling angry', but as Bedford notes "this does not accord with the confidence we have in our beliefs about our own and other peoples' emotions respectively." (*ibid.* p.285) and emotion terms apply whether we know someone is *feeling* an emotion or not. These problems stem from both the dominance of feeling-centred concepts of emotion and uncertainty about introspection and states of consciousness. This is not to say we should reject emotion terminology in favour of empirical findings, but we should bear in mind that emotion terms cannot function as names, offering intersubjectively shared meanings, due to the essentially private nature of emotional experiences.

For musical emotions the distinction between experience and expression of emotion is important. A frequently raised argument against musically aroused emotions being *real* emotions, is that they typically lack associated behavioural components. People listening to 'sad' music do not typically manifest sad behaviour. However, in making the distinction between 'is sad' and 'feels sad', one can see that expression of an emotion is not necessary to the experience or recognition of that emotion. (A notable characteristic of some emotions is that we may control their behavioural expression e.g. amusement, resentment etc.). Indeed we would not deny that someone incapable of behavioural expressions of emotion was incapable of experiencing emotions, only that they are incapable of demonstrating standard behavioural characteristics. Conversely it is quite reasonable to suggest that (as actors must commonly do), we could simulate the correct behavioural responses for an emotion yet not feel that emotion ourselves.[8]

The second issue here concerns the cultural diversity of emotions. Whilst we are trying to separate emotional states from emotive language, language nonetheless plays a key part in the social construction of emotions, and can certainly influence how many, and in what way emotions are conceptualised. Emotions as social constructs reflect culturally variable conceptions of the self and in this sense we see cultural diversity in emotional classification.

> "Emotions such as pride, ambition, guilt and remorse, imply a certain view of ourselves. They are probably not felt in cultures in which little importance is attached to individual effort and responsibility." (Peters 1974 p.402).

In attempting to analyse emotions in terms of cultural variance, we can at least draw a distinction between purely physiological symptoms, which may be universal, and culturally, and socially constructed emotional behaviours, e.g. expressions of grief or anger.[9] A good example here which again allows us to distinguish between mandatory physiological and conventionally adopted expressions of emotion, may be drawn from studies of autism. Autistic children are poor at recognising both facial and vocal expressions of emotion, and relating such emotional input to correct emotional states or situations, demonstrating specific emotional deficits in the presence of normal perceptual processing. In expressing emotions, some autistic children do however, exhibit emotional behaviour. But they do not typically adopt conventional (learnt) expressions of emotion, rather they choose their own idiosyncratic emotional vocalisations and facial expressions (for further references see Willliams, D, 1996; Schopler, E & Mesibov, G B, 1986 pp.112-113).

Cultural diversity then is demonstrated in naming, recognising and expressing emotion. The number of emotions identified by different cultures exemplifies this, ranging from just 8 to over 700 (p.238 *The Social Construction of Emotions*). Putting aside the ambiguity of emotional language, the existence of mandatory affective behaviours leads us to question whether there may nonetheless be a common core of emotional representations that operates universally and given the insufficiency of emotional language, how this might be identified. I am wary of referring to 'basic' emotions, this being a controversial issue in the psychology of emotion. An important distinction needs to be made between identifying emotions as 'basic' (i.e. prototypical cases) within a specific classificatory schema, and 'basic' referring to emotions having universally shared features. I am concerned with the latter, that is in what respects emotions may have common physiological patterns of arousal, behavioural characteristics, cognitive components or causal antecedents. Many schemas have identified 'basic' emotions according to their own particular biases. James Averill comments on this issue:

> "simply because an emotional concept is basic within some classification scheme, it does not follow that the corresponding emotion is somehow more fundamental than other emotions." "If our goal is a general theory of emotion, we must transcend parochial allegiances. Basic emotion has no more place in psychology than basic animals in zoology or basic diseases in medicine." (p.8, p.14. Averill in Ekman and Davidson).

Many theorists do hold that it is however, possible to identify universal affective features or components of emotion e.g. facial expressions corresponding to e.g., anger, fear, disgust and sadness, which appear across all cultures (see Ekman and Davidson (eds.) 1994, ch.1).

relating this to music, due to perceptual restraints in auditory processing, certain structural elements of music - rhythmic, melodic and harmonic, are consistent across cultures and perhaps these will be sufficient to produce uniform responses to and recognition of emotional content in music. An example of cross-cultural emotional responses to music might lend support to either an empirical perspective, that emotions are evoked primarily due to physiological responses or to a view that emotions are evoked and recognised due to acculturation. What seems most likely is that like ordinary emotions, musical emotions involve a combination of mandatory universal responses to stimuli and also culture specific, acquired responses and the relationship of these types of responses will be given further consideration in Chapter 3.

Importantly then, for music, we want to talk in terms of both universal and culture specific affective features and any comprehensive theory of emotion must also encompass this distinction. Music, like emotion, is culturally variable and so it is worth considering in what respect emotional responses to music could be universal, and how these responses might relate to universal affective features. What degree of uniformity is observed in the number and type of emotions aroused by and recognised in music? Indeed, why should sad music evoke sadness, joyful music happiness, yet angry music be unable to evoke anger in the listener? Music chiefly makes us sad and happy, sometimes scared or amused perhaps, but rarely if ever does the music's content provoke anger (unless directed at some relationship of the music and extra-musical events, or an aspect of its performance). Music's inability to arouse certain emotions does not obviously correspond to its lack in representational powers. Music does not seem markedly better at representing sadness, happiness, or fear, than it does anger. A different approach is to consider how emotion is transferred between people, and empirical findings might then be integrated into a unified account of expression.

Studying which emotions are transferred between people may assist us in explaining which emotions music is capable of arousing. As an example, Table 1.1 offers a classification of emotions as contagious and non-contagious. An initial consideration is whether we may identify any similarities amongst 'contagious and non-contagious' emotions.

Table 1.1 Contagious and Non-Contagious Emotions

Contagious Emotions	Non-Contagious Emotions
Fear	Grief
Joy	Regret
Sadness	Disgust Shame
Anxiety	Yearning
Distress	Shock/surprise
Worry	Embarrassment
Irritation	Anger

It would appear that there are different degrees of contagion, and we also need to make a distinction here between *contagious* and merely *detectable* emotions. Anger is non-contagious but is detectable: we can recognise anger in music and people but it does not make us feel angry. Sadness and happiness seem to be highly contagious and neither are they easily concealed, whereas emotions such as fear and grief *can* be contagious but are also concealable. This offers a fairly puzzling picture of emotions once again, but turning to an evolutionary explanation might be fruitful. The detectability and contagiousness of emotions may well be explained in terms of their evolutionary necessity. An immediate observation is that most of the 'contagious' emotions are those that would be advantageous in evolutionary terms, both as survival aids for the individual and for successful social groups. It would be a useful tool if emotions such as fear and distress could both be detectable and contagious, so that not only oneself, but also others were prepared for flight in the presence of a harmful stimulus. Similarly it would be necessary to both successful social interaction and a survival aid to *detect* anger, but not necessary that this is contagious. Those who could identify, respond to and convey emotional states, would be better fitted to effective co-operation than those lacking these abilities.

1.4 Empirical Investigation of the Emotions

Increasingly theorists are becoming aware that, whilst components of emotions usually form a cohesive whole, it *is* possible for them to occur in isolation. One can have a distinct feeling, whilst lacking cognitive content, or one can have certain evaluative beliefs about an object and behave in a certain way towards it, without feeling an emotion oneself or recognising one's emotional state. One can forget or fail to recognise the object of one's emotion, yet continue to be in an emotional state. Attempts to classify affective states need to invoke both physiological and cognitive characteristics and, before proposing my own general account of affective states (2.5) which attempts to do just this, I wish to highlight some empirical findings which are particularly relevant as regards the relationship between cognitive and physiological components of emotion. Specifically, I examine the possibility of there being *entirely* non-cognitive emotions or non-conscious affect. Certainly not all affective processing is post-cognitive. Affective responses (realised in terms of preference for certain objects), are developed when presentation of stimuli is too fast to allow for recognition of objects presented (see LeDoux in Gazzaniga, (ed.) 1984).

In terms of perceptual processing, an initial distinction needs to be made between recognition of emotional content (e.g. facial expressions, behaviour, emotional contours of the voice) and recognition of perceptual features themselves (e.g. identity of faces, content of an utterance). Emotion recognition is not always dependent on conscious recognition of perceptual input, but may in many cases be more automatic. This suggests there is a need for caution in contrasting examples of 'emotion', some of which may be the result of conscious cognitive evaluations, whilst others may be largely non-cognitive. Good examples of this are seen in the neuropsychological literature. There is evidence for separate processing of facial identity and facial expression and similarly, a distinction between identity and emotional content of the voice. A subject may recognise facial expressions of emotion, but not identity of faces, or may identify the voice as belonging to a particular person but not recognise its emotional tone. Peretz and Gagnon (1998) observe that

> "It has been recurrently reported that brain damage can produce selective deficits in the recognition of identities of seen faces while leaving intact the recognition of expressions. Inversely, selective deficits affecting the recognition of emotions from facial expressions without disturbing recognition of their identity have been reported (e.g. Etcoff, 1984; Parry et al., 1991; Young et al., 1993). These observations entail that certain aspects of face identity and facial expression are analysed separately in the human brain." (p.21, Peretz and Gagnon, Neurocase, 1999).

This evidence suggests there may be separate 'channels' for processing emotional content and calls for a clear distinction between affective processing and processing of identity. This distinction is neglected in conceptual analysis of emotion, where emotion recognition is typically explained in terms of conscious awareness and evaluation of causes and objects.

Further evidence supports the claim that it is possible to have an emotional response to an object without having recognised the object itself. We may have a positive affective response to, e.g. music or speech, without knowledge of its content (Jauregui, 1995, p.179-181), or one might have a positive response to a smiling face without being able to recognise it *as* a face. The idea of having emotions in response to 'unknown' (or unidentifiable) stimuli gains further support from the neuropsychological literature. To give a further example, split-brain patients may experience an emotion and its associated feelings but without awareness of its cause.

> "Thus Gazzaniga (1988) reports on a split-brain patient to whose right cortex was shown a film clip of a person being thrown onto a fire. This patient could not describe what she saw since expressive language abilities/verbal language depends on the left side. She said: 'I don't really know what I saw; I think just a white flash maybe some trees, red trees like in the fall.' Then she continued, speaking to Gazzaniga: 'I feel kind of scared. I feel jumpy I don't like this room or maybe it's you getting me nervous" (p.146, Understanding Emotions).

This example shows emotional recognition and experience might occur without the usual cognitive content associated with the emotion and certainly should lead us to re-evaluate the relationship between cognitive awareness and emotional experience.[10] All the same, one must be cautious about the strength of claims made on the basis of this evidence. Can one judge from the inability to verbalise, that the patient had not perceived the event? Further evidence would suggest not, LeDoux reports on split-brain subjects, that;

> "If stimuli are presented in such a way that only the right hemisphere sees them, the split brain person is not able to verbally describe what the stimulus is. However, if you give the right hemisphere the opportunity to respond without having to talk, it becomes clear that the stimulus has registered. For example, if the left hand, which sends touch information to the right hemisphere, reaches into a bag of objects, it is able to sort through them and pull out the one that matches the picture seen by the right hemisphere." (LeDoux, 1996 pp.13-14).

What these examples do show is that information about emotion may be processed without the ability to verbalise or have awareness of an emotion-object or affective state in terms of language. That is, one may have an emotion aroused even if one is unable to verbalise its cause or object. These findings support my comments in 1.3, that one should be cautious of over-emphasising verbalisation as an accurate measure of underlying psychological states.

1.4.1 Emotion and the Brain: Neural Mechanisms of Emotion

The above findings are chiefly concerned with functional models of emotion. But given that emotion processing can be both affected by, and resistant to brain damage, the question naturally arises as to whether there are any localisable neural structures associated with affective processes. Two main areas of the brain have been associated with emotion, but these are involved in the mediation of radically different affective functions. Subjects with frontal lobe damage have been seen to exhibit emotional 'detachment' and deficits in 'emotional and social reasoning, often with patients losing the emotional 'feeling' that should accompany events, memories, and responses to people. These subjects are often unable to judge the appropriateness of emotional behaviour and language, unable to involve affective implications in reasoning, and unable to control affective behaviour. These subject seem to be suffering from deficits in emotional cognition. Another area of the brain (or rather set of brain structures) called the limbic system has long been associated with emotion. But the functions mediated by these areas are markedly different from the frontal lobe patients above. The limbic system would seem to be involved in 'affective perception' as opposed to 'emotional cognition'. (See Damasio, 1994; LeDoux, 1996). The limbic system lies beneath the neocortex, surrounding the brain stem, and consists of evolutionarily older structures which are also seen in animals. The limbic system is functionally concerned with visceral processes including monitoring of one's physiological affective states. We might say that the limbic system is involved in primitive emotional processes as opposed to the higher cognitive processes associated with neocortical structures.

Much current research focuses on a component of the limbic system called the amygdala (LeDoux, 1996, *New Scientist*, April 1996, Aggleton, 1992) as an important centre for emotion processing (see Appendix I for a summary of amygdala function). Notably, as well as auditory and visual inputs, the amygdala receives sensory information directly from the thalamus, that is *before* auditory and visual input has been otherwise processed. So emotion is processed directly, but as Oatley & Jenkins put it "not via routes that result in the recognition of objects or distinctive sounds."[11] This brings into our discussion the concept of *nonconscious affect* - that we may have non-conscious affective responses involving split-second processing of sensory information. The hypothesis is that with such high-speed reactions we may have emotions without cognitive awareness. A positive or negative state may be induced without knowledge of its cause (rather like the split brain subject above). Primitive emotional circuitries (supposedly a throwback to evolutionary survival mechanisms) produce a 'feel' prior to cognitive awareness. Although tests with subliminal images show that this initial 'feel' may subsequently change when the subject becomes aware of the source, it seems possible this initial emotional reaction may have influence on subsequent cognitive states. Zajonc (New Scientist, April 1996) states "our brains are wired to 'feel' before they 'think'...and what they feel in those first few thousandths of a second may influence subsequent thoughts, even ones which appear to be rational and emotionless" (*ibid.* p.21). And it seems such split-second responses are certainly what occur when we react in fear to harmless objects. An object resembling a snake will trigger a flight (aversive) reaction before we have evaluated or processed the visual information to tell us that it is in fact something harmless.

From a philosophical point of view, this raises the question whether we should include such 'emotions' or reflexive physiological responses within our analysis when they seemingly lack any cognitive content (particularly if one adopts the cognitivist model). It is interesting to consider to what extent such initial positive or negative reactions influence our 'conscious' emotions. This hypothesis might explain why we appear to have distinct types of fear and happiness but not distinct types of shame or embarrassment, which are dependent on cognitive content, the former being perhaps influenced by strong reflexive responses. However, this is certainly not to say that individual emotions may have anything like dedicated neural circuitries and neither do these initial reflexive responses predetermine our subsequent emotional states which involve many other factors. That is, it is not to say that cognition cannot subsequently alter affective states induced by reflexive responses rather, for example that subsequent cognition maintains or suppresses the physiological response e.g., calming down when one realises an object is a harmless piece of rope and not a snake. Importantly, as LeDoux comments, the "wiring of the brain at this point in our evolutionary history is such that connections from the emotional systems to the cognitive systems are stronger than connections from the cognitive systems to the emotional systems.".[12] In light of this it would be problematic to exclude reflexive responses if they form part of, or influence subsequent emotional states.

1.4.2 Reflexive and Intentional Emotional Behaviour

In addition to considering the relationship of reflexive responses to cognition, we should also consider whether their relationship to emotional behaviour. As noted in 1.1, behaviourist *theories* of the emotions were largely rejected by philosophers. Nonetheless, Behaviourism as a theory of human conduct continued to flourish and led to the development of new experimental methods. Importantly Behaviourism has been interpreted as an account of intentional action and therefore having little or nothing to do with underlying neural mechanisms of emotion. However, as we have seen above, some emotional behaviours may be a consequence of mandatory responses to stimuli. Therefore the examination of emotional behaviour may be fruitful if one makes important distinctions between the *types* of action observed.

The need for this distinction is exemplified in the behaviourist analysis below (Table 1.2). Emotions are categorised as regards 'tendency' to action. One can see from such attempts to define emotion in terms of action tendencies that again there are many insufficiencies. Action tendencies are neither necessarily unique nor sufficient to define emotions in this way and in this respect the account suffers from the same criticisms as feeling-centred accounts

Table 1.2 Classification of Emotion by Action Tendencies[13]

Action	Definition	Associated Emotions
Approach	Tendency to get closer	Desire, Happiness,
Being-With	Tendency to stay close	Enjoyment, Confidence
Attending	tendency to watch or think about	Interest, Energy
Excitement	Tendency towards undirected action	Restlessness, Nerves
Exuberance	Generalised action readiness	Happiness, Elation
Rest	Acceptance of Absence of action readiness	Relaxation
Apathy	Generalised absence of action readiness	Depression, Sadness
Passivity	Absence of goals for action	Disinterest
Inhibition	Action readiness in the absence of action	Fear, Anxiety
Helplessness	Uncertainty about direction action readiness should take	Desperation, Confusion
Submission	Tendency to submit to control	Resignation, Humility
Avoidance	Tendency to avoid, flee, or protect oneself	Fear, Anxiety
Rejection	Tendency to reject or break contact	Disgust, Gruffness
Antagonism	Tendency to remove obstacle, hurt, oppose or resist	Anger, Irritation
Dominance	Tendency to control	Distrust, Arrogance
Interruption	Tendency to interrupt ongoing action	Shock, Surprise

The most obvious criticism is indeed that the behaviourist categorisation fails to distinguish between *motivations* for emotional behaviour, or rather *how* affective states are realised as action. Affective states may be realised as *intentional* actions relating to the cognitive content of an emotion, or associated beliefs and desires. If you are angry with someone, you may take action such as to avoid meeting them (an intentional, long term behavioural strategy). In other cases, affective states may be accompanied by culture specific (acquired) but nonetheless mandatory physiological responses, for example, particular mannerisms accompanying anger - clenching fists and teeth, pointing, stamping etc. As discussed above (pp10-11), there appear to be two distinct areas of the brain, damage to which causes emotional dysfunctions. Subjects with frontal lobe damage exhibit problems in emotional cognition (judging appropriate emotional behaviour and involving affective considerations in reasoning) and subjects with damage to the amygdala display difficulties with affective perception (recognising displays of emotion). It would seem that these distinctions in emotional functions relate well to the kind of distinction seen in terms of emotional behaviour - intentional behaviour relating to emotional cognition, and reflexive responses to affective perception. In view of this, some emotional 'behaviours' may be direct responses to stimuli, and it may be worth considering how these mandatory affective responses relate to underlying neural structures.

Importantly, this is exactly the distinction which behaviourism fails to account for. That is, between actions as reflexive and intentional. Emotional behaviour may be realised as 'reflexive' affective responses through immediate and often 'uncontrollable' responses to perceptual input e.g. retreating in response to a noxious stimulus, blushing, and trembling. These are responses of the autonomic nervous system and are universal affective actions. (The amygdala is one of the 'control centres' of the ANS). A particular concern then is to what extent our common-sense notions of emotions as motives for actions as in the behaviourist account, relate to actual levels of emotional arousal. It seems we may intuitively refer to emotional feelings and physiological effects as 'active' or 'passive' in terms of recognising emotions' action tendencies or lack of. Purely physiological affective responses may be quite successfully defined in terms of their 'action potential' or arousal level and subsequently may be classified as 'active' or 'passive.' However, these descriptions are not merely intuitive measures of 'tendencies' for intentional action, An important function of the ANS "is to provide support for behavioural demands" (Ekman and Davidson p.253). The autonomic nervous system (ANS) controls responses to sensory stimuli, provoking mandatory attractive/aversive responses. The ANS controls mobilisation and energy conservation of the body, heart rate and blood flow. The sympathetic division increases metabolic rate, resulting in vascular dilation and pupil dilation, (arousal). The parasympathetic division conserves energy, resulting in vascular and pupil constriction (lowered arousal). Different combinations of autonomic responses will be elicited in relation to the emotion or perceptual input - e.g. a fear response triggered by the amygdala may result in a flight response and regulation of blood to particular groups of muscles. It seems we have an unconscious awareness of the autonomic states of others too, for example, we will consistently pick a face with dilated pupils (aroused) as more attractive, without knowing why we find it so. Such responses are universal and largely involuntary processes, although in some instances we may learn to control them. Musicians and athletes, for example, may learn to control their 'nerves' so their performance is not affected, or indeed may be enhanced by such physiological reactions.

Further studies (Damasio, 1994; Levenson, 1992) show that autonomic responses may be measured whether subjects themselves are aware of any affective arousal or not. It is not possible however, (and likely never to be possible) to identify emotion-specific physiological effects at this level of physiological arousal. One can identify arousal and lowered-arousal corresponding to positive and negative affective states, and differing arousal patterns for gross categories of emotion (e.g., grief, contentment, resentment). This is easily explained when one considers that the function of arousal responses is to mediate necessary action - running, withdrawing, fighting, or their function (by means of lowered arousal) is returning the body to a state of rest. In light of these facts it is unlikely that specific emotions themselves (e.g. pride, jealousy etc.) would exhibit autonomically unique arousal patterns although they might be initiated by autonomic responses. Nonetheless, the findings do indicate that there are universal physiological affective features. Music also evokes affective responses and this raises the question whether there are universal affective responses to music which function as affective responses to stimuli in the same way as the affective responses outlined above. Indeed, this hypothesis would seem to gain support from empirical measurements of affective responses to music.[14] The interaction of physiological and cognitive aspects of emotion will be reviewed in Chapters 2 and 3. Certainly classification in terms of *intensity* would add a missing dimension to the cognitivist account. This will be considered further in Chapter 2

1.5 Problems Within the Analysis of Musical Emotions

In the light of both theoretical and empirical analyses of emotion, I would now like to consider some problems specific to musical emotions. Historically, disagreements have centred on whether music could or could not express emotion. Alongside these studies, consideration was given as to how the *description* of music in expressive terms might be properly understood. It is now generally accepted (given an appropriate explanation of the application of expressive predicates to music) that music does express emotion, that is, it may typically *sound* sad, happy, etc. to a listener. Nonetheless, distinct problems occur in the explanation of expression and arousal of emotion by music. For listeners to recognise emotional states as expressed by music (e.g. to describe music as sounding sad, happy and the like), one must explain how music as a non-representational art form can provide sufficient information to convey specific emotional states.

Taken alone, the *recognition* of emotions expressed by music might not seem so problematic. Many accounts provide promising explanations of the phenomenon, for example, music mimicking the characteristics of a person in an emotional state, music mimicking emotional contours or the 'feel' of an emotion, music conveying emotion by its associations with certain events, or even that music just 'sounds' sad' due to the effects of its formal properties on our perceptual systems. Some or all of these accounts may hold some truth but aestheticians have been roughly divided in response to this issue. This division occurs on two fronts: Firstly, whether the affective states music arouses differ from ordinary instances of emotion, whether they are truly emotions, (as opposed to moods, feelings or other affective states). Secondly, *how* music evokes these states, whether by musical features themselves without any external reference, or music's associations with external (extra-musical) events. This opposition in accounts of expression will be subject to detailed criticism in Chapters 2 - 4. For the moment however, I should like to consider the relationship of expressed emotion to its arousal in the listener in light of the empirical and theoretical analyses of emotion discussed. This will offer a brief overview of the approach to musical arousal within aesthetics which will be subject to criticism in Chapters 2 - 4. A particular aim is to make it clear that in light of empirical findings, commitments to differing recognition theories have strong implications for arousal. I should add here that, when referring to 'emotions', I am concerned with music's arousal of affective states in general. Music undoubtedly arouses affective states however these might be described.

Initially I want to dispense with the claim that music merely evokes moods or feelings. Whilst this is one solution to music's lack of intentional objects, it is not strictly true to say that expressive music provokes 'moods' of sadness as opposed to instances of emotion. Musically evoked states lack the duration associated with moods and this is one feature that theorists do largely agree upon in attempting to distinguish between moods and emotions. Also we do (usually) know it is the music which is responsible for our emotional state and in this sense we have the determinate antecedent event typically associated with emotions rather than moods.[15] Moreover, the reasons behind these claims are not substantial. If one ties music's lack of intentional object to its inability to represent, this conflicts with explanations of objectless emotion in non-musical contexts. An ordinary occurrence of objectless anxiety would hardly be put down to an inability of the context to provide a representation of an intentional object, and neither would the lack of intentional object legitimate calling this state a mood rather than an emotion. Nonetheless, I do not claim that all musically aroused affective states conform to paradigm cases of emotion, rather, that claiming musically aroused states to be feelings and moods is no answer to the problem of how these states are aroused. It would seem music is capable of arousing a wide range of affective states which may encompass moods and feelings but also encompasses what are ordinarily taken to be emotions. The nub of current debate is *how* music may arouse 'emotions' in the listener. Furthermore, what is the nature of these aroused emotions and, importantly, in relation to ordinary occurrences of emotion, what functions as the object of these musical emotions?

1.5.1 What are Musically Aroused Emotions 'About'?

One way in which musically aroused emotions seem to differ from everyday occurrences of emotion, is their lack or apparent lack of an intentional object. This is arguably the chief problem if one wants to maintain that music *arouses* emotions: What are musically aroused emotions about or directed towards? In all other senses we might arguably want to describe them as 'fully fledged' emotions. That is, emotions not differing substantially from their ordinary occurrences. There are two routes which may be taken here: the first is to attempt to identify what might act as the intentional object of musical emotions whether real, imaginary, or identified by reference to extra-musical features. The second is to consider how musical emotions might function as 'objectless' emotions without being explained away as moods or feelings - affective types which are no more appropriate categorisations than emotion itself.

Let us begin by considering what musically aroused emotions might possibly be 'about'. Perhaps the most obvious suggestion is to say that the emotion aroused is directed towards the music itself which then becomes the intentional object. Several problems arise on this account. Suppose we listen to a particularly 'sad' piece of music, and sadness is aroused in us in virtue of hearing this piece. It is difficult to conceive how the music itself might function as the object of our emotion. Our sadness is not 'directed at' the music, we are not sad because it is badly composed, indeed one may enjoy the sadness aroused by music. Note also that the arousal of sadness in response to music is distinct from being sad *about* a piece of music, for example in response to some aspect of its composition (being badly written), or to some aspect of its performance, (being poorly played) or to the context in which a work is being performed (one is being forced to listen against one's will).[16] Without further qualification, suggesting music is the object of our emotion does not mark a distinction between being saddened *by* a piece of music and being sad *about* a piece of music. It seems this explanation also fails to capture the negative aspect of sadness in its ordinary occurrence: if we are sad about something, then we would wish that thing to be otherwise. However, we surely can both experience sadness through music and yet not want the music to be otherwise.

An alternative response to the problem of intentionality is to take a line similar to Levinson's in *Music and Negative Emotions*, (1982) and to suggest that the objects of musical emotions are imaginary objects. Levinson explains,

> "When one hears sad music, begins to feel sad, and *imagines one is actually sad*, [my italics] one must, according to the logic of the concept, be imagining that there is an object for one's sadness and that one maintains certain evaluative beliefs (or attitudes) regarding it'.... 'I feel sad but my sadness has no determinate object;' it is directed only to 'some featureless object posited vaguely in my imagination." (Levinson, *Music and Negative Emotions*, p.337).

It is certainly plausible considering the complex associations of music with external features that it might readily suggest by imitation or otherwise an object for the aroused emotion. However, it is difficult to see why it would be advantageous to posit that musically aroused emotions are imaginary. If music may provide an object by reference to external features, whether in fact or is imagination, this nonetheless an object (just as in ordinary instances of emotion, objects may be real or imaginary). Why then for music, should one need to 'imagine one is actually sad' as in Levinson's description?

To return to Levinson's account, he goes on to claim that the feelings evoked by music are aroused as empathic responses to the recognition of emotions expressed by music,[17] and these empathic responses are like but not identical with real emotions (lacking *determinate* cognitive content). His claim then is that one imagines that one is sad, whilst the object and related evaluative beliefs remain indeterminate. This then avoids him having to explain how music may provide *specific* objects and evaluative beliefs, whilst still maintaining that music is capable of arousing cognitively complex emotions. On Levinson's view then 'music accomplishes this without actually having to represent cognitive content' (Karl & Robinson, p.404). It does seem unclear though how one can maintain evaluative beliefs towards an indeterminate object. Levinson does not explain this in sufficient detail, except to suggest that he interprets indeterminate content to be that music can represent emotion types e.g., hope and grief, as opposed to tokens e.g., John's hope *for* a reward. Perhaps what he has in mind for indeterminate content of hope, is merely a general concept of a happier future state - in musical terms, a resolution of tension.
This seems to offer no better solution than suggesting musical emotions are objectless emotions. Levinson's account does not reflect the 'immediate' nature of affective responses to music, and draws us away from the idea that affective responses to music are essentially like ordinary instances of emotion. More often than not we do not enter into any process of imagination (at least, not a process of imagination that is subject to introspection), although it is certainly plausible that we might do so in relation to music with strong extra-musical associations: music with lyrics, programme music, conventionally used musical styles. Whilst Levinson's account seems plausible in light of the specific piece he takes as his example (Mendelssohn's *Hebrides* overture), it still does not seem to provide an explanation of how music in general, (and musical structures in general) might cause or produce these responses. If it is really just a matter of our imagination producing an object irrespective of the musical content, then the music itself would seem to be redundant. But quite apart from this, if Levinson's account were correct it would seem that music could arouse quite a variety of emotions, but the fact remains that pure instrumental music itself has a fairly limited repertoire of emotions which it may arouse in the listener.

The fact that music itself only has the capacity to arouse a limited range of emotions has reinforced the view that responses to music may be empathic in nature, that is we recognise musical expression of emotion and respond to the music as if it were an expression of emotion by a person (or state of affairs). This view is chiefly represented by the behavioural similarity thesis - that music may imitate or otherwise represent characteristics of emotional expression.

Certainly the 'imitative' account seems credible if the music is to imitate gross behavioural characteristics of a person in an emotional state or imitation of sounds such as thunder, crashing waves etc. But suppose the object to be imitated is an inanimate object, or a belief - for example, the object of my fear is a dark menacing cave, or the belief that I may be mugged. This makes it difficult to see how music *independent* of extra-musical associations (convention etc.) might be able to imitate or represent such objects. Aaron Ridley presents exactly this critique:

> "music is poor at representing persons, things, ideas, or states of affairs: and so the melismatic gesture is unable to resemble behaviour expressive of responses *to* persons, things, ideas, or states of affairs. This is important inasmuch as what an emotion is *about*, what an emotions object is, will very often be its chief distinguishing feature. ....Many of our emotions are what they are, then -

> can be characterised or expressed -just because their objects are what they are. But music can never show us what an emotion is *about*; and hence music cannot resemble behaviour which is expressive of any emotion whose prime distinguishing features include its object." (Musical Sympathies. p.50)

Ridley's critique, like Levinson's account suggests that music cannot represent tokens of emotion as opposed to types. But this does not seem unduly problematic, as we have noted the range of pure music's expressive powers *is* limited and it is rare, if at all possible, that music without narrative or lyrics or contextual information could represent or imitate the specific cognitive content necessary to convey a particular instance (or token) of emotion. All that music *can* do, claims Ridley, is represent or mimic 'snapshots' of expressive behaviour in isolation. This does not refute the behavioural similarity view, it only serves to say that music may struggle to express emotions which *are* characterised in terms of their objects. For example, complex emotions - those that necessarily take objects e.g., grief, love, and hate (and emotions whose objects are propositional as rather than actual) as opposed to emotions that may be generalised and also function as moods, such as happiness and sadness. Indeed Putman in *Why Instrumental Music Has no Shame,* suggests that rather than refuting the behavioural similarity view, the object dependency of some emotions, and music's lack of representational powers, just outlines why pure music has a limited range of expression and arousal.
Nonetheless there is still a more damaging problem for this view. If one wants to adhere to the view that emotions (as intentional states) *must* have objects, then this carries over to the empathic states which are aroused. For even in the case of empathic responses, these are still intentional states - they are still directed at or towards some object. If, for example, one responds to a person or situation with pity - one feels pity *for* someone, if one responds with shared pride, anger, shock etc., one still requires an intentional object for one's empathic response and it does not seem true to say that one pities, envies, or is happy *for* the music or even that these responses are directed towards the expression of emotion by the music. So in terms of arousal a *general* imitative account the behavioural similarity view fails. Music may still be able to express by means of behavioural similarity, but specificity will be restricted to gross behavioural characteristics which music *can* successfully imitate. Music may then still express strongly physiological affective states which do not need an intentional object, without needing to refer to extra-musical information.

In light of these criticisms, this offers an opportunity to see both how empirical findings might offer alternative solutions and also how the nature of arousal might bear upon the problem of intentionality. Considering the communicative properties of emotions themselves might offer a different perspective on imitative accounts of music. Mimicry plays an important role in the contagion of emotions. We naturally mimic the behavioural gestures, vocal contours, postures and facial expressions of others and synchronise our own movements with theirs. This may be an evolutionary feature enabling us to learn about others emotional states and to adopt appropriate emotional behaviours. In adopting the emotional behaviourisms of others, we may induce emotions in ourselves and a variety of empirical data supports this:

> "Nina Bull (1951)...observed that attitudes comprise both mental and motor components and that the two are tightly linked. To test this notion, she conducted a series of 53 experiments. In the first set, she found that when men and women were hypnotised and were instructed to experience certain emotions (joy, triumph, disgust, fear, anger, and depression), they automatically adopted appropriate bodily postures. In the second set, she required subjects to adopt a series of emotional postures. Some examples:

> *Depression:* "you feel heavy all over. There is a slumping sensation in your chest."
> *Fear:* "Your whole body feels stiffened up You can't catch your breath. You want to run away but you can't"
> *Anger:* "Your hands are getting tense and your arms are getting tense. You can feel your jaw tightening."
> *Joy:* "There is a feeling of relaxation and lightness in your whole body."
>
> When subjects were required to adopt these postures, they soon came to experience the emotions associated with them. When instructed to try to experience emotions incompatible with these postures, they had great difficulty in doing so." (p. 69 Emotional Contagion. For more recent examples see Riskind and Gotay, 1982; Ekman, 1992).

This analysis of emotion may offer further clues as to how an imitative account of musical expression might work, and bears similarities to the examples of objectless emotions (nonconscious affect) discussed in 1.4. However, I do not want to claim simply that music mimics gestural or vocal contours as empirical evidence contradicts this claim A more sophisticated account of mimicry for music would be that music has a direct physiological effect on the ANS inducing positive or negative affective state and importantly perhaps inducing their associated postures In inducing these postures, emotions may be aroused in the listener. This suggestion will be examined further in Chapter 4.
One thing that is evident from the aesthetic accounts is the insistence that aroused emotions must have an intentional object. While this may be true of some emotions, there are surely many instances of ordinary emotions for which this is not the case. Certainly, in light of the empirical findings this claim must surely be brought into question. As in the account of mimicry above, *how* the aroused emotion is induced may bear heavily on whether it is focused upon any particular object. Indeed within emotion theory there *is* some acceptance that not all emotions have to conform to paradigm cases. Most theorists would agree to some extent on the existence of 'objectless emotions,' with musical examples most famously being attributed to this category.[18]

Whilst most theorists have now come to accept that the expression of emotion in music is ultimately dependent on perceptual properties of music, few concessions have been made to psychological and neuropsychological accounts. Most aestheticians seem to adopt a fairly analytic conception of the listening experience which does not match the experience of the naïve listener, (and in many cases, does not seem to match the experience of *any* listener). Evident within the preceding discussion is that many explanations of musical emotion neglect the immediate *physiological* effects of music. However, these will form a significant part of the investigation into musical expression. Particularly how physiological and cognitive responses to music interact. It is clear that music can evoke a wide range of affective states, in a variety of ways. And the above example of mimicry is only one example whereby empirical studies may be a useful addition to the issue of musical expression. Chapter 2 will examine the limitations of the cognitivism to account for varieties of affective state, and will outline an attempt to incorporate musical and ordinary instances of emotion into a general account of emotionally affective states.

Notes

[1] See Lyons, 1992 for an overview of feeling-centred accounts.

[2] Michael Tye, in *Ten Problems of Consciousness* actually tries to account for sensations as a species of intentional or representational states. One merit of his account is that it is able to deal with phantom limb cases via intentional inexistence (that the intentional object may or may not exist) e.g., you can still represent your foot as hurting even when you no longer have a foot. This might seem to offer support to feeling centred accounts but in fact, we do not have to concede much to Tye. Bodily sensations all involve representing *parts or areas of the body* as having certain qualities, which is not normally the case with emotions, although in some cases it is: e.g., one can be relieved that one's foot isn't hurting any longer, or can be upset that one has toothache. The bodily sensations in these standard cases are still non-intentional states. The subject of the intentional state is the bodily sensation (e.g. I am upset *that* my foot hurts) it is not the bodily sensation itself which has intentionality.

[3] See Gordon pp. 21-22. This echoes the comments of James (1890); "the merely descriptive literature of the emotions is one of the most tedious parts of psychology. And not only is it tedious, but you feel that its subdivisions are to a great extent either fictitious or unimportant, and that its pretences to accuracy are a sham. ..." "The trouble with the emotions in psychology is that they are regarded too much as absolutely individual things. So long as they are set down as so many eternal and sacred psychic entities like the old immutable species in natural history, so long all that can be done with them is reverently to catalogue their separate characters, points, and effects" (James *The principles of Psychology* Dover edition 1950, Vol. 2, p.449).

[4] See Donellan, Causes, Objects, and Producers of the Emotions, and Ekman/Davidson, The Nature of Emotion: Question 4 on evidence of universals in antecedents of emotion.

[5] The best translation we have of this is 'the pleasure taken in someone else's misfortune' certainly a psychological state which occurs in English culture. Perhaps though this corresponds to the concept of retribution, though we would not consider this to be an emotion. This underlines the lack of boundaries between 'emotions' as a psychological category distinct from other types of mental state.

[6] p.26-27 The Social Construction of Emotions

[7] The application of emotion terms is discussed further in Chapter 4: 4.2.1.

[8] This point is of particular relevance to music as empirical evidence suggests that we often respond emotionally to music without overtly recognising our physiological responses. It seems quite likely that in such cases conditioned responses override our recognition of physiological responses. This issue is discussed in detail in Chapter 6. However, see also Damasio's Point (1994, p.209, that one cannot have a full emotional response in the absence of certain physiological responses.)

[9] What I have in mind as examples of these divisions are firstly universal aspects as basic physiological responses of the autonomic nervous system, universal behavioural aspects as for example, facial expressions (see Ekman) and culture specific expressions of emotion for example variations in the expression of grief as seen in western and eastern European cultures.

[10] I concede it might be argued that it depends what we determine to be cognitive content. The subject here may have cognitive content in some sense, despite it not being lexicalised or available to introspection. Perceptual events have nonetheless been interpreted to produced a specific and appropriate emotional response.

[11] Note that this relates closely to my two-stage theory for emotional expression below (Chapter 4) where this idea will be expanded upon.

[12] The amygdala also receives cortical (non-sensory inputs) so initial responses may subsequently be altered in light of subsequent information. This issue will be discussed in more detail in Chapter 3.

[13] From Parkinson: Ideas and Realities of Emotion (p.73)

[14] See for example, Trehub, *Human Processing Predispositions and Musical Universals* (In Wallin, Merker and Brown, The Origins of Music.)

[15] I do however, acknowledge that it seems possible for music to emotionally affect us without us realising it is the music which has caused our emotional state.

[16] I will discuss in Chapter 2 what is asserted when we say music 'expresses' emotion. For the moment, I will take this statement in its common form to describe the experience of hearing music *as* an expression of emotion.

[17] This idea of empathic responses will be subject to specific criticism in Chapter 4.

[18] Thalberg for example, comments "It is not self-contradictory to suppose that some emotions are not founded on thoughts. I shall attempt to show...that this holds only for emotions without objects", *Emotion and Thought* p.46.

Chapter 2

Limitations of the Cognitivist Account

2.1 Introduction

There have been many attempts to solve the problems of musical expression within aesthetics and within musicology. Nonetheless these issues are typically dealt with in isolation. Even between musicology and aesthetics there is often little overlap, with musicians tending to look at musical features for an explanation of its expressive properties, whilst aestheticians look towards the experience of expressive music and emotion theorists tend to avoid musical emotions altogether. As a result we have numerous accounts of musical expression of emotion, but relatively few attempts to incorporate music within a broader theory of emotion.

The aim of Part I of the present thesis is to consider how these issues may be reconciled. This chapter will be particularly concerned with cognitivism, which has become the dominant theory in philosophy of emotion. Some of the attractions of the cognitivist position have already been made apparent in Chapter 1, in terms of its advantages over feeling-centred approaches to emotion. I am sensible of those advantages and have no desire to neglect them. However, in so far as the expression of emotion via music is concerned, cognitivism seems liable to make what might otherwise be just enigmatic, either highly problematic, or outright impossible. For, if what is distinctive of a particular type of emotion is some linguistically specifiable cognitive content, then music would not seem to be an appropriate medium for its expression or transmission. At least, it is hard to see how it could be. This is because, without the accompanying information supplied by lyrics or a libretto, the representational capacities of music seem severely limited. Despite these limitations, music nonetheless successfully conveys a wide range of affective states, some of which seem too closely allied to ordinary instances of emotion merely to be cited as anomalous cases. Referring to several theorists who have adopted a cognitivist conception of emotion, 2.3 examines the problems cognitivism poses for the musical account. In conclusion I offer my own general account of emotionally affective states which outlines the domain of cognitive and physiological affective constructs of concern to this inquiry.

2.2 The Case for Cognitivism

Cognitivism has been widely embraced as shedding new light on the analysis of emotions and broadening our understanding of emotions as essentially 'cognitive processes.' Common to cognitivist theories is the view that some form of cognitive content is a conceptually necessary constituent of emotional states. Cognitivism holds that the bodily feelings which accompany an emotion, e.g. twinges or palpitations etc., are not sufficient to distinguish between different types of emotion, e.g. anger and indignation, yearning and longing and so on. Indeed it seems that there are emotions which are almost entirely 'cognitive' ones, (e.g. resentment), lacking many of the physiological features identified with emotions in feeling-centred accounts, yet we would undoubtedly call these occurrences emotions. On the cognitivist account, we may distinguish between emotion types by referring to the content of the emoter's beliefs. With grief for example, it is essential that the emoter believe they have suffered a loss. We would find it incoherent if someone were to say "I am angry at my sister but I don't believe she can be criticised in any way" (Calhoun and Solomon p.22). In addition to this method of classification, identification of cognitive content allows an assessment of emotions in terms of rationality and intentionality.

The identification of cognitive and physiological elements as separate components leads to an important distinction between 'controllable and uncontrollable' states, which has contributed to an assessment of emotions as rational or irrational. We would not describe certain physiological responses, e.g. blushing as irrational yet we would be able to evaluate other behavioural responses, e.g. angry gestures as rational or irrational, in light of relevant beliefs. The difficulty remains to distinguish between spontaneous or reflexive behaviour on the one hand, and intentional actions on the other. The rationality assessment therefore has different dimensions: behavioural, cognitive and attitudinal (one's evaluation of the emotion as positive or negative), but the cognitivist schema nonetheless allows for emotions to be analysed as rational or irrational just as beliefs can be. The problem for the cognitivist lies in establishing how evaluative cognition fits as a component of emotional states. That is, what causal role does it play and what is its relationship to physiological aspects and felt qualities of emotion. One particular criticism of the rationality argument is important. There is a problem in that not all emotions seem capable of being distinguished by reference to conceptual elements, for example, objectless emotions and those with indeterminate cognitive content such as musical emotions, or emotions in response to fiction. Indeed emotions produced by subliminal images or directly by perceptual input (as opposed to those having propositional antecedents) might even be evaluated as irrational by the emoter, if they are unaware of the cause of their emotion. Indeed, we often find ourselves puzzled as to why we should feel a certain way, and unaware of any particular cause. A further question then is whether emotions without objects open to conscious awareness (such as those described in Chapter 1) may be accounted for within the cognitivist schema.

As outlined in Chapter 1, one of the problems for feeling-centred accounts was their inability to account for emotions as intentional states, being directed *at* or *towards* objects or which are *about* something. Conceiving emotions as principally cognitive states has a distinct advantage in that the intentionality of emotions may be successfully explained in terms of their cognitive content. Nonetheless, intentionality still raises problems for the cognitivist. There do seem to be mental states that lack intentional objects, but which we nonetheless characterise as emotions, for example, *objectless (or general)* anxiety, depression and frustration. It seems inconsistent to accept the cognitive account in light of this problem, whilst feeling-centred accounts are rejected for their inability to account for intentionality. The cognitivist therefore needs to offer a satisfactory explanation of objectless mental states for the account to be a viable alternative. The usual responses to this are either that such objectless emotions are not in fact emotions proper, or that they have subconscious objects. However, to exclude objectless emotions from the class of emotions proper would certainly cause problems for the musical case. Accounts which reject emotions with indeterminate cognitive content, or claim objectless mental states are insufficient to warrant status as emotions will automatically exclude many instances of musical emotions. Interestingly, whilst musical emotions have been highlighted as an anomalous category, other instances of emotions suffer problems of intentionality.

Emotional responses to fiction, objectless anxiety, and depression also deviate from the paradigm case.

2.2.1 Classifying Emotions.

Perhaps the most sophisticated exposition of the cognitivist account is that given by Robert Gordon in *The Structure of Emotions*. Gordon acknowledges many of the problems involved in the classification of emotion and I will refer to his account in some detail below.

Emotions clearly lend themselves to classification and hence there seem to be 'natural' divisions between 'positive and negative', 'rational and irrational' etc. However, these are still unsatisfactory, and frequently emotions fall into two or more categories, or are excluded altogether. Perhaps it would be best to begin with a classification that appears on the surface to be unproblematic: the positive/negative distinction. It seems natural to class emotions as positive or negative, and when asked, we can give clear examples of what we have in mind. We intuitively take fear to be a negative emotion, happiness a positive one. When asked however, to explain what is meant by 'positive' and 'negative' in emotional terms, the confusion sets in. An initial explanation might be to take 'positive' as entailing pleasant, and negative, unpleasant states to be in. However, as is the case with musical emotions, this distinction does not hold: Whereas we would intuitively class sadness as negative, we enjoy the sadness of a Mozart Piano Sonata, and similarly we enjoy fear-provoking fairground rides. As Gordon rightly points out, we can only say that positive and negative emotional states are 'typically' attractive or aversive. 'There seems no reason to rule out the possibility that someone might find it pleasant and therefore attractive to be sad or angry and unpleasant and aversive to be proud'[1]. The hedonic qualities or typical 'feel' of the emotion is not sufficient for classification.

Such binary classifications as they stand make only gross distinctions, which as in the examples above, still fail to cater for a number of cases, thus further qualification is required. With this in mind, Gordon seeks out an alternative position for making this distinction, that the negative and positive emotions involve a negative or positive attitude *toward* something (which Gordon loosely calls the object of the emotion).

> "For example if Mary is embarrassed by (or about) the publicity about her wedding. She has a negative attitude toward there being publicity about it - roughly, a wishing there not be such publicity. But if she is glad that there is publicity, she has a positive attitude toward there being publicity about it" (p.29, *The Structure of Emotions*).

Lyons also makes such an 'approval-disapproval' distinction (*Emotions*, 1980) which he describes as a 'distinction in the evaluative aspect of different emotions'. Lyons refers to positive and negative attitudes as pro-evaluations and disapproval evaluations respectively. He asserts that this 'evaluative distinction' is sound and 'it is hard to think of an emotion whose evaluation does not fall into either the approval or disapproval category' (p.90). From my point of view though, Lyons acceptance of this distinction is a little too eager. It is fair to say that we should guard against thinking of emotions solely in terms of positive and negative as these terms bring with them certain connotations, as in Lyons' account, negative emotions incur disapproval evaluations, and positive emotions an approval evaluation. Yet evaluative dispositions towards emotional states may vary for a single emotional state or instance of that emotion. It is quite conceivable that one might disapprove of being in a positive state - perhaps one did not want to be amused by the joke as it distracted you from the task at hand. For the case of negative emotions music provides a prime example. On Lyons' account, music expressing a negative emotion, e.g. sadness, would invoke a 'disapproval evaluation', although we commonly enjoy the evocation of negative emotions by music and explicitly choose to undergo the experience.

One can see that it is not always useful to categorise emotions exclusively in terms of positive and negative. Music may be emotionally classified as negative for a variety of reasons[2], not necessarily due to the positive or negative *hedonic* quality of the emotion type in question. Notably the positive/negative distinction has been taken as one which may be used interchangeably with an approach/avoidance distinction (in terms of survival instincts). One must be careful to avoid confusion here as the positive/negative distinction as used in relation to emotion typically infers a more complex cognitive component, or more importantly infers a *self-assessment* of emotions as positive and negative, as opposed to uncontrollable physiological responses to perceptual stimuli. The approach/avoidance distinction captures a far more basic emotional response in terms of innate or conditioned physiological responses to specific patterns of perceptual input. As has been generally acknowledged, the positive/negative distinction is useful in terms of our explaining the 'feelings' we associate with emotions. However, it is not sufficient to categorise emotions fully and we are intuitively aware of other distinctions which we will now consider.

To return to Gordon's account, alongside the positive/negative categorisation, he makes another fundamental distinction between emotion types and a distinction upon which much of contemporary cognitivism has focused. In evaluating the tendency to classify emotions as forward-looking or backward-looking, Gordon explains that backward-looking emotions are "directed towards things, persons or states of affairs that exist presently or in the past. Forward looking emotions are said to be directed towards future possibilities."[3] E.g., I am afraid I will crash my car. Tense however, cannot exclusively categorise emotions as Gordon noticed there are anomalies within this backward/forward looking distinction. For example, we can hope that things have not happened - I hope he didn't open the letter (a forward-looking emotion directed at the past) or 'I am disappointed my poem won't be published' (a backward-looking emotion directed at the future). This led Gordon to the conclusion that there must be some conditions relating to forwards and backwards looking emotions that would explain these anomalies. The response was that the distinction depends upon the emoter's knowledge of the event or object. That a person may only be for example, happy that p, if they *know* that p, and only afraid or hopeful of p if they *do not know* that p. This distinction characterises what Gordon calls factive and epistemic emotions respectively. Some examples may make this distinction clearer. I may only say, 'I hope he didn't open the letter', if I *do not know* whether or not he has in fact opened the letter and it would not make sense to say 'I am disappointed that my poem will not be published' unless I *know* that it will not be (for further examples see Gordon, *The Structure of Emotions* and Thalberg, *Emotion and Thought*). With this distinction in mind we may readily draw a line between what Gordon terms as factive and epistemic emotions (Table 2.1) and also between positive and negative factive and epistemic emotions (Table 2.2).

Table 2.1. Factive and Epistemic Classification.

Factive		**Epistemic**
Horror	Sadness	Hope
Disappointment	Pride	Terror
Guilt	Happiness	Anxiety
Irritation	Frustration	Yearning
Shame	Excitement	Longing
Regret	Amazement	
Pity		

Table 2.2. Positive and Negative Factive and Epistemic Classification.

Positive Factive	**Negative Factive**	
Delight	Anger	Indignation
Gladness	Annoyance	Resentment
Gratefulness	Disappointment	Horror
Happiness	Disgust	Sorrow
Pleasure	Sadness	Embarrassmen
Pride	Shame	Fury
Positive Epistemic	**Negative Epistemic**	
Hope	Fear	
Longing	Anxiety	
Yearning	Terror	

In combining this factive/epistemic distinction with the positive/negative distinction, we have a fairly accurate method of distinguishing between emotion types, acknowledging the positive/negative affective content and emoter's beliefs and desires as so:

Table 2.3. Classification by Type and Content.

Emotion Type	**Cognitive Content**
Positive Factive	The emoter has a positive attitude toward p — wishing that p and knowing (or believing) that p
Negative Factive	The emoter has a negative attitude toward p — wishing that not p and knowing (or believing) that p
Positive Epistemic	The emoter has a positive attitude toward p — wishes that p but does not know whether p or not-p
Negative Epistemic	The emoter has a negative attitude toward p — wishes that not-p but does not know whether p or not-p

The factive/epistemic and positive/negative distinctions seem a satisfactory method of classifying the emotions listed. However, it seems that this schema is really only successful by default for it avoids many problematic issues entirely. Cognitivism seems hard pressed, for example, to adequately account for love, 'aesthetic emotion', musically aroused emotion and emotion provoked by fiction. Most importantly, it fails to account in any detail for the physiological aspects of emotion. This is problematic as the empirical investigations discussed in Chapter 1 demonstrate that physiological affective responses may have influence on subsequent cognitive processing. In addition, the modern cognitivist account takes a culture-specific approach to both emotion concepts and terminology and consequently loses its explanatory force in wider cultural contexts. Any global account of emotion needs to allow for universality of emotions as psychological states.[4] From the preceding discussion of emotion-classification we have noted that there are many further methods of classification other than by cognitive content and, indeed, many emotion distinctions are not catered for by cognitivist account in terms of classification by type and content. Notably cognitivism also seems incapable of dealing with finer distinctions between emotional types, for example, we seem to experience characteristically distinct types of fear: long term fears, (e.g. of ill health), phobic responses, (fear of spiders), and short term fears, (fear of missing the plane). These seem identifiable as distinct sub-classifications of one particular emotional type (see Chapter 1, p.4 for examples). That emotional states which vary as regards 'intensity,' cognitive content, evaluation and physiological symptoms may still fall under the same classification is potentially problematic.

2.3 Cognitivism and Music

Whilst cognitivism is obviously subject to general critiques as a theory of the emotions, it poses specific problems for the explanation of musical expression and arousal. Despite these problems many contemporary theorists (e.g. Budd, Kivy, Karl and Robinson) still adopt a cognitivist analysis. Perhaps this is due to the fact that cognitivism has something of a history in musical aesthetics, being central to one of the most influential accounts of musical expression to date, Hanslick's, thesis '*The Beautiful in Music*', (Von Musikalisch-Schonen, 1854).

No discussion of musical emotions would be complete without some reference to Hanslick's musical aesthetics. His thesis '*The Beautiful in Music*' has undoubtedly been a major influence on accounts of expression to follow. Hanslick's concern was to give an autonomist account of aesthetic value in music - that music's value lies in nothing beyond the formal properties of the music itself. This formalist approach was a response to the Romantic Movement and ideas that music's aesthetic value could be explained solely terms of its ability to express and evoke emotion. Hanslick referred to music's non-representational nature, arguing that it cannot provide thoughts or beliefs necessary for definite emotions and feelings, and therefore can neither represent nor express definite feelings or emotions. As a result, Hanslick argued that music may express nothing more than the 'dynamic properties of emotions' through changes of strength (intensity), speed and texture. Hanslick's thought can still be seen to mark divisions between contemporary aestheticians, despite the change of focus within musical aesthetics. Previously aesthetic accounts of musical expression were centred on value claims or with problems of reference: how music could properly be said to express anything, and the aesthetic value of its expression. Recently attention has turned more specifically to analyses of the emotions themselves as aroused and recognised in music, and how these may relate to ordinary instances of emotion.

A particular concern will be to show how adopting a cognitivist account of emotions is restrictive for the explanation of musical expression. Music may express and arouse a variety of affective states in differing ways. And, as in Chapter 1, it seems we *may* explain the apparent absence of intentional objects for musically expressed and aroused states. The cognitivist classification nonetheless, may serve to explain why music *cannot* express certain types of emotion without extra-musical reference.

Two alternate camps can be outlined. First, those adopting a cognitivist analysis of emotions (e.g. Kivy, Robinson) claim that, whilst music is capable of expressing emotions and it moves us, it does not move us to sadness or happiness as it *cannot* provide an intentional object for emotion (a contemporary version of Hanslick's position). In contrast, the 'emotivists' claim that music can and does arouse full-blown emotions (e.g. sadness). For the purposes of this discussion, 'emotivist' and 'cognitivist' labels can function as a general means of outlining opposing positions. However, there is some variation in the use of this terminology. The cognitivist account of expression relates to, but should not be unequivocally equated with cognitivism in the philosophy of emotion. Importantly emotivism has on occasions been equated with the arousal theory of expression[5] - that music expresses emotion in virtue of its arousal in the listener. I explicitly do not want to equate the emotivist position with arousal theory.

An initial cognitivist claim is that music merely evokes moods and feelings as opposed to emotions. However, this is an easy escape for the cognitivist and, as seen in Chapter 1 (p.10-11), the grounds for making this distinction are sketchy to say the least. An alternative response is the claim that people listening to sad music are not really sad, for they *enjoy* the music, hence it cannot truly be sadness that they feel. Paradoxically, say the cognitivists, we enjoy sad music and one might argue that, if we were truly sad about the music itself, we would remove ourselves from the concert hall or attempt to stop the performance.

On the cognitivist account, the problem for musically aroused emotions is that subjects do not have the cognitive content typically associated with the emotion. For sadness, (a negative factive emotion), the emoter typically has a negative attitude towards the (sad) event *p* as in Table 2.3 above; wishing that *not-p*, whilst knowing or believing that *p*. For example, if I am sad that my house caught fire, I wish that it has not happened, whilst knowing it has in fact burnt to the ground. My response to this is that the cognitivist confuses the emotion aroused with an *evaluation* of the emotional state. The emotion aroused by music is sadness, though I suspect that evaluation of the emotional state itself may lead to an appraisal of the musical experience as a positive and appropriate response (not therefore leading to a desire to leave the concert hall). An analogous case might be fear evoked by funfair rides. The emotion evoked is fear (typically a negative emotion), yet an evaluation of the emotional state may be positive - the ride is exhilarating. For the musical case, the emotion aroused is sadness nonetheless and empirical studies (e.g., Panksepp, 1996) would agree with this claim that musically aroused emotions, (and indeed fear aroused by the funfair) share the same physiological aspects or patterns of arousal as ordinary instances of emotion. Intensity of emotion seems to mark an important distinction here between those emotions which are accompanied by 'uncontrollable' behavioural characteristics, and those we may control, or which lack behavioural expression. Rather than behavioural expressions being associated with specific emotion types, (e.g., fear, sadness, anger) more importantly they correspond to the *intensity* of individual occurrences. This makes a useful addition to the analysis of musical emotions offering an explanation of how they may differ, but still relate to ordinary occurrences of emotion.

Peter Kivy has addressed the problem of musical arousal on a number of occasions, and explicitly supports a cognitivist account of the emotions (*How Music Moves*, in Alperson, 1987; *Feeling The Musical Emotions*, 1999). Kivy advances a rather compelling account where the music itself functions as the object of the aroused emotion. Kivy is concerned only with instrumental music in the concert hall and its equivalent as recorded music in the home (*Auditor's Emotions*, 1993, pp.1-2). He makes a slightly different claim to the standard cognitivist position.[6] Rather than claiming musically evoked states to be moods, or feelings, he claims that music does indeed move us but rather it moves us to a generalised emotional state. Nonetheless Kivy does not want to equate this with ordinary occurrences of emotion and to this end he highlights the lack of accompanying behavioural characteristics of musical emotions. This is no defence for the cognitivist, many ordinary instances of emotion lack distinct behavioural characteristics or lack their expression. For example, if one is sad one does not necessarily burst into tears under any circumstances, indeed whilst we might find something humorous, we are able to suppress our laughter if we deem it is inappropriate. As noted above our behavioural expressions often depend on the intensity of the emotional state. Indeed, a relevant feature of many emotions is that we are able to suppress their modes of expression and, in the musical case, this would seem most appropriate. Kivy's claim is also inconsistent with examples of emotional responses to fiction. If we were to respond to emotional films and books with behavioural outbursts of anger, fear, hatred or depression, we would certainly not take these to be rational responses. Neither would we take responses to fiction to reflect some 'generalised emotion' - we can clearly identify such responses as fear, sadness joy, etc. Responses to music are no different in this respect.[7]

Nonetheless Kivy's explanation of music itself functioning as the intentional object has a certain plausibility. Kivy claims that the beauty of the music acts as the object of our aroused emotion, providing the determinate cognitive content necessary to emotions on the cognitivist account which he supports. On Kivy's account, the specific beliefs or thoughts towards which the emotion is directed, concern the beauty of the music, (its internal relationships and structure being recognised by the listener). However, Kivy also claims this cognitive content is insufficient to identify specific types of emotion, but only a 'generalised state.' It is at this juncture that Kivy's account seems to conflict with the cognitivist theory of emotions he claims to adhere to. One advantage the cognitivist account holds over feeling conceptions, is that intentionality *allows* us to distinguish between specific emotion types.

Kivy's position also seems contrary to our experience of expressive music. Most listeners, even musically naïve listeners, have no problems describing the specific nature of emotions generated by music (see appendix A5.13). Although we might grant that in response to pure or absolute music (with which Kivy is primarily concerned), emotions aroused might only be given in terms of broad categorisations, we would still not call these 'nameless emotions'. Kivy's idea suggests an emotion specific to musical experience, but, as we noted above, one issue is that musical emotions *do not* differ significantly in feeling from ordinary instances of emotion. In addition, if Kivy suggests nameless or non-specific emotions are evoked, exactly how many varieties of non-specific emotion is he proposing? It is clear that emotional responses to music do vary significantly, so how then do we differentiate between these 'nameless emotions', other than by relating them to their closest counterparts in ordinary occurrences of emotion?

Kivy's claim is that we cannot differentiate between these states, except by reference to their individual intentional objects (specific pieces of music). He comments:

> "But to say that the emotional excitement stimulated in me by the music is a nameless emotion is not to mark it out as in any way mysterious or ineffable. Lots of perfectly ordinary emotions have just that nameless character. If I am moved by a sunset, or the face of a child, or a kind and generous action, not done to me but to someone else, those emotions have no names: they are not sadness or fear, anger or gratitude: their names are their descriptions. I can do no better than to say: the feeling one gets in watching the sun go down, seeing the face of a child, hearing about a benevolent act to a perfect stranger." (p.5, Feeling the Musical Emotions, 1999)

But Kivy's description leads me to think he has a very unusual affective life indeed. We are on the whole very good at giving voice to our emotions, and what Kivy fails to explain is that the examples he uses may differ according to context. Seeing the sunset may evoke awe, (at the wonder of the solar system), sadness, (as the day has ended), fear (as one is afraid of the dark) etc. It is not the case that these examples represent nameless emotion, rather that they require further qualification.[8] In addition, one must acknowledge there is variability in naming both in ordinary and musical instances of emotion. Kivy goes on to say that these instances of emotion *are* differentiated by their objects, and in the musical case, he concedes that we have differing emotional responses to e.g. Bach, Brahms, and Mozart. But it simply does not follow that object dependent emotions are nameless ones and this seems to be the error in Kivy's analogy. This seems to highlight a flaw with the cognitivist account itself as a theory of the emotions.

Whilst cognitive content may be sufficient to *differentiate* between specific emotional states, it is by no means sufficient to identify those emotions.

2.3.1 Specificity of Musically Expressed Emotion

A further problem for music is how we may attribute the arousal or expression of 'cognitively complex' emotions - those which require *specific* evaluative beliefs and desires. Some emotions necessarily take objects in this way, for example, *grief, love* and *pity*. To feel grief, for example, one has to believe one has suffered a loss, to feel pity, one has to believe that someone (or something) is suffering unnecessarily. Karl & Robinson (1995), attempt to address this problem, but their account offers a very convoluted conception of musical listening, referring in great detail to specific musical features, motifs, key changes, and particular instruments. In line with the views of Levinson (1990) and Cone (1974), they suggest that music may convey specific cognitive content through a musical persona, represented by formal properties of the work. Although they present a convincing account for the particular extract in question, (a section from Shostakovich's 10^{th} Symphony), they stress that the work needs to be placed in its historical context, providing us with knowledge of the work in a quasi-narrative sense, and biographical information about the composer. This presents some problems, first, by conceding that an understanding of the work requires extra-musical information, this entirely contradicts the specificity attributed to musical detail. (For example, why bother to analyse the details of a funeral march when the title alone is enough to attribute grief to the work, let alone all that can be gleaned from its full historical context?). And second, what are we to say about works whose origin is largely unknown? If historical context is a necessary condition for the attribution of cognitively complex emotions, unknown works would be incapable of evoking or expressing such emotions.

This draws us towards a problem frequently raised in aesthetics, that we begin to attribute musical expression to extra-musical information itself and not the music, so the musical content itself becomes redundant. Karl and Robinson's initial position seems quite plausible and they make a commendable interpretation of musical features which could feasibly be related to the cognitive content of hope. However, even if we granted that music could represent the cognitive content of resentment, for example, purely by relationships of features, motif's or harmony, etc., it seems unlikely that musically naïve listeners, who nonetheless claim to recognise such emotions, could recognise such complex relationships in music. This would be the case even if, as Peter Kivy suggests, they recognise them, whilst being unaware of the terminology or musical function of such features.[9] All it seems music could express in such a way are again gross behavioural aspects of emotion, as in the imitation accounts of expression discussed in Chapter One that is, the ups and downs of emotional life, much like Hanslick's 'dynamics' of emotion.

Having criticised Karl and Robinson's account, I do not want to dismiss the role of acculturation in accounting for at least some emotional expression and arousal. The focus of my critique above is directed at the contradictory analysis of musical features, when extra-musical information is available. My point is that the extra-musical alone is often sufficient. Clearly music can be highly conventionalised, if we consider musical propaganda, particular styles of music or even specific motifs can come to represent specific ideas to culturally or institutionally situated listeners, and in this way provide determinate cognitive content.[10] One only has to look at contemporary film to see this is true and to recognise the strength of these associations (e.g. our immediate recognition of music from Jaws or Psycho, and stereotypical music accompanying many horror movies). An important point here is not to generalise about musical emotions, it is clear that certain types of music, opera and other lyric forms, can provide the necessary cognitive content for specific emotions, and emotional recognition or arousal will evidently be relative to the listeners' musical experience and knowledge. For my part, I hold that cognitively complex emotions require extra-musical information for both their expression and arousal and it seems Karl and Robinson failed to show otherwise.

The problems of cognitively complex emotions do however, offer an insight into *which* emotions pure music may express and arouse. Putman (1987) says it is exactly those emotions that require determinate cognitive content for their identity which instrumental music cannot express. Putman's view is that rather than classing musical emotions as an exclusive category of 'objectless' emotions, we should refer to examples of objectless emotions in non-musical contexts. Putman's view might certainly be thought to conflict with Karl and Robinson's, however, this conflict can be resolved if we acknowledge their differing conceptions of pure or absolute music. Putman takes this to refer to music without any extra-musical associations, perhaps Bach chorales or instrumental music without conventionalised emotional responses. Karl and Robinson's theory on the other hand depends on just these responses: highly conventionalised interpretations of music and a highly acculturated musical audience. Importantly within this investigation, whilst acknowledging such responses might in theory be possible, I am concerned with musical responses of the ordinary listener, not those of a specific culturally or institutionally located group. (Although this is not to say the ordinary listeners responses cannot be highly conventionalised too as in the examples above).

Both Karl and Robinson, and Putman's accounts bring us back to Hanslick's problem that music itself lacks representational powers. Cognitivism within music, it seems, is more appropriate to exemplify the limitations of pure musical expression, than to offer a theory of the emotions which may satisfactorily encompass musical affect. As Radford noted above, (Chapter 1, p.15) "music is poor at representing persons, things, ideas, or states of affairs." This is certainly a problem for instrumental music and I am happy to concede that in terms of specificity, music alone has a limited range of expressive powers. Again though this brings me back to a central concern which is to analyse the *range* of music's expressive powers: from music's formal properties alone, to music in specific context, accompanied by extra musical information and conditioned responses of the ordinary listener.

2.4 The Limitations of Cognitivism

The time has come to reveal the limitations of cognitivism. It has become almost a commonplace within the philosophy of mind to refer to 'the cognitivist theory of the emotions'. But this is at best seriously misleading. For cognitivism is not a fully-fledged theory of the emotions at all. It is much better understood as an analysis of explicit and articulated emotional concepts, which focuses upon their differentiation from each other, rather than upon what distinguishes the emotional in general from other psychological states and processes.

Indeed, the common interpretation of Gordon's account as a cognitivist theory of the emotions exemplifies this. Gordon in fact explicitly states

> "I shall not pretend to be talking about every state we are wont to call an emotion, nor indeed that my generalizations do not apply to some states one might balk as calling emotions. The term 'emotions' will serve only as a rough guide as to the initial scope of this investigation. The final scope may be

> defined *as those states of which my generalizations hold true.*" (p.22, *The Structure of Emotions*).

Nonetheless, Gordon's account is often cited as the prototypical cognitivist theory and it is widespread in philosophy of mind that cognitivism constitutes a theory of the emotions as opposed to merely a classificatory system for certain emotion-types.

One way in which we can see this is by drawing attention to the characteristic way in which cognitivism is argued for. The advocate selects some appropriate type of emotion, *E*, and says that no subject could be in state *E* unless they thought that p (or something like it). It can emerge from this sort of consideration that it is a necessary condition for having *E* that one should think that p. This may well be so. But revealing a necessary condition is by no means the same thing as providing a general theory. Let's say the cognitivist's conceptual analysis is correct about the concept *E*. Just how much does that tell us? Only that thinking p is a necessary condition for having *E*, rather than some other emotion. This leaves out an awful lot. It does not tell us what the emotion *E* consists in. It doesn't even tell us exactly how the thought that p, is involved in the emotion *E*. For the fact that the thought that p is a necessary condition for *E* leaves open at least the three following possibilities:

(1) that the thought that p is *part of E*, actually one of the constituents of the emotional state;
(2) that the thought that p, while not a constituent of *E*, is a necessary accompaniment to it in this sense: that no one would count as having *E* unless they thought that p;
(3) that the thought that p is a cause of *E*, and a conceptually required cause at that, in that one cannot have an *E*-type state without a p-type thought causing it.

These are clearly quite distinct possibilities, and we hardly have a complete cognitivist theory without grounds for opting for one or other of them. Clearly cognitivism does not offer a full, explanatory account of the relationship between emotion and thought.

But quite apart from that, the cognitivist approach falls short of supplying a theory of the emotions, in at least two distinct ways. Firstly, it does not tell us what else has to be true of an individual who has *E* (or some other emotion) besides thinking that p (or whatever the appropriate cognitive component/accompaniment/cause might be). Secondly, it does not tell us what is *in general* the difference between being in an emotionally affective state and not being in any such state. One might, I suppose, say that cognitivism is a theory of *these* emotions (rather than those others). But since it dwells on what distinguishes emotions, rather than on what they have in common, it hardly qualifies as a *theory of emotion* at all. This point is all too regularly missed in philosophical discussions of the emotions. Missing it threatens to warp such discussions badly, since being pro-cognitivist and anti-cognitivist would both be erroneous options. The important thing is to realise the limitations of the cognitivist view.

It may be helpful to have a recurrent argument, in the form of a schematic thought-experiment, in order to remind ourselves of the limitations of cognitivism. Cognitivism fails to provide sufficient conditions for having an emotion, and so it does not tell us (properly construed does not even attempt to tell us) what emotions *are*. This should really be fairly obvious. Yet since it seems so often to be overlooked, we can propose a *'Vulcan'* thought-experiment. Taking the proposed cognitive requirements for a given emotion, we may then ask whether somebody (Mr. Spock, say) who satisfied those cognitive requirements would necessarily be in the specified emotional state.

Taking resentment as our example: Can somebody coherently say: A: I think that somebody did such and such.... B: I think they really ought not to have treated me like that ... C: I wish that they had not treated me that way ... and yet D: I do not feel any resentment. The belief and desire states alone do not constitute resentment. Similarly for Jealousy: I might think that A: x has won prize this year, B: I wanted to win the prize, and made a great effort to do so. C: I do not believe x deserved to win and yet, D: I do not feel jealous of x. It is certainly plausible then that one might have the relevant beliefs and desires yet not feel any emotion. Indeed in light of this thought experiment the suggestion (as made in Chapter 1) that there may be purely cognitive emotions seems somewhat lacking. (Having the cognitive component does not equate to having an emotion). Perhaps it is better to say there may be emotions that are *principally* cognitive, and what is lacking, indeed what the cognitivist theory fails to offer is a distinction between emotional and non-emotional evaluative thoughts. What *is* distinctive about the beliefs and desires accompanying emotions, as opposed to non-emotional mental states?

Along similar lines to the Vulcan thought-experiment above, Alston comments that

> "we cannot identify emotions with evaluations alone, without completely losing contact with such phrases as "emotional reaction," "getting emotional over it," and "controlling one's emotions." An evaluation can be either emotional or unemotional. Two people can see a snake as equally dangerous, and yet one is gripped with fear while the other is calm" (Alston 1967, p.485).

Cognitivism may in some respects be an improvement on feeling-centred accounts, but it also seems to neglect something they emphasise. Cognitivism on its own lacks *an account of the feel* of emotions - what it is like to be in an emotional state, as opposed to merely acquiring a relevant set of beliefs and desires. It seems we can coherently distinguish between having the relevant belief/desire states, and having the relevant belief/desire state *and* the emotion.

Two replies are typically offered to this problem: the first is to identify *emotional* mental states as those which are somehow marked by their intensity. One might be tempted to reply that desire states themselves entail an affective or pro-evaluative component. Or perhaps that the intensity of the desire itself is relevant. Yet I can have desires, even strong desires without feeling emotion. A further reply to this critique has been made by evaluative theorists - those holding that the cognitive content involves an evaluation. Solomon comments:

> "what is distinctive about emotional judgements is that they are self-involved and relatively intense judgements.....The judgements and objects that constitute our emotions are those which are especially important to us, meaningful to us, concerning matters in which we have invested ourselves." (1976, p.188).

But this reply fails on two parts. First, that judgements themselves hardly seem subject to degrees of intensity. If I judge, for example, that my colleague is mistaken, how might this be more intense than my judgement that I will not make the 5.30 train? It seems rather, that where judgements already involve emotional components, only then may they be evaluated in terms of their intensity. Second, it is far from clear that judgements which are meaningful are necessarily emotional. Perhaps what Solomon intended to capture is the pre-occupation which occurs in relation to emotional thoughts, that they can dominate our thought such that our attention is completely focused upon the emotional event. Whilst cognitivism might incorporate this 'pre-occupation' into its account of the cognitive components, it is neither a necessary nor sufficient feature of emotional mental states. Non-emotional evaluations may similarly pre-occupy us, whilst emotional ones may be consciously put to one side.

The second reply to this problem is exemplified by Lyons. He comments,

> "Excepting their denial that emotions are feelings, philosophers have had very little to say about the 'bodily motions' parts of emotions, particularly in recent times, even though, somewhat ironically, it is this very aspect of emotions which distinguishes them from being just beliefs and desires of certain sorts." (1980, p.115).

However, identifying behavioural responses alone is not sufficient. A purely cognitive interpretation of emotion as in the Vulcan experiment might still succeed here, after all by rational thought the subject could still produce appropriate 'emotional' action. Nash comments along similar lines, that an account of emotion must be "sufficient to distinguish, e.g., the terrified man who flees out of fear from the fearless man who flees out of prudence."(1989, p.487). He proposes a similar thought experiment to the Vulcan account above.

> "Suppose for example that a human being lacked the neurological mechanisms that give rise to these bodily disturbances; and suppose the mechanisms in question have no other causal role. Would this defective human lack emotion?" (*ibid.* p.486).

If emotions were analysed in terms of behavioural responses, then the subject might still have 'emotions' - despite the fact that they wouldn't e.g., tremble with fright, blush with embarrassment or *feel* emotional. It seems then that even identifying cognitive content and behavioural expression does not account for the 'feel' of emotion, and cannot distinguish between actions caused by emotional and non-emotional evaluations. Indeed I am wary about claiming bodily sensations to be what distinguishes emotional and non-emotional states. It would seem wrong to suggest that a paralysed subject would lack emotional feeling simply due to their lack of bodily feelings. Would they not still be in an emotionally charged state as opposed to merely having appropriate beliefs and desires? A good response to this problem is offered by Tye (1996). His suggestion is that one does not require actual bodily sensations, but only sensory representations. Thus "you might even feel anger if you lose your body altogether and you are kept alive as a brain in a vat, stimulated to undergo the very brain states you do when you are angry in normal circumstances" (p.126). Indeed it is quite plausible to suggest that those brain states need not be caused only by perceptual information but also in some cases directly by beliefs and desires. In any case this would require more than the pure cognitive account can offer, requiring some acknowledgement of both affective perception and affective cognition. Whilst cognitivism may add to its account by outlining further requirements of cognitive content, none of these provide necessary and sufficient conditions for what emotions *are,* however well they outline what emotions typically tend to be. It seems that a pure cognitive account has to be rejected.

2.5 Proposing a General Account of Emotionally Affective States

Taking into account the failure to adequately identify what constitutes *specific* categories of affective state and where the boundaries between these states lie, I would like to propose my own general account, with the purpose of outlining the range of affective states to be addressed by this inquiry. This will provide me with a more elegant method than referring to individual emotion types by name.

I do not wish to enter into the debate regarding whether music may evoke a specific type of state, e.g. moods, emotions, feeling, etc., as music is clearly capable of evoking or representing a range of emotionally affective states. Within psychological thought, affect has perhaps the widest range of application, incorporating the most basic (universal) perceptual responses and also a basic positive/negative distinction reflecting underlying physiological arousal of the nervous system (see discussion of autonomic nervous system Chapter 1, p.11). However, I want to refer to more complex states in this analysis, so affect as it stands will not suffice. In addition, I have noted above that neither the existing categories of mood or emotion are sufficiently unambiguous. Attempts to define differing branches of affective states are seemingly misdirected due to the very nature of affective states themselves. William Alston puts this very succinctly,

> "it may be that the concept of emotion is like many other concepts such as religion, poetry, and science, in that we cannot explicate it without making a distinction between central (paradigm) cases and cases which deviate from the paradigm in lacking some central feature but do not deviate sufficiently to completely inhibit the application of the term. Thus the full range of cases exhibits what Wittgenstein called "family resemblances." There is a list of typical features, such that some are present in all cases, no one feature is present in all cases, and only the paradigm cases exhibit all the features."(p.486 *Emotive Meaning*).

For this reason I wish to refer to musically evoked responses and musical expression in terms of *emotionally affective states* and to include affect, mood, emotion and feeling within this category, encompassing both cognitive and physiological, culture specific and universal responses to music.

Perhaps at best what might be offered is a general conception of what I take this category of *emotionally affective states* to cover: Affect referring to purely physiological components of emotional states, involving positive and negative dimensions; Moods, involving cognitive elements, in terms of limited but not necessarily determinate cognitive content and object/cause relationships, and moods also being typically longer in duration. Emotions may be markedly different in terms of their cognitive components and determinate causes and objects, including states that are almost entirely cognitive, lacking behavioural components. However, none of these may exclusively define each category. As Frijda notes, (Ekman and Davidson p.63) affective states are perhaps better described in terms of processes than categories, in this sense it is wrong to talk of emotions as if they are distinct events. We should consider affective states in terms of a continuum.[11] Affective states are always present, merely moving from one 'focus' or degree of intensity to another, moods becoming emotions, emotions moods, and both perceptual and conceptual input influencing our affective lives. This might be loosely represented in terms of a hierarchy of emotion processing as opposed to affective categorisations (Fig.2.1). Some affective states are principally cognitive, others physiological. But emotion names typically cross these boundaries, i.e. fear applies to feelings, emotions, affect states etc. Whilst this perhaps says more about use of emotive vocabulary than emotional states, this is not to say emotion naming is arbitrary.

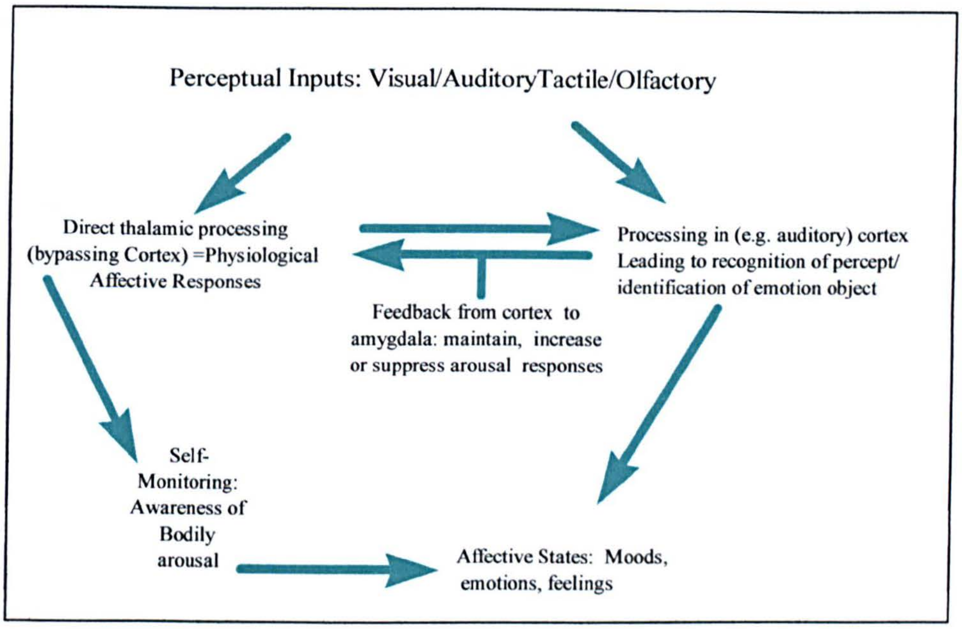

Fig. 2.1: Schematic model of affective processing routes.

Inevitably it needs to be acknowledged that emotions must be discussed in terms of the vocabulary available (21st Century English). However, this does not mean that we may neglect to consider the distinction between states themselves and language used to describe them. Neither should we forget that the target of this enquiry is exactly these mental states as opposed to their descriptions and the capacity of music to represent or evoke these psychological states whether lexicalised or not.

The overview of emotion theories in Chapters 1 and 2 demonstrates that there is still largely a cognitive/perceptual split.[12] Categorisations of emotion have been (and remain) largely constructed for theoretical purposes, but perceptual/cognitive accounts need not necessarily be rivals. There has been some acknowledgement that emotion must involve both affective cognition and affective perception. 'Hybrid' theories of emotion do seem to be gaining favour. Gordon, and de Sousa (*Rationality of Emotion*) do enter into some interdisciplinary discussion and hybrid accounts are explicitly proposed by Charland, (1996), Damasio, (1994) and Greenspan (1989). Empirical findings do support a distinct model of underlying emotion processes, and allow some insight the *actual* role of conscious cognitive evaluations. This will be born in mind in the further investigation of musical emotions, looking towards some level of convergence between conceptual analysis and empirical findings. This theme will be maintained throughout the investigation of music cognition with the aim of developing a coherent account of both music emotion processing and musical experience.

Notes

[1] Gordon *The Structure of Emotions* p.28. We might also consider here that there are cultures where concept of emotions are different, for example, where anger is seen as a positive emotion. I will consider this within my further examination of culture specificity in Chapters 4-7.

[2] A good example of a 'negative' piece of music that also produces a negative response is *Penderecki's Threnody to the victims of Hiroshima* which has been described as harrowing as well as producing strong emotions of sadness but without the *usual* experience of enjoyment for 'sad' music. Although we might perhaps enjoy the piece for the unusual textures, orchestration and other techniques employed.

[3] Gordon, p.25 *The Structure of Emotions*

[4] One must acknowledge for example that other cultures may have emotion terms and concepts, which are not adequately explained by our own terminology. For example the German notion of Schadenfroide the name given to a particular kind of pleasure taken in the suffering of others.

[5] Kivy, (in Alperson, 1987) may be interpreted as equating emotivism with the arousal theory although I feel his use of emotivism and cognitivism is intended rather to outline the distinction made above. Stecker in Nolt on Expression and Emotion refers to 'emotionalism' -again defining what is commonly taken to be the Arousal theory of expression. This might also be wrongly confused with the interpretation of emotivism which I intend here.

[6] Kivy assimilates his account with the contemporary cognitivist account in Philosophy of emotion, however, as we will see in the following critique, his account contradicts the cognitivist position.
[7] The cognitivist may reply to this by asserting that for fiction, there are identifiable objects available, whether fictitious or not. However, have seen some of the problems invoked by such claims in the discussion of Levinson's account in Chapter 1.

[8] Perhaps this context dependence *is* what Kivy intends when he says 'their names are their descriptions' but if so he fails to make this clear.

[9] It would be interesting to consider the frequency of musically naïve listeners reporting cognitively complex emotions. It seems unlikely they would be capable of distinguishing between and formulating such complex relations between musical features, but nonetheless they do seem to report cognitively complex emotions. See Appendix A5.13

[10] In a very famous case, the composer Hans Eisler was accused of attempting a communist infiltration of Hollywood through his music, which, heard in context did have strong political significance. One prosecutor went so far as to say, "Mr Eisler is the Karl Marx of communism in the musical field and he is well aware of it." (Betz, 1982, 'Hans Eisler Political Musician' p.200). Nonetheless, in court, the charges were hard to prove, out of context and not heard by its intended audience, the music lost its significance.

[11] This idea receives some support from Izard (1993, 1994).

[12] The recent debate between Zajonc and Lazarus, highlights the division between cognitive and perceptual accounts. Neither willing to acknowledge that emotion may in fact involve both affect and cognition. See Charland 1997, pp.561-2.

Chapter 3
New Perspectives on Philosophy of Music: Towards A new Theory of Musical Expression

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3.1 Introduction

Chapter 3 introduces the main body of neuropsychological evidence, and the second part of this thesis will draw heavily on these findings. Recent neuropsychological studies have made considerable progress in the investigation of music cognition with far-reaching implications for philosophy of music. The aim of this chapter is to outline an underlying structure for music-emotion cognition, which is currently lacking in attempts to explain musical expression of emotions.[1] Implicit in the development of this framework will be a critique of existing accounts of musical expression. Within philosophy of mind, cognitive deficits have been extensively drawn upon in order to support functional models of the mind, and it is now deemed acceptable both in philosophy and the cognitive sciences that we may infer albeit carefully from damaged to normal cognitive systems. Adopting a more cognitive approach to philosophy of music may enable us to reconcile traditional aesthetic accounts with neuropsychological insights, and develop an empirically sound theory of musical expression which also matches our musical experiences.

3.2 What Is Wrong With Traditional Accounts of Musical Expression ?

There is now a wealth of empirical research, yet this body of information is largely ignored by philosophical inquiries. Fundamental problems for expression theories are rooted in the nature of aesthetic inquiry. Mcdonald Meidner explains,

> "the aesthetics of music is a hybrid study. Informal, non-professional psychology, formerly very prominent in musical aesthetics has understandably declined over the last forty or fifty years. Aestheticians have been intimidated or alienated by academic professional and laboratory psychology. To what extent we have been neglecting to inform ourselves of developments in those fields, which might be profitably instructive to musical aesthetics, would demand a special inquiry." (McDonald Meidner, 1985, p.349).

There is no reason however, why such a 'special inquiry' cannot be undertaken, yet this portrayal seems to accurately describe the situation for musical aesthetics, with aestheticians blindly continuing to discuss musical expression, and arousal, without any notion of an underlying cognitive framework for music. It is not enough to acknowledge that,

> "an explanation of emotional expression in western music requires, besides musical knowledge and experience, some acquaintance with the physics of

sound, the physiology of the ear and the perception of auditory stimuli" (Mcdonald Meidner, 1985)

Few aestheticians take time to explain these aspects in relation to their proposed theories of expression. If they were to do so, it seems likely that most would be relying on 'traditional (and out-of date) psychological aesthetics' such as Pratt's *The Meaning of Music* (1931) for empirical data. However, the empirical developments made in the last forty or fifty years (particularly those in neuropsychology) have serious implications for aesthetics, and it is these findings which are to be the focus of this inquiry. The aim is to provide an underlying framework for music-emotion cognition, upon which we might build on such expression theories as those proposed in Aesthetics, and explore music from a more cognitive stance.

In addition to the enigma of music's emotional relationships, the issue of emotional expression is intimately attached to central problems of aesthetics, for example: aesthetic value, aesthetic experience, and aesthetic properties, to name but a few. Yet contemporary accounts of musical expression still fail to hit the mark and disagreement between aestheticians remains high, even at the fundamental level regarding whether music *itself* (without referring to the extra-musical) can or cannot express emotion. In fact the issue of musical expression in aesthetics has not really made any substantial progress in the last hundred years or so since Hanslick denied music could express any definite emotions. The nub of this controversy lies with the division between holders of the expressionist thesis. The debate remains whether music can express emotion *directly* (i.e. emotion having an intrinsic relationship with musical properties and a causal relationship with listeners' responses), or only with reference to the non-musical world. In this respect there still seems to be an 'all or nothing' approach in aesthetics - either music expresses and arouses emotion directly or it is entirely a result of socially and institutionally conditioned responses to music.

Despite the fact that neither of these approaches has yielded satisfactory results, there is rarely any middle ground or any serious attempt to explain how it may be some combination of these effects which allows us our musico-emotional experiences. Indeed it seems that both attempts to explain emotion recognition capture something which seems intuitively right about musical experience. So it might seem that rather than being two opposing theses, these accounts may be better explained as components of a multi-level theory of music and emotion cognition, though this is not to say all aesthetic accounts can be reconciled with empirical findings. Further problems for aesthetics are invoked by the 'over-theoretical'[2] approach adopted, and selective use (and abuse) of empirical findings. All in all this has led to many accounts of musical expression which simply do not match our experiences of listening to music. Accounts such as Cooke's in *The Language of Music*[3] (attempting to give particular musical phrases analogous expressive properties), seem counterintuitive, and as we will see are not compatible with models of music cognition suggested by empirical findings. In many cases we would agree that we do not make a detailed cognitive evaluation, we just seem to have an *awareness* of the emotion expressed, and this is not captured by aesthetic theory. I feel however, there is still more to be said about the specific claims of expressionism before moving on.

The development of expressionist theories must owe at least something to the fact that music does not fit within the dominant 'representational' theory of art. While music lacks powers to represent persons, actions and events in any reliable sense, expressionism in music maintains that music *is* capable (in whatever way), of reliably expressing emotion. Claims vary considerably regarding what sort of emotions, (moods, feelings, affect), how they are expressed, and whether emotions are also aroused. As noted in Chapter 1, the debate is no longer whether music per se can or cannot express emotion, but rather *how* it does so, with nobody wanting to deny music's emotional links altogether.

There are many ways in which expression theories might be categorised (e.g. the cognitivist/emotivist dichotomy in Chapter 1). However, the division between direct and extra-musical modes of expression is fairly well represented.[4] Direct expressionism (which I shall call *natural expressionism*) is represented by two main accounts. First, accounts such as Kivy's, claim that the relationships of music's formal properties alone, chords, melodic lines and harmonies are sufficient to convey emotion. Second, arousal theorists (e.g., Matravers) suggest that music expresses emotions directly, in virtue of arousing them in the listener. Extra-musical accounts (which I shall call *cultural expressionism*) vary significantly, with theorists such as Karl and Robinson claiming that music must be heard in context and with biographical information about the work for it to properly express some emotions. Other theories (Putman) suggest that music may imitate the behavioural characteristics of a person in an emotional state, or (Levinson) that it may represent an imaginary person with whom we may empathise. A popular imitative account is that music may imitate other emotional sounds - vocal contours, cries or other sounds of the environment - perhaps thunder or animal cries.

These accounts have been criticised in Chapter 1 in relation to emotion theory and they will be subject to further scrutiny in Chapter 4 in light of neuropsychological findings. Despite the difficulties expressionist theories have encountered in providing a *comprehensive* account of music-emotion cognition, some accounts *are* still effective in explaining our conscious cognitive evaluations of music (how it is that we might hear musical phrases, or pieces, as representative of a certain concept, e.g. by acculturation or musical convention). Some aesthetic accounts seem able to explain this aspect of music cognition well and for this reason I would still like to offer support to the expressionist thesis. Far from being passé as some (Sharpe, 1983) would like to hold, I believe expressionist theories for music may still have much to offer, even if in a revised form in light of recent empirical findings.

Through our discussions below we will see that it is first necessary to have a basic picture or framework for music-emotion cognition before attempting to explain emotional expression in music. An initial objection might well be raised here - that aesthetic accounts do not *need* to give a full explanation of music processing, they are merely satisfied with giving an account at the cognitive level of musical evaluation. But this objection is not satisfactory for two reasons. Firstly, this is not all that aesthetic theories claim to be doing. Many accounts make assumptions clearly dependent upon certain types of perceptual processing.[5] Secondly, emotional responses *are*, as we have seen in Chapters 1 and 2, an amalgamation of both cognitive and non-cognitive (affective) responses. Consequently we need to understand whether cognitive evaluations are guided by or dependent upon lower level responses (something which will be considered further in Chapter 4). To explain the conceptual element therefore is not enough - it is not a full account of how we recognise emotion in music. The underlying structure we propose of emotion cognition is important as this will undoubtedly impinge upon how we may explain music's ability to convey emotions.

3.3 Introduction to Neuropsychology

Whilst philosophical methods of investigation are largely self-explanatory, neuropsychology requires some introduction, and indeed some reply to critiques of its methodologies.

Neuropsychology[6] focuses on study of the damaged brain, being concerned with disorders of language, perception, and action, the relationship of mental function to brain structure, and of specific functions to comprehensive mental structure. Initially one might question what a damaged system can tell us about the workings of a normal system. In most cases normal behaviour is 'seamless', we simply cannot tell where the boundaries between different functions are. Brain damage literally seems to carve nature at the seams allowing us to see cognitive functions as both physically and functionally distinct, and suggesting which systems interact with each other and which are independent. The two main aims of neuropsychological inquiry are, first, to explain patterns of impaired performance seen in brain-injured subjects in light of cognitive models. Second, to make inferences about normal cognitive processing in light of these patterns of impaired performance. Neuropsychology is now a well established field within the cognitive sciences. Its recent growth over the last twenty years perhaps owing to the coming of age of behavioural sciences in general and linguistics in particular.

Nonetheless neuropsychological findings have not always been readily accepted. Originally a theory driven enterprise, neuropsychology was largely rejected by those interested in normal cognition. The late nineteenth century saw the rise of the 'diagram-makers', the founders of neuropsychology, who produced complex theoretical models capable of explaining dysfunctions observed. To some extent these models were supported by empirical findings but the approach soon came under attack for its weak empirical methods and claims that the functions identified could be precisely localised. In many cases, the citing of neuroanatomical locations was highly speculative and theoretically advanced accounts were not matched by adequate empirical support. The critics held sway well into the twentieth century, until a move towards group studies, marking an attempt to make investigations more scientific in light of the empirical shortfalls of single case studies. Group studies soon became the norm, but, while large volumes of data were generated, few theoretical advances were made. The development of neuropsychology as it is known today, began in the 1960's. Cognitive psychologists found that many models devised for normal brain function could not account for function observed in brain impairment. However, models developed by studying impaired processing *could* account for both the effects of damage, and normal function. (For a full review see Shallice, 1988).

3.3.1 Neuropsychological Methods

Specific methods within neuropsychology are given prominence. *Associations* are demonstrated by co-occurrence of two deficits on tasks (fig.3.1a), for example, two musical perception tasks. There are limits, however, to the inferences which can be made from associations. Hypothesised relationships between tasks may be purely due to lesion localisation, not due to shared processing strategies.[7] Just because two things correlate does not mean that there is necessarily a relationship between them, e.g. hair colour and car ownership. There might well be a correlation between fair-haired people and people owning red cars, but this correlation might well be arbitrary or, non-causal. The major problem for associations then is that of interpreting any correlation between deficits. It is perhaps *dissociations* in processing tasks which form the main body of evidence from neuropsychological findings. A *single dissociation* is demonstrated when a subject shows intact performance on one task, whilst performance on another is impaired (fig. 3.1b). An example might be intact discrimination of melody and impaired rhythm discrimination on musical tasks.

Fig. 3.1a **Fig. 3.1b** **Fig. 3.1c**

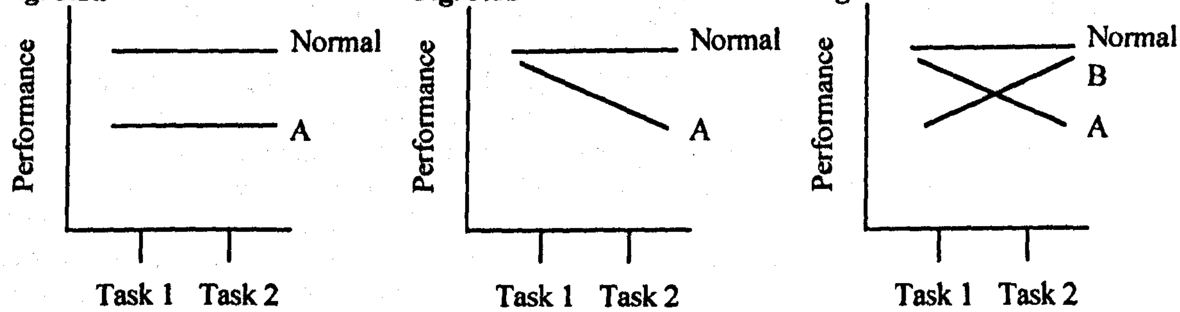


Fig 3.1 Patterns of Normal And Impaired Performance: 3.1a; association: 3.1b single dissociation: 3.1c double dissociation.

There are problems too for single dissociations. For example, the intact performance may be the result of a revised processing strategy. A task might be completed by trial and error, from memory, or conditioned responses may come into play when the task would ordinarily be undertaken by a specific processing strategy in normal subjects. For example, someone impaired for prosodic (intonational) aspects of speech might nonetheless be able to 'work out' the emotional tone from the content of the words and facial expression of the speaker as opposed to merely having an 'automatic' response to intonational aspects (e.g. vocal contours). Alternatively, the intact task may simply be *easier* than the task showing impaired performance. These problems limit the powers of inference from single dissociations. Stronger evidence though is provided by *double dissociations*. In such cases, subject A shows intact performance on task 1, but impaired performance on task 2; whilst a second subject B shows the reverse pattern of impairment (fig.3.1c). This eliminates the 'task difficulty' factor as an explanation of a single dissociation. Taken with converging evidence from normal behaviour, double dissociations are a useful tool in the development of both functional and neuroanatomical hypotheses.

3.3.2 Critiques of Neuropsychology

There are many critiques aimed at neuropsychological investigations, concerning methodologies, preconceptions of cognitive structure, and to what extent findings have relevance to normal cognition. The critics of neuropsychological methods have to some extent been assisted by the rapid transitions in methodology during the development of the discipline.

Goldberg (1995) argues that studies have become biased in their dependence on dissociations and in turn are approached from a narrow perspective. He stresses that "isolated demonstrations of strong dissociations should not be treated with an unrestrained enthusiasm as the major tool of neuropsychological discovery and theory building." (Goldberg, 1995, p.195). Philosophers and faculty psychologists should equally guard against over-enthusiasm towards isolated clinical observations which seem to support theoretical studies. On the whole though, it is not the aim of neuropsychologists to develop a theoretical framework based entirely on single dissociations, but to evaluate hypotheses in light of the dissociations observed and where possible in light of findings from normal brain studies. Neuropsychologists have been at pains to stress that we cannot develop a model of a whole system based only on a few subsystems and it is still the case that relatively few subsystems have been studied in any detail - mainly language, memory, and vision and we cannot infer about global systems purely from these.

This brings us to perhaps the most frequently advanced criticisms of neuropsychology: the validity of inferring from damaged to normal cognitive systems, which in effect is a critique of the field itself. A key issue is whether damaged systems reflect normal processing with damaged components, or damaged systems using compensatory strategies. In making inferences from brain damage, we are commonly inferring that the damaged brain is working as a normal system with a selectively damaged component, as opposed to operating as a restructured cognitive system, compensating for such a loss. This approach however can be defended. From a very basic physiological perspective, the brain cannot repair itself. One cannot grow new parts to replace those lost, so a damaged system must work with what is available. Although there is greater plasticity in the pre-pubescent brain (which demonstrates better outcomes after damage than mature cognitive systems), this is a matter of re-organisation and re-distribution of functions to 'functionally uncommitted' areas. Basic functions take priority, and consequently, later learned skills such as literacy, numeracy, and quite possibly music, are eclipsed by re-organisation of basic functions. Functional models support the view that one can infer from damage to normal systems. If conceptually 'lesioned', many models will produce results consistent with those seen in brain injured subjects. A difficulty is to identify what processing strategies are at work. A damaged system may apply a different strategy to a task, resulting in a performance which is not analogous to normal cognition. In some cases though, processing strategies may be identified or at least narrowed down and we can have some knowledge about the stages of processing which are being identified (see Peretz; 1990, 1993: Auditory agnosia: A functional analysis).

In most scientific studies we have the opportunity to replicate experiments. A particular problem for neuropsychological methodology is the failure to replicate single-case studies.[8] There needs to be much caution in making comparisons across cases, and it is often difficult to reproduce the same conditions both across single cases and within group case studies. While one might have patients with functionally similar deficits, and neuroanatomically similar lesions, there are a variety of factors which remain unaccounted for and one has to acknowledge variability in both individual function and neuroanatomy. The pre-morbid variation across subjects therefore invites caution when attempting to generalise about particular subject groups. However, standardisation of testing is rapidly developing allowing genuine comparison of single case studies, so long as individual variance is considered.

While neuropsychological evidence intuitively invites assumptions of modularity, this has produced further criticisms of the approach. As Shallice (1988) notes, it is possible to provide examples of non-modular systems which may conceptually be lesioned such as to produce dissociations.[9] Chapter 6 will deal with such criticisms arising from assumptions of modularity. In any case, there is unquestioningly an implicit understanding that double dissociations alone neither predict, nor prove the existence of a specific cognitive architecture. Needless to say, the most powerful defence for neuropsychology is convergence of evidence. Where neuropsychological findings converge with normal evidence, brain imaging and animal evidence (as they frequently do), one is then likely to have a robust theory. Any field can be important in developing a novel hypothesis which can then be tested across other disciplines.

3.3.3 Current Findings in Neuropsychology of Music.

The term 'amusia' was introduced by Steinhals in 1871 to describe musical deficits and brain damage specifically affecting musical function. The first case report of musical dysfunction was published by Proust in 1886.[10] Whilst clinicians have long been aware of such cases, there is not a vast literature on musical deficits simply because music has not been considered an essential function. Where detailed studies have been made, the subjects are usually professional musicians, (as seen in Table 3.3 below), so historically the investigations are biased towards cases of highly developed musical abilities. Recently however, musical function has been studied in both musicians and non-musicians, although subjects studied are still typically those who have an interest in music - avid listeners or amateur performers. It seems that the musically non-literate population is not well represented, quite possibly due to the fact that those not interested in music would not be overly concerned with its loss in the face of more pressing problems.

Music has nevertheless become subject to ongoing empirical studies in neuropsychology, but there are still methodological problems to be considered. To begin, there is a lack of standardised musical tests and normative data for musical function. Some psychological batteries exist for testing musical ability, but these are ill-suited to assessment of the effects of neurological damage on musical function. Individual musical abilities vary dramatically, posing the problem of catering for both musically literate and musically illiterate populations. Unlike language, the development of musical skills varies greatly. There is not always a correlation between receptive and expressive musical abilities, or between formal training and level of musical ability. There is certainly no universally adopted clinical method for musical assessment and many clinicians themselves are not musically literate. The lack of standardisation for classifying musicality and lack of standardised test batteries have consequently lead to many inconsistencies in the literature. Perhaps the most frequently used tests are those by Seashore, Wing, Bentley, and Gordon, but the use of these tests is perhaps marked by the lack of suitable alternatives, as opposed to their suitability for application across cases. (see Henson and Wyke's critique of Seashore's tests).[11]

There are a wide range of documented dissociations involving music, including both selective damage and sparing of specific musical functions, e.g., rhythm, melody, or reading musical notation. Both receptive and expressive aspects of musical performance may be affected. Tables 3.1 and 3.2 provide a summary of selective musical impairments. It is worth noting that terminology used is not always consistent. Often musical deficits are described under the more general title of auditory agnosia, a blanket term which can be applied to the inability to interpret all sounds or all non speech sounds.

Table 3.1: Expressive Amusias

Deficit	Definition
Instrumental Apraxia	Loss of ability to play instrument in absence of motor deficit.
Oral-Expressive or Vocal Amusia	Loss of ability to sing hum or whistle melodies by imitation or from memory
Musical Agraphia	Loss of ability to produce musical notation, either copying, transcribing, or from memory.

Table 3.2: Receptive Amusias

Deficit	Definition
Global Amusia	Loss of ability to interpret all aspects of musical stimuli, (can include loss of expressive musical abilities).
Musical Alexia	Loss of ability to read musical notation
Arhythmia	Loss of ability to discriminate rhythmic aspects of musical stimuli
Amelodia	Loss of ability to interpret melodic aspect of musical stimuli
Auditory Atonalia	Inability to use tonal cues for music discrimination
Music Agnosia	Inability to recognise familiar melodies.

In some cases, isolated musical deficits have been recorded, but more often, they are accompanied by further disorders e.g. language deficits, motor deficits, or dysfunction encompassing a range of musical deficits. Table 3.3 provides a summary of some documented cases.

Table 3.3: Summary of Documented Cases of Sparing and Damage of Musical Function
See Appendix II for details of lesion localisations. A summary of the associated deficits listed is given below in Table 3.4

Case	Sparing/Damage to Musical Function	Other Deficits at Time of Testing	Pre-morbid Musical Abilities	Lesion localisation	Laterality
Souques & Baruk, 1930	Spared Musical abilities	Wernicke's aphasia	Professional musician (piano teacher)	Left hemisphere, lesion covering almost all of left temporal lobe.	Inconclusive
Alajouanine 1948, (Ravel)	Spared musical abilities	Wernicke's aphasia, ideomotor apraxia	Professional composer & performer.	(Bilateral ventricular enlargement)	Not Given
Luria et. al 1965, (Shebalin)	Spared musical abilities.	Severe (global) aphasia	Professional composer	Left hemisphere: massive lesion to temporal and inferior parietal regions (haemorrhagic cyst in left temporo-parietal region)	Not Given
Assal 1973 (H.B)	Expressive musical abilities intact, some receptive deficits: rhythmic processing and naming familiar melodies.	Wernicke's aphasia	Professional pianist	Left temporo-parietal	Suggests right-handed (writing hand) -but no other evidence given.
Mavlov 1980	Global amusia & music agnosia. (receptive and expressive)	Acalculia, mild orthographic deficit, left-right disorientation.	Professional violinist	Left hemisphere, occlusion of posterior parietal artery.	Right-handed
Brust 1980 (Case 2)	Expressive amusia, with severe alexia and agraphia	Conduction aphasia	Professional musician	Left hemisphere	Right-handed
Brust, 1980 (Case 1)	Musical alexia & agraphia, other musical abilities intact	Transcortical sensory aphasia, mild alexia, severe agraphia	Professional musician	Left hemisphere	Right-handed
McFarland & Fortin 1982	Expressive amusia, difficulty recognising familiar melodies.	None	Accomplished organist -not musically literate, no formal musical training.	Right temporo-parietal	Right-handed

Table 3.3 Continued

Case	Sparing/Damage to Musical Function	Other Deficits at Time of Testing	Pre morbid Musical Abilities	Lesion localisation	Laterality
Eustache et al 1990 (R.L)	Impaired melodic discrimination, expressive arhythmia, oral - expressive amusia (restricted to examples without words.)	Left sensory-motor hemiplegia. Left visual neglect, mild constructional apraxia, (and anosognosia)	Non-Musician	Right capsulolenticular and frontal ischaemic lesion	Right-handed
Eustache et. al 1990 (M.H)	Inability to identify familiar tunes, oral expressive amusia, mild expressive arhythmia.	Mild word-finding difficulty, impairment in writing to dictation, oral comprehension deficit apparent in conversation.	No formal musical training, avid listener enjoyed singing.	Left temporo-parietal	Right-handed
Peretz & Kolinsky 1993 (CN)	Vocal amusia, global receptive amusia some spared temporal processing for music.	None	No formal musical training, enjoyed singing.	Bilateral temporal lobe lesions	Right-handed
Peretz et. al 1994 GL	Receptive amusia, (auditory atonalia) spared temporal processing for music	Mild receptive language difficulty	No formal musical training, avid listener to classical music.	Bilateral temporo-parietal	Right-handed
Johannes et.al, 1998	Sound agnosia (non-verbal) and amusia	None	Sound engineer with perfect pitch.	Right perisylvian	Right-handed
1998 Peretz et. al (IR)	Can no longer sing or recognise familiar melodies. Spared emotion recognition for music.	Mild articulation difficulty. Left hemiplegic arm.	No formal musical training but raised in musical environment: Brother and grandmother professional musicians.	Bilateral lesions. Left temporal gyrus, right inferior and middle frontal gyri.	Right-handed
Estanol, B & Mendez, A 1998	Receptive amusia	Mild Wernicke's aphasia	Pre-morbidly musical	Bilateral damage to superior temporal convolutions.	Not given

Other cases of interest are: Ustvedt (1937); Jellinek (1956); Botez & Wertheim (1959); Trethowan, (1977); Shapiro et. al (1981); Morgan & Tilluckdharry (1982); Munte et.al (1998); Schuppert et. al (2000).[12] Note that this is not a fully comprehensive list of cases, but includes those which are of particular relevance to this investigation. It may seem that contrary to my remarks above, that there is in fact a vast literature on musical deficits. The large number of papers, however, does not reflect the relatively few robust cases which have been subject to detailed investigation (although I might add that this situation has improved in the last three years whilst I have undertaken this study). Many cases of musical dysfunction are mentioned in passing, as interesting asides discovered in the investigation of co-occurring deficits. Often (particularly in earlier cases) there is no detailed assessment of musical skills, and assessment of pre-morbid abilities relies on self-assessment by the subject. Hence one should be wary when contrasting cases.

Table 3.4 Associated deficits: A summary of non-musical deficits in the above cases.

Deficit	Description
Acalculia	Disorder of calculation following brain damage.
Agraphia.	Loss of ability to write, may be specific to language or music
Alexia	Loss of ability to read, may be specific to language or music, and may occur independently of agraphia.
Anosagnosia	Denial of deficit or rather a lack of awareness of a deficit.
Aphasias	Collective term for impairment of language skills following brain damage. Some, or all language functions (global aphasia) may be damaged in both receptive and expressive modalities.
Broca's Aphasia	An aphasia characterised by halting effortful speech, associated with damage to 'Broca's area, a portion of the left inferior frontal gyrus.
Conduction Aphasia:	An aphasia characterised by difficulties repeating heard utterances.
Wernicke's Aphasia	(Also known as sensory aphasia) an aphasia characterised by fluent but meaningless speech, consisting of strings of neologisms, may include semantic errors, and often accompanied by impaired comprehension.
Apraxia	loss of loss of ability to make purposeful fine body movements
Ideomotor Apraxia	An Apraxia characterised by a distortion of movements. Execution of movements is only impaired when they are executed out of context.
Hemiplegia	loss of voluntary movements on the contralateral side, due to brain damage affecting the motor cortex.

3.3.3.1 The Independence of Music Cognition

In light of the co-occurrence of music with other deficits, many suggestions have been offered as regards how music relates to other functions, both in terms of its physical localisation and processing strategies. Implicit in many accounts is a view of music as integrated with other auditory functions and ultimately dependent on language. Historically, the approach has been to assess music's interaction with language as opposed to assessing its independence as a cognitive function. This is despite well documented phenomena in the history of neuropsychology, e.g. high profile cases such as Ravel, and Shebalin, composers who retained musical abilities in the face of severe aphasias. And there is also the frequently reported ability of aphasic patients[13] to sing songs containing words they could not speak. These observations would surely suggest a lack of dependence of music upon language. However, often cases of dissociation were dismissed as interesting asides, and the retained abilities of musicians were attributed to unusually advanced pre-morbid musical skills.

Whilst it is becoming more widely accepted in neuropsychology that music functions more or less autonomously, this view is not shared across other disciplines. There are still wide ranging assumptions that music is language-dependent. For example, comparisons between music and prosodic aspects of speech are frequently made. Storr, comments that

> "There are many similarities between prosodic communication and music. Infants respond to the rhythm, pitch intensity, and timbre of the mother's voice; all of which are part of music." (Storr, 1992, p.9).

The following quote by Henson exemplifies similar thoughts within neuropsychology. Henson suggests that for musically experienced listeners,

> "it is difficult to divorce the music heard from the internal verbal analysis, say, 'modulation' or 'full close', which accompanies the auditory experience. And then words are required to describe, discuss, direct, sing and teach music." (1985, p.488).

These shared perceptual features of music and language however, do not in any way legitimise inferring shared processing capacities. Not only do such remarks overlook the non-linguistic nature of music itself, but they view music cognition and indeed the listening process itself as part of a far more complex behavioural context. Ultimately language is not required to *listen* to music, rather assumptions of language dependence arise as a consequence of music's involvement within the language dominant culture.

Nonetheless, the suggestion that music may be functionally autonomous has been criticised from the standpoint that, whilst musical function is occasionally selectively spared or impaired, more often amusia is accompanied by aphasia. Benton, for example, (1977) reported that 7/10 amusic subjects also suffered some form of aphasia, however, as I noted above, associations have multiple interpretations, and one shouldn't jump towards the simplest explanation. Clarifying the relationship of aphasia and amusia may go some way towards supporting the claim for a functionally autonomous music processing capacity. However, investigation is also needed regarding how and whether musical function may *develop* in the absence of language, in addition to functioning autonomously in the presence of acquired language deficits. Neuropsychology (focusing on acquired damage) has little to say about the possibility of mutual dependence in acquisition, yet this may be of importance in any attempt to suggest autonomous processes for music. The evidence from developmental psychology is contradictory. Cases of good musical ability in the absence of language e.g. in autism suggest that music may develop independently. However, where developmental language disorders are present, musical ability varies greatly. Controversially it has been suggested (Cox, 1993; Edwards 1979) that lack of linguistic communication may encourage development of right hemisphere functions as a compensatory mechanism. Developmental evidence may then offer some further support for a model of music as an independent cognitive function and will be considered further in Chapter 7.

3.3.4 Lateralisation of Musical Function

A prominent finding in the history of neuropsychology was the hemisphere dominance exhibited by language, and following in the footsteps of language studies one of the main aims of studying amusias has been to establish hemisphere dominance for music cognition. Many functions exhibit hemisphere dominance. While different processes may be bilaterally distributed, one hemisphere often has control for specific functions. The most notable example is language for which the left hemisphere is dominant in over 95% of cases in right handed subjects (in left handed subjects the figure is closer to 70%, and left handers may show very different patterns of brain organisation)[14]. A further example is visuo-spatial cognition, which typically exhibits right hemisphere dominance in right handed subjects. While this does not mean one can neatly identify specific locations for individual functions, it gives a map of their typical asymmetrical distribution. These cases are well matched by neuropsychological findings with damage to left and right hemispheres affecting specific cognitive functions.

For music however, lateralisation of function to one hemisphere has not been straightforward. Bearing in mind the hemisphere dominance of language, and the coexistence of language and music deficits, to some theorists it seemed obvious to suggest music and language both exhibit left hemisphere dominance. But one only needs to scratch the surface of popular psychology to be confronted with the strongly ingrained view that music (and other creative arts) are mediated by the right hemisphere. Indeed, the move towards single case studies has turned neuropsychologists in favour of this view, with cases of pure amusia being the result of right hemisphere damage. Nonetheless, (as Table 3.3 shows), left, right *and* bilateral lesions, (and of varying localisations), have all resulted in musical deficits, so it would not seem appropriate to attempt to lateralise 'music' in a uniform way, as a unified function, to either hemisphere. But perhaps the more influential factor in this approach has been the attribution of *general* processing capacities or strategies to left and right hemispheres - analytic processes mediated by the left (or language dominant) hemisphere, holistic processes by the right. It is unsurprising then that contradictory claims for hemisphere lateralisation persist as do problems for localising musical faculties. Table 3.4 summarises some contradictory claims for hemisphericity of musical functions, but one must note the consistency with regard to non-musicians.

Table 3.4. Claims For Hemisphericity of Music in Musical And Non-Musical Subjects

Author(s)	*Musician*	*Non-Musician*
Milner (1962)	RH	RH
Kimura (1964)	RH	RH
Bever & Chiarello(1974)	LH	RH
McFarland & Fortin (1982)	RH	RH
Basso & Capitani (1985)	LH	RH
Peretz (1980-)	LH	RH

A new approach towards establishing hemisphere dominance was initiated by the findings of Bever and Chiarello (1974). The findings were significant as they led to revised thought on both hemisphere dominance and the nature of processing strategies employed in musically sophisticated and naive subjects, suggesting that musicians and non-musicians used very different processing strategies, and importantly, different hemispheres for analysing music. Bever and Chiarello used a dichotic listening task, a method where different stimuli are presented to each ear at the same time, and the subject is asked to report what they hear. When listening to linguistic material, a right ear (left hemisphere) advantage is generally displayed. Bever & Chiarello found that musically experienced listeners demonstrated a right ear advantage for the recognition of melodies, (supporting a left hemisphere dominance), whereas musically naïve subjects demonstrated a left ear superiority (and right hemisphere dominance). Bever and Chiarello's findings also supported the analytic/holistic conception of processing strategies, with the left hemisphere operating via an analytic processing strategy and the right hemisphere via a holistic strategy. On such accounts 'analytic' strategies refer to algorithmic, sequential processing, whereas holistic strategies refer to parallel or simultaneous processing.

Following Bever & Chiarellos' findings there has been widespread acceptance of their hypothesis. Gates and Bradshaw (1977), Peretz (1990), and Basso & Capitani (1985) have all supported revised models of hemisphere dominance where lateralisation is variable in relation to musical experience. It is suggested that musically sophisticated subjects who know the 'musical code' (i.e. have a music lexicon and syntax) employ analytic processing strategies mediated by the left hemisphere (or language dominant hemisphere), whereas musically naive subjects employ holistic processing strategies mediated by right hemisphere functions. This is supported by findings that musically experienced subjects do refer to local features in processing musical information (intervals between notes in a melody), whilst non-musicians refer to global features such as melodic contour (Peretz 1990). (Fig. 3.2) (And would also account for the consistency seen in Table 3.4).

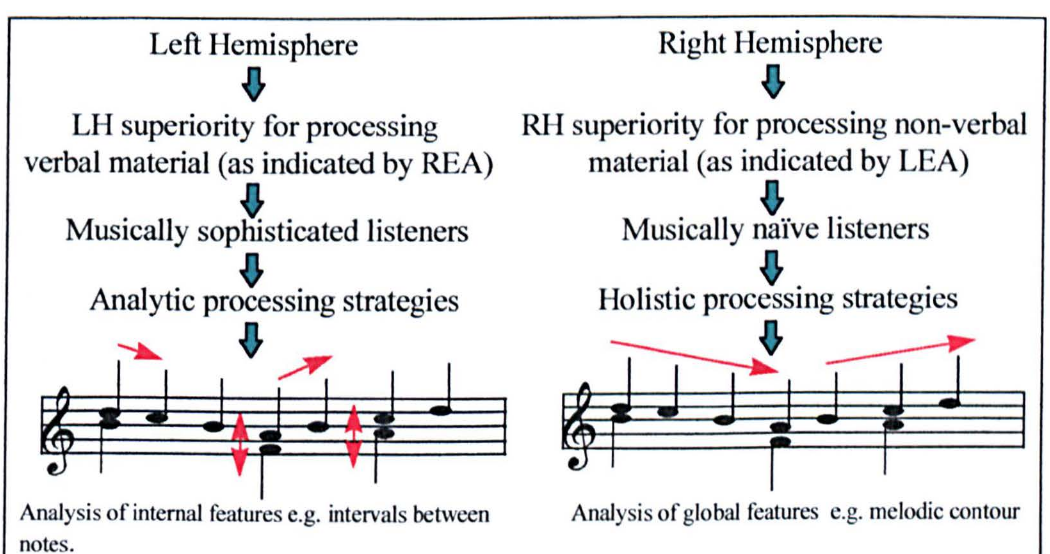


Fig. 3.2
Suggested Lateralisation of Music For Musical and Non-Musical Subjects. LH = left hemisphere, RH = Right hemisphere. LEA = Left Ear Advantage, REA = Right Ear Advantage.

Nonetheless, this acceptance is very puzzling. Not only have Bever and Chiarellos findings been largely unreplicated, the test also depends upon experimental techniques (dichotic listening) which are unreliable, difficult to administer and verify. And it is a very weak claim to ground hemisphere dominance on ear advantage for one type of musical task. Other tasks may well demonstrate an opposite ear advantage, and therefore contradictory hemisphere lateralisation. Indeed, contradictory evidence for hemisphericity is provided from several sources: Milner, 1962; Kimura, 1964; McFarland & Fortin, 1982; Johannes, 1998.

The heart of the problem however, seems to be the misdirection of laterality claims which is in part due to the global/local conception of hemispheric function. This has lead to attempts to lateralise music as a unified function without considering laterality of individual subjects. This is of particular concern in the case of music where there is a higher proportion of left-handed and ambidextrous subjects amongst the musical population[15]. And as I noted above, cerebral organisation (particularly lateralisation of language) in such subjects is variable. Rather than attempting to lateralise functions full stop or even just to lateralise in terms of musicians and non-musicians the focus has to be on individual subjects and individual cognitive organisation. If as we shall later see, one considers laterality issues, musical experience, and the nature of the musical task involved, one may then be in a position to examine whether specific musical tasks are undertaken by a particular hemisphere in a particular group of subjects.

There is growing support for bilateral processing of music (and auditory processing in general), and in light of the above considerations, one can see why the dominance debate is becoming somewhat obsolete. Indeed it is hard to see why the brain would be 'structured' to process in such radically different ways across hemispheres. A far more plausible explanation is that differences that have been identified in hemispheric processing strategies reflect *what is processed* in each hemisphere (with strategies used being those most suited to the task), rather than suggesting there are fixed strategies for each hemisphere which determine what is processed. For example, language, (a serially organised, rule governed system) in the left hemisphere, and visuo-spatial information (lending itself to gestalt, integrative processing) in the right hemisphere. The case study presented in Chapter 5 also provides further evidence on this issue and I will return to this in detail in Chapter 6. Although operating on a different level, localisation of musical function is also an issue. This will be considered further in Chapters 6 & 7 but it is worth noting that some of the issues concerning lateralisation will impinge upon issues of localisation - e.g. the type of processing strategy assumed for each hemisphere, in relation to the localisation of a particular musical function.

3.4 Drawing on Musical Dissociations

In this section I shall first discuss dissociations relevant to a general picture of music cognition, before examining those specific to music and emotion, and giving a more precise picture of the musical deficits concerned. Some intriguing and surprising discoveries have been made giving us a radically different perspective of music in relation to other general cognitive processes and indeed other auditory processes.

To begin, it would be useful to have a clearer concept of what it means to be 'amusic' (and what we mean when we say amusic patients cannot process music). Amusic patients have no physiological problems with hearing, the mechanisms for receiving auditory input are intact, and are proven to be so by subjects' other auditory abilities. Amusic subjects cannot interpret or recognise the musical information and complain of hearing music as 'garbled' sounds. We can imagine more clearly the similar case of a subject with auditory agnosia (inability to recognise and identify auditory input) who says

> "I know exactly what I want to say but I don't know whether it is right or wrong...I know I am speaking but I can't hear the words right, not the actual words, I can hear the voice." (Klein and Harper 1956, p.114). An amusic patient might say 'I know it's music - I can see the orchestra playing....I can hear the sounds - but I can't hear the actual notes'.

As seen in 3.3.3, music exhibits dissociation[16] from other cognitive systems in various ways. Firstly, there is evidence of music as independent of other auditory functions. Some subjects with amusic deficits can process (recognise and interpret) both environmental sounds and speech without any difficulty, and there are examples where subjects are unimpaired in all other cognitive functions. Non-musical deficits are also of relevance here - that environmental sound and speech can be selectively spared and impaired may provide a key to understanding the organisation of the auditory system as a whole..[17] Double dissociations observed between music and speech (where music is spared in one subject with speech damaged, and selectively impaired in another subject with speech intact), offer a new perspective as regards music's relationship to speech (and indeed environmental sound.) Expression theories suggesting that music conveys emotion via its similarity to speech and environmental sounds (Pole, 1924; Spencer, 1857; Cooke 1959; Revesz, 1953), begin to lose credence on further examination of this evidence. In particular, those accounts suggesting musically expressed emotion is a subsidiary of prosodic elements of speech seem too simplistic.[18] Evolutionary considerations may offer some insights here as to whether music and language may share common roots. It may be that musical emotion developed from prosodic aspects of language, but once developed, the two systems now operate independently. If it can be shown, however, that prosodic aspects of speech (i.e., recognition of emotional tone of voice) are independent of music-emotion recognition, then this will refute the expression theories which depend on similarity of music to other auditory domains. However, there is also the possibility that some 'music' tasks *are* performed by general auditory processing mechanisms, whilst others have their own dedicated systems. The empirical evidence and controversy surrounding this issue will be reviewed in detail below. For the present, it does seem that emotion in music and affective prosody in speech can be independently processed and this calls for rejection of the brute similarity views outlined above.[19]

So far we have discussed mainly auditory dissociations, but music can be dissociated from other systems too. The most startling dissociation, and that which leads us to seriously review theories of musical expression, is the dissociation witnessed between music and emotional processing in amusic subjects. Amusic subjects have frequently reported being unable to recognise or interpret music, whilst they still reported feeling a sense of enjoyment from music as they were aware of its emotional content. They could still tell if a piece was happy or sad, and recent tests have shown amusic subjects respond well within the range of normal subjects in correctly identifying the emotional tone of musical works (see Peretz et. al, 1998). This initially seems somewhat paradoxical, and new questions arise: How is it that subjects who cannot recognise music 'as music', or discriminate between musical features, can still identify the emotion being conveyed? and, what is it being detected which allows emotional distinctions to be made? The idea of being somehow able to process or recognise the emotional content without the recognising musical features is initially a difficult one to accept. Peretz (Neurocase, 1999), makes a useful analogy with face recognition through which the situation does not seem quite so paradoxical. We may be able to progress from here towards our new theory.

> "One striking finding that emerges from studies of processing impairments due to brain damage is the double dissociation observed between recognition of identity and of emotion in faces. It has been recurrently reported that brain damage can produce selective deficits in the recognition of identities of seen faces while leaving intact the recognition of expressions. Inversely, selective deficits affecting the recognition of emotions from facial expressions without

> disturbing recognition of their identity have been reported (e.g. Etcoff, 1984; Parry et al., 1991; Young et al., 1993). These observations entail that certain aspects of face identity and facial expression are analysed separately in the human brain."

Peretz goes on to compare this to music, commenting on the lack of musical studies and similarity of the two cases.

> "The situation is odd because, like faces, melodies are highly structured, easily recognisable and conceived as an emotional medium. Just like for faces, brain damage can produce a selective loss of recognition abilities for melodies.....while leaving intact recognition of speech and familiar environmental sounds"

This analogy can hopefully make the idea clearer, particularly if we think in terms that the emotional recognition is not dependent on recognising musical (identity) features (or even recognising music 'as music'), just as interpreting facial expression is not dependent on recognising identity of faces.[20] Indeed, the analogy with face recognition may give us further help if we look to current neuropsychological models of face recognition. Most such models suggest three separate routes for information processing in recognising faces - "for processing information required in the recognition of a familiar face, for matching unfamiliar faces, and for the analysis of facial expressions." (Peretz, J. Cog. Neuroscience 1996).

With this in mind, the dissociations observed in music might lead us to suggest different routes for music processing: (on the surface) it certainly seems to be the case that separate pathways exist for the recognition of musical affect and the recognition of musical identity features. However, I suggest some caution in using this analogy. Whilst it is a useful means of explaining the independent processing of identity and expression, one should be wary of comparing functions across modalities. Identifying faces has strong adaptive value, as may be the case for voice identity too, but whether music might have inherited all the characteristics of these systems is questionable. It is possible that music itself offers some adaptive advantage by functioning in this way and I will consider this in Chapter 6.

Nonetheless, one can see the concerns for aesthetic theories of musical expression whether attributing emotional expression to context, particular musical features, its similarity to vocal contours, or by imitating human behaviour. None of these accounts alone seems able to match the picture of music cognition as exemplified by neuropsychological studies. There are discrepancies between the way in which aesthetic accounts are proposing music expresses (the specificity, and reliability they claim for such methods), and the picture neuropsychological data paints of music and emotion cognition[21].

An initial reply from the aesthetician might be that cognition in brain damaged subjects is different - that it is 'damaged processing' we are seeing and this does not reflect normal patterns of music cognition. However, as noted above these claims are unfounded. Further tests on normal subjects, and evidence from other domains of cognitive science indicate that the damaged brain is giving an accurate picture of normal cognition. The findings point to musical identity features and musically expressed emotion being *recognised* by two different systems.

There is also some evidence of a double dissociation for emotion processing where subjects whose recognition abilities remain, complain of loss of musical enjoyment, saying the music sounds flat and unemotional, although such cases have not been objectively tested[22]. While firm evidence of such a double dissociation would strengthen the case for separate affective and perceptual processes, other empirical support is readily available. Subsequent evidence shows that emotion recognition is faster than recognition of familiarity. In tests, subjects (normal and amusic) were able to correctly identify the emotional tone of an excerpt on hearing only the first half-second, whilst recognition of the extract as familiar or novel occurs at around two seconds.

(Peretz, Cognition, 1998). This picture suggests not only that emotion judgements are prior to familiarity judgements, but that emotional judgements are made before a subject has time to recognise any substantial musical features. In combination with the evidence from amusia, this suggests that emotion in music can indeed be perceived independently, and emotion processing can work very fast without needing to recognise musical features i.e. without needing to recognise the music *as* music that is, as novel or familiar or identifying musical features. So amusic subjects who report hearing music as 'grating and squeaking sounds' can interpret the emotional content nonetheless, and this hypothesis seems highly plausible in light of the account of affective perception given in Chapter 1. We can conclude from neuropsychological findings that: (1) Music (in mature cognitive systems) is a highly independent cognitive function; (2) Music is subdivided, into melodic and rhythmic components in processing (this is demonstrated by cases of dissociation as documented in Table 3.3. One can selectively lose the ability to process either rhythm or melody. Other further subdivisions seem to be suggested and these will be examined further in Chapters 5-7). (3) Music has a separate memory, (again this is demonstrated by examples in table 3.3. One can lose the ability to recognise melodies as familiar, and to sing or play from memory.) and (4) Music appears to have a separate pathway for the processing of emotional information. We now need to begin to make sense of this data, in our attempts to formulate a new framework for emotional expression in music.

3.5 Towards a New Theory of Expression

The (philosophical) problem here is whether we may reconcile aesthetic accounts of expression with empirical findings as discussed above (and obviously what are the constraints on expression theories imposed by these findings). In order for existing expression theories to hold we may have to say that they explain responses at a higher 'cognitive level'. Basic emotional responses, which are produced independently of recognising musical identity features and familiarity, do not include sufficient information to make a more detailed emotional ascription. What we are inferring from the empirical data is that, by the time music has been processed (that is before we *can* make any cognitive evaluations), the basic emotional content has already been determined, and we have evidence to show music as a completely independent process at this stage[23]. So therefore, only after an initial emotional evaluation has been made can we build on the picture and relate musical features to emotional terms etc. in a detailed way i.e. as in Cooke's *The Language of Music*, "whereby predicates in the English language are matched with intervals, harmonic progressions and phrases of different shapes." (Sharpe, 1983, pp. 100-101). This could not be a part of any initial processing of music due to the independence exhibited by music as a cognitive function. Only after initial processing could this happen. That we are able, and do in practice, make far more detailed attributions of musical expression of emotion, leads us to suggest a two-stage notion of identifying emotional expression in music involving 'a music specific affective response (which I shall call 'musical affect'), and a further cognitive evaluation[24]. I would suggest that due to the nature of initial affective processing, (direct non-cognitive responses to auditory stimuli as discussed in Chapter 1), only a 'positive, negative, or neutral' evaluation could be made here, (neutral interpreted as perceptual stimuli failing to trigger any affective response). This is supported by studies of amusic subjects in that, while amusics may have intact affective recognition, they have not been shown to give detailed responses but only classification in terms of 'happy and sad' - which accord with my positive and negative dimensions. I will be concerned here only with specifically musical responses - 'musical affect' and 'cognitive evaluations', which I will call primary and secondary[25] stages of expression recognition. (These correspond to natural and acquired modes of expression outlined in Chapters 1 and 2).

3.5.1 Primary Stage Processing

Before continuing, we need to clarify the picture of music cognition we are proposing, and explain exactly what these 'primary' and 'secondary' stages of expression-recognition may entail. From the analysis of neuropsychological findings, and our discussion of emotion cognition, it seems that initial emotional responses to music may be physiologically very basic. Jaak Panksepp has been investigating such a hypothesis and has identified a reaction he refers to as 'musical chill.'

Panksepp believes this may be related to an 'ancient emotional mechanism' to "make mammals and other animals emotionally responsive to the needy cries of their offspring."[26] They may involve very basic emotional mechanisms, (the limbic system) and induce physiological responses - typically a shiver down the spine. It has been suggested that such reactions may be throwbacks to basic evolutionary mechanisms. After all, it would be an important survival aid to be able to decipher the emotional state of others, whether it be fear anger, sadness etc. The term 'musical chill' or (musical thrills) has now been adopted more widely, to incorporate other affective responses (e.g., a lump in the throat, tears, racing pulse). However, chill seems to be equated with responses to negative emotions so I would prefer to adopt my own terminology for such responses - musical affect to refer to physiological (non-cognitive) affective responses to music which might also involve positive affect. For the two-stage model, I am suggesting that such basic responses would consist in a 'positive, negative or neutral response to music.' In keeping with our suggestion that this may be an evolutionary trait, it may be appropriate to consider 'positive and negative' in terms of pleasant and unpleasant emotional classifications: positive being happy and derivatives of this, negative being sadness and its derivatives, (see Blood et.al, 1999). Gordon comments on this intuitive characterisation of emotions as positive and negative, despite our difficulties in offering a full explanation of this distinction. However, I think Gordon's initial explanation may serve to underline the distinction I am attempting to make and I would like to agree with the clarification he gives (see also discussion in Chapter 2, p.).

> "One might be tempted to say that the typical hedonic quality of the former is positive, that of the latter negative: Typically, it is pleasant or "feels good," to be pleased about something; it is unpleasant or "feels bad," to be sad, angry, or embarrassed about something. One might also say that, because of their respective hedonic qualities, being pleased and being proud are attractive states, states we are typically disposed to being in. On the other hand, sadness, embarrassment are aversive or repellent states, states we are typically disposed not to be in. One must add "typically," however. There seems no reason to rule out the possibility that someone might find it pleasant, and therefore attractive to be sad or angry..."[27]

This is much like the example of fair ground rides given in Chapter 2 and, for example, horror movies, both examples of negative emotions which are nonetheless enjoyable and attractive states to some people in these contexts. Gordon stresses the addition of states we are *'typically'* disposed not to be in, which is useful as it will allow us to hold that musically expressed 'sadness', for example, needn't be aversive or repellent. Obviously we do not respond to music in exactly the same way as to a crying child, but it is possible that music somehow tricks this same circuitry and we experience the result as recognition and sometimes arousal of emotion on listening to music.[28] Typical 'musical affective' responses are characterised by particular physiological changes and arousal of the nervous system. We commonly experience musical affective responses though as a shiver down the spine, and we respond more to 'sad' music than any other emotional expression, which ties in with the idea of a response to offspring or others in pain. On the whole, women experience stronger and more frequent responses, again tying in with the idea that it is a throwback to basic parental responses - we would expect the maternal response to be stronger. If this is the case, such basic responses should be universal, and this is indeed something we can test for. The evidence of young infants' responses to music also support the hypothesis that such responses are physiologically very basic, as do the findings that animals too experience physiological affective responses to music.[29]

At this point, one objection is frequently raised (i.e., see Peretz & Morais, 1989 and also see Wallin, Merker & Brown, 2000), why should music feature at all in relation to early evolutionary mechanisms - and why indeed it should have it's own independent processing system. After all, music is not a biologically essential function. A frequent reply is that we may be able to justify music-emotion responses as an early evolutionary trait if we look to music's importance as a social function, and music's ability to allow shared emotional response. Every culture has music, and in addition we have an instinctive ability to create music through our voices, even where individuals have grown up deprived of musical input, they develop the ability to sing, hum, etc. (see examples of auditory deprivation in developmental psychology). It appears music's ability to allow us to express our emotions non-linguistically may account for its success, because it provides an alternative medium for the communication and expression of emotion. In particular, music's ability to allow shared emotional response may account for the enjoyment of negative emotions. In this sense, it might seem that music has exploited a necessary evolutionary mechanism - to be able to express and recognise emotional states - prior to a linguistic ability to do so.[30] Such sociological defences of music's adaptive advantage and evolutionary force are fairly common (e.g., Peretz, also see Wallin, Merker & Brown, The Origins of Music). Nonetheless one might well question the force behind such attempts to justify music's evolutionary advantage. After all, any theory of musical evolution is at least largely speculative. In addition, one does not have to propose specialised musical mechanisms at this stage of processing, it may be that general purpose mechanisms are in fact in operation. This is a contentious issue within music cognition, and one which requires more detailed discussion than can be offered within this chapter. I return to the issue in Chapters 6 and 7 and discuss the problem with reference to specific empirical findings. Nonetheless, in relation to many models the evolutionary critique is certainly relevant and the reply deserves some further elaboration.

A further flaw for sociological accounts is that they seem to explain the pressures for *retaining* music as an existing function, and social tool, as opposed to accounting for its initial development. It may well be a useful social tool, but this does not really seem to account for its development in terms of the auditory and affective mechanisms involved.

There is, however, a tension between claiming that music has colonised pre-existing auditory systems, in place for detecting emotion in offspring etc., and also to claim that it is music per se that is selected for in evolution (as in the sociological account). But we don't have to make such concessions to the evolutionary criticism as in the sociological account (e.g., Peretz & Morais 1993). Perhaps one does have to, if one wants to claim complex music-specific predispositions. But one can have musical predispostions which are a function of general purpose auditory processing mechanisms, and by fine-tuning auditory perception mechanisms, one can develop music-specific processes. This does not cause any problem in terms of the evolutionary selectivity argument. What is adaptively advantageous are fine-tuned auditory processing abilities, in addition to an auditory-motoric conversion ability (e.g., allowing imitation of sounds or movement to sounds). With these mechanisms in place, one can acquire an endless variety of complex capacities, including the subsequent development of music specific cognition and music specific affective cognition.

To continue then, we have sufficient evidence to support the idea of such a 'primary stage,' that is initial processing of music by an independent cognitive processing system. The pertinent question within the following chapters will be whether this system is a general purpose auditory system or whether it is music specific, and, whether affective responses to music are also the result of a music specific system. We cannot deny, given the empirical evidence, that there are very basic physiological emotional responses to music, although we still need to determine the universality of this, what range of distinctions can be made and how this occurs. We must conclude that there are underlying and seemingly powerful responses to music even if we cannot yet give full explanations of these, and this fits the general model of music cognition suggested by neuropsychological observations.

3.5.2 Secondary Stage Processing

We know from experience that we (both musically literate and illiterate) feel able to make stronger claims about the range of emotions music can express than 'positive, negative, or neutral' and this is done quite reliably too. So we are now in the position to ask how further emotional classifications are made. It seems they cannot be arrived at purely by initial music processing as this does not involve anything more complex than the basic 'physiological affective response'[31]. Neither does it seem to be a process of consciously evaluating a piece for emotional content *whilst* listening, as this certainly does not match our experiences of listening to music, and does not match empirical findings either. So it must be something else - but what? We must therefore suppose that there is a secondary stage whereby we attribute emotional expressions to music and it is here that we make more detailed emotional classifications.

We are now faced with the problem of just what this 'secondary stage' of emotional recognition might be, and how existing theories might fare within this model. In light of our proposed model, one might suggest that a secondary evaluation is the result of sociological, cultural, and developmental influences on our music-perception which we will call *acculturation.*[32]

The idea of 'expression via convention' (acculturation) is a popular one in aesthetics. Although commonly put forward as the *only* method by which music may express, my model would suggest acculturation acts as a supplementary faculty - so we can build on lower level responses of the primary system.[33] Acculturation would allow us to explain the attribution of more complex emotional labels to music, including cognitively complex emotions if we so wish. What the idea entails is that, after initial affective processing, detailed emotional responses can be made, which relate to musical knowledge, current emotional arousal, extra-musical factors - lyrics, visual effects, narrative etc. For example, we might learn that particular types of music are used to represent fear, or grief, and we would then recognise similar types of music as expressing fear or grief. In this way, cognitively complex emotions could be attributed to music and 'recognition' of these might be explained in terms of emotions realised in the listener and projected onto the music. It may be that we have the ability to override our immediate instinctive responses (as discussed in relation to the ANS above, p.11). This may be responsible for the often cited lack of consensus in emotional response to music. Or, we may have to acknowledge the underlying affective reaction (even if subconsciously) and attribute a similar, though more complex, positive or negative emotion to the piece. This is certainly something that might be empirically tested. So according to this model, anything more than happy, sad (positive negative), and derivatives of these, will be our own expansions on the music's expression, reflecting a process of acculturation, and musical training.

Alternatively, we could suggest there is something about specific musical features which enable us to attribute emotional qualities to them directly: that music somehow mimics components of human autonomic nervous system,[34] e.g. racing pulse, trembling, or human expressive behaviour - an idea which is still prevalent in aesthetics (Budd, 1983; Kivy, 1990). It is also perfectly plausible that secondary emotion processing may employ an amalgamation of these two possibilities. For 'known' pieces - acculturation being predominant, whilst 'unknown' pieces chiefly utilise this autonomic "palette of sound".

The idea of imitation also has much support in aesthetics, however, I want to show that attempts to use mimicry at this 'secondary level' to explain detailed emotional ascriptions are misguided, and that mimicry, if it belongs anywhere should be a primary level explanation. The idea behind this is a kind of musical onomatopoeia - that music uses a 'cheap trick' to convey emotion, by mimicking components of the human autonomic nervous system, that is, mimicking our physiological expressions of emotional states. The autonomic nervous system divides into sympathetic and parasympathetic: The sympathetic division is responsible for fight/flight responses and hence is responsible for very basic yet powerful arousal. Physiological symptoms are increased heart rate, pupil dilation, dilated airways, increased sweating and also pilo-erection (hair standing on end) which relate to feelings of musical 'chill'. The parasympathetic system exhibits the opposite of these. The important issue here is that there are 'automatic', non-cognitive responses, and the suggestion is that music may mimic these features or other gross symptoms of human expressive behaviour and in this way directly convey specific emotions e.g. by rhythm imitating the increase in heartbeat accompanying fear.

There are several problems for reconciling this thesis within our proposed model. Firstly, one might argue that it is not clear just how music could use such tricks to express emotion without some form of conventional association between musical structures and emotional labels (reducing this to a convention/acculturation theory). Secondly, it does not seem that mimicry could be effective enough to allow us to make the detailed classifications we want to claim are possible at this stage (without using conventional associations). For example, we do attribute very specific terms to music such as grief, terror, arrogance, and it seems hard to see how mimicry could convey specific states, particularly those lacking imitable components. For this reason mimicry would have to refer to specific, and less obvious physiological signs of emotion. We possibly would not admit to conscious recognition of these features however, we do consistently recognise them. Overtly, we recognise peoples' emotional states reliably, and subconsciously people recognise more subtle features, e.g. we will consistently pick a face with dilated pupils as 'attractive', showing an implicit awareness of such arousal signals. However, if mimicry were to work in such a way, by 'subconscious' recognition of musical features resembling subtle physiological symptoms, (as in the case of recognising pupil dilation), it would seem this account belongs in a primary notion of expression recognition. Indeed this would correspond to the account of mimicry that I suggested earlier in Chapter 1, to account for the arousal of musical emotions. Music might cause affective responses, inducing subjects to adopt particular postures and facial expressions, which in turn cause them to feel a specific emotion despite lacking a determinate object.

3.5.3 Summary

To conclude, although this two-stage model seems highly plausible and is clearly subject to further empirical testing, there are still difficulties to be explained. The relationship between the two proposed stages certainly requires further consideration. It seems recognition via acculturation may be very fast and very strong. For example, we have immediate recognition of emotional significance when we hear music from film soundtracks such as Jaws or Psycho.[35] If this is the case, one might even see a higher level of consensus at the conventional level than the basic level. And the boundaries between these modes of expression seem to become less distinct. Indeed perhaps certain types of music are so successful because they combine primary stage outputs (e.g., heightened arousal) with equally successful acculturation.

It also remains to be seen whether basic affective responses can reliably detect anything more than positive or negative. Shouldn't we be able to immediately detect fear, or anger? To add to this, having begun by making a distinction between arousal and expression, we are left with the problem of whether musical 'chill', consisting in physiological responses to music, can really be classed as emotional recognition as opposed to arousal. This again calls for a deeper understanding of the relationship between the types of recognition (conscious and non-conscious), otherwise this model may only be seen as a version of the arousal theory - that music is expressing (secondary level) in virtue of the underlying physical responses (arousal) of emotion in the primary level.

Wherever the boundaries lie between primary and secondary processes, music clearly does have different means of expression. It is clearly mistaken to maintain that music can only express in *one* way: *either* by acculturation *or* by musically expressive properties. Rather than continuing this supposed conflict, it might be better to consider music in terms of both *naturalistic* expressionism and *cultural* expressionism, as outlined above in terms of primary and secondary stages. And it seems we may successfully reconcile at least some of the expressionist accounts within a comprehensive framework for music-emotion cognition whilst carefully considering degree of reliability and specificity of emotional expression.

Notes

[1] It is important here to disambiguate the use of expression in relation to expression of emotions by music and 'expression' as used in relation to expressive deficits where a subject has a difficulty in some productive aspect of musical (or linguistic) function.

[2] By 'over-theoretical' I mean that attempts to explain musical expression have become concerned with cognitively complex musical evaluations, and in some cases the evaluation of musical features in precise detail - almost to the extent of suggesting a complex code for 'deciphering' musical expression. This doesn't match our everyday experiences of music listening. We do not usually make such detailed cognitive evaluations when listening just as we do not make a detailed critical analysis of musical features as we listen. Such explanations have become increasingly detached from the actual experience of music.

[3] Cooke's account "is an attempt to assemble evidence to justify this assimilation of music to verbal language in certain respects." Hanfling p.195. Cooke took a large number of phrases and passages from western tonal music and attempted to match these with linguistic explanations of the emotion expressed- that we could decode music in this way, and objectively identify the expressive content.

[4] This division corresponds with autonomist and heteronomist theories of value respectively. Rather than being 'anti-expressionist' as is often assumed, the autonomist claim is that music may express, but only in virtue of conventional associations, not in virtue of musical properties themselves. The chief concerns of such autonomist and heteronomist theories however, are claims that music's value is located in either intrinsically musical or extra-musical features respectively. Although I do not want to become drawn into problems of aesthetic value, expression theories do bear heavily on this issue so it deserves at least some consideration and I will return to it in Chapter 4.

[5] Cooke in particular explains expression in terms of recognising specific musical features, which are ultimately perceptual distinctions. However, he makes no attempt to explain the perceptual processes involved. See Hanfling p.197 for discussion of this.

[6] There is a lack of consistency in the use of terms within the cognitive sciences. Neuropsychology: how specific brain structures and processes relate to behaviour. Cognitive Neuropsychology: (Ellis & Young, 83) (i) To explain the patterns of impaired and intact cognitive performance seen in brain-injured patients in terms of damage to one or more of the components of a theory or model of normal cognitive functioning. (ii) to draw conclusions about normal, intact cognitive processes from the patterns of impaired and intact performance seen in brain-injured patients. Neuropsychology is more interested in physical brain processes than cognitive neuropsychology which is more interested in function. However, with functional imaging techniques becoming prevalent there begins to be a breakdown of this divide.

[7] Similarly, because we do not see damage to specific tasks in isolation does not imply that they share processing strategies. Whilst the organisation of some processes may prevent them being damaged in isolation, it may equally be that some functions occupy an area of the brain which is particularly resistant to damage.

[8] It is often perceived as less interesting to replicate - and more difficult to get a replication published, than to report novel dissociations.

[9] Shallice (1988) Chapter 11 provides five non-modular accounts capable giving rise to dissociations.

[10] See Wertheim, (1969) p.196.

[11] **Seashore, C. E., Lewis, D, and Saitveit, J,** *Seashore Musical Talents' Manual* (revised). New York, Psychological Corporation (1960); **Wing, H. D,** *Tests of Musical Ability and Appreciation* (second edition). Br. J. Psychology. Monographs, Suppl. 27 (1968); **Bentley, A,** *Musical Ability in Children and its Measurement,* London, Harrap (196); **Gordon, E,** *Musical Aptitude Profile Manual.* Boston, Houghton Mifflin (1965). For a critique of Seashore see Henson, R. A, Wyke, M. A, The Performance of Professional Musicians on the Seashore *Measures of Musical Talent.* Cortex 18 (1982) 153-157.

[12] **Ustvedt, H.,** (1937), study of 14 cases of amusia, Acta Med. Scand. Suppl. 86.: **Jellinek, A.** (1956) Amusia. On The Phenomenology and Investigation of Central Disorders of Musical Functions. Folia Phoniatr.8, 124-129: **Botez M. I. and Wertheim, N.** (1959) Expressive aphasia and amusia following right frontal lesion in a right handed man. Brain 82, 186 - 202: **Trethowan, W. H.,** (1977) Music and Mental disorder, in Critchley and Henson (eds.) Music and the Brain, London, Heinemann Medical Books: **Shapiro, B. E., Grossman, M., Gardner, M.,** (1981) Selective Musical Processing Deficits in Brain Damaged Populations, Neuropsychologia 19 161-169. **Morgan, O S, Tilluckdharry R,** (1982) Preservation of singing function in Severe Aphasia, West Indian Medical Journal, 31/3 (159-161; **Munte et. al,** (1998) Brain Potentials in Patients With Music Perception deficits: Evidence For an Early Locus. Neuroscience Letters 1998 pr; 256/2 (85-88): **Schuppert M, Munte, TF,**

Wieringa BM, Altenmuller E, (2000) Receptive Amusia: Evidence for Cross-hemispheric Neural networks Underlying Music Processing Strategies. Brain 123/3 (546-559).

[13] Aphasia is an acquired disorder of language resulting from focal lesion of the cerebral cortex and associated subcortical structures which results in impairments in the comprehension and production of linguistic messages.

[14] It should be noted that this is a complex issue, left handers *may* show the reverse pattern to right handers (e.g., right hemisphere = language; left hemisphere = visuo-spatial cognition), some may have bilateral processing, (e.g., language in both right and left hemispheres); and some are like right handers.

[15] See for example, Aggleton et.al, 1994; Byrne, 1979; Hassler et al, 1990.

[16] Unless otherwise indicated we will be referring to cases of double dissociation which involves evidence of two subjects one with function A intact and B damaged and a second patient where A is damaged and B intact. The value of double dissociation is that it can counter the criticisms surrounding single dissociations (that they only show spared tasks to be easier to perform than the damaged ones). To give a relevant example where rhythm recognition is spared and melody selectively damaged, if we did not have examples of double dissociation this could simply be dismissed by saying that rhythm is easier to process.

[17] While selective damage and sparing to environmental sound is rare, there are examples in the literature. Spreen et.al (1965) report selective damage., Tanaka et al. 1987, & Eustache et al. (1990) report on sparing.

[18] It has been shown that prosodic elements of speech are independent of 'musical' prosody. Pole (*The Philosophy of Music),* suggests "The earliest forms of music probably arose out of the natural inflections of the voice in speaking."

[19] See Gorelick, P. B. & Ross, E. D. (1987) but also Patel et. al for conflicting evidence. These cases will be examined in detail in Chapters 6 and 7.

[20] I want to stress that this analogy does not hold exactly but only serves to clarify our concept of amusia. Particularly as prosopagnosic subjects may still recognise a face as a face whereas amusic subjects do not always recognise music as music, (only in that they no longer recognise it as anything) Also there may obviously be decided differences between auditory and visual processing.

[21] For example, the expressionist may claim both that music expresses emotion directly, (without extra-musical reference) and that it expresses specific emotions. This is contradicted by empirical findings.

[22] Peretz 1996 notes "Several brain damaged patients whose recognition abilities seemed intact complained about having lost interest in music or that music sounded "flat" or without emotion after brain injury." (see Mazzuchi et. al 1982, Mazzoni at. al 1993). This is supported by Damasio's (1994) evidence from subjects with frontal lobe damage.

[23] Music at this level functions as an independent 'module' being able to process music without access to other cognitive functions.

[24] Reflex responses to sound would be for example startle responses, on hearing a loud noise (not necessarily music), and recognising and turning towards new sounds in the environment. So the effects of some musical works, which might be claimed as emotional responses are actually reflex responses to sound. e.g. Haydn's Surprise Symphony. I have excluded these from the discussion at present as I am concerned specifically with affective responses.

[25] I intend to use 'primary' and secondary' only for simplicity in referring to the stages within the proposed models. I do not intend by using these classifications to make any claims as regards whether processing is serial as opposed to parallel processing.

[26] New Scientist supplement, '*Emotions*', April 1996, p.18

[27] Gordon, 1987. p28. Gordon does go on to give a different explanation of the positive/negative distinction in terms of attitudes towards the object of emotion which does not apply to musical cases.

[28] It would seem more likely that we have developed music in particular ways precisely because it has this ability to use ancient emotional circuits, and we may control our experience of 'chill' responses.

[29] Panksepp, New scientist Supplement, *Emotions* April 1996.

[30] It is plausible that music may in fact offer some adaptive advantage, this will be discussed in Chapter 6 below.

[31] At this stage music operates independently, does not and seemingly cannot access other faculties for extra-musical information which would enable more detailed ascriptions of emotion to be made.

[32] I would like to use acculturation as opposed to convention, as convention seems to bring to mind something more flexible which we may choose not to adopt, or which we may put to one side in our musical evaluation.

[33] This relates closely to Damasio's account of affective processing: *Descartes Error* (1996).

[34] This relates to ideas in The Meaning of Music by Carroll C. Pratt and Malcolm Budd's article Motion and *Emotion in Music: How Music Sounds.*

[35] It therefore needs to be investigated whether responses to such pieces are non-cognitive responses. It may be that such pieces merely exploit the 'chill' response.

Chapter 4

The Arousal Theory and Musical Expression

4.1 Introduction

The framework for musical expression presented in Chapter 3 suggests that initial affective responses to music may impinge upon subsequent cognitive evaluations, and that recognition of emotion in music may involve radically different methods both 'automatic' physiological responses *and* cognitive evaluations (*naturalistic* and *cultural* expressionism). The framework as a whole adds support to the claim that we need to consider the nature of music's cognitive foundations far more carefully. What this model will mean for aesthetic accounts is that the way in which they propose music is expressed, (by natural or cultural modes of expression), will determine the level of specificity they may claim for musically expressed affective states.

In light of the empirical evidence, many existing accounts no longer seem capable of providing a full account of expression. For example, in light of the proposed model, it is no longer plausible to claim that music can express specific affective states directly (by natural expressionism). If one wishes to hold that music expresses directly, one must accept that music may only convey a basic positive or negative affective state in line with the nature of physiological affective responses. If, on the other hand, one wants to support the claim that music *can* reliably express specific affective states, then one must acknowledge that it does so via some process of acculturation or convention. The most problematic issue for expression theories is that music seems capable of expressing at least some emotional content without requiring recognition of musical features.

This is specifically a problem as regards value claims in aesthetics. Malcolm Budd in his book *Values of Art* notes that;

> "it has often been thought that the sole and sufficient explanation, or at least a considerable part of the explanation, of music's eminence as an abstract art is its ability to express emotion." (Budd 1995, p.133)

He goes on to say that for this to hold three propositions must be true, and it is the second of these which concerns me, the claim that

> "abstract musical works must be valuable in proportion to their merit in expressing emotion, that is to say in proportion to the extent that, or to the degree to which or the manner in which they do so, or to the nature of the emotions they express."(*Ibid.* p.133).

There seems to be something inherently wrong with the claim that music's value is proportional to its ability to express *directly*. If recognition of emotional expression is independent of musical feature recognition, this supposes that we might value music purely for the emotional experience it provides by tapping into certain auditory channels. If this were the case, an amusic person would be at no disadvantage in determining music's aesthetic value, and such value would be largely independent of musical identity features themselves which clearly seems wrong. So it would seem that, if we wish to ground value claims on emotional content, we must refer to a comprehensive picture of emotional expression and arousal. Whilst I do not want to be drawn too much into problems of aesthetic value, this example serves to highlight why it is necessary for aesthetic explanations to consider the underlying architecture of music cognition.

As yet, the relationship between natural and cultural methods of emotion-recognition is largely speculative. It seems likely though that underlying physiological responses may be overridden or suppressed, and indeed may not even be reliably recognised by some listeners although they may be objectively recorded e.g. change in pulse, temperature etc. (see the examples by Damasio, Chapter 1 p.13, and p.19, Note 8). The physiological affective responses to music outline a further problem in terms of the relationship between arousal and recognition of emotion. If basic responses to music are physiologically induced affective responses, do they not constitute arousal rather than recognition? In terms of physiology perhaps the answer is yes, but in terms of auditory perception things are not as straightforward. Responses by amusic subjects are not reported as *aroused* emotion, but as recognition of the music's emotional content.

Similarly, many subjects may not recognise the physiological arousal in themselves in response to music, but rather they report that the music sounds sad. For example, while a shiver down the spine is not sufficient to make one feel sad, it may nonetheless be sufficient for one to attribute sadness to the music — that is, it may be experienced as recognition of expressed emotion. Indeed, referring back to the discussion of the amygdala in Chapter 1, the split-second 'feel' produced by direct affective perception is not always recognised as a felt emotional response but may nonetheless direct perception towards a particular emotionally affective response or evaluation. While the relationship between arousal and recognition is complicated by these early perceptual responses, they are not damaging to the model of expression as a whole, so long as one accepts that there are multiple modes of recognition.

The nature of primary responses might nonetheless be interpreted as support for arousal theories of expression. While arousal and recognition may in some cases be intimately related (as in the case of physiological affective responses to music), this relationship is grossly misrepresented by the arousal theory, which cannot provide a full account of music's expressive powers. There have been many attempts to reject the arousal thesis, and in light of the empirical evidence presented in Chapters 1 to 3, I now offer a critique of the theory both as an account of expression, and to exemplify specific problems for expression theories in light of empirical claims.

I will begin with a critical analysis of the arousal theory taking as an example Derek Matravers' recent attempts to revive a brute version of the arousal thesis. Specifically I will claim that the arousal theorists' interpretation of expression is flawed, and that any attempt to revise the thesis in light of the objections raised necessarily constitutes a radical departure from the central claims of the arousal thesis.

4.2 Why Reconsider the Arousal Theory?

Simply stated, the arousal thesis claims that a piece of music x expresses emotion e if and only if it arouses that same emotion e in a suitably qualified listener. The central claim of the theory is that arousal of emotion is both necessary and sufficient for its expression. Whilst strong versions of the thesis maintain that the emotions aroused are 'real'[1] emotions, weaker versions of the theory suppose that aroused emotions may be imagined or simulated. In both versions however, it is assumed that the listener then projects the aroused emotion onto the music. On the arousal theorist's account, the listener attributes emotional qualities to the music by virtue of the feelings the music provokes, such that the music is said to be 'expressing' an emotion, and the experience is such that the emotion appears to emanate *from* the music.

Both weak and strong versions of the thesis have attracted sustained criticism. Wittgenstein declared the theory 'stupid and ridiculous', Nelson Goodman described it as 'preposterous' and 'crude', and Peter Kivy dismissed it as being 'profoundly wrong', an 'utterly hopeless view.'[2] The most common rejections are that to describe one's *reaction* to something is not to describe what it is *expressive* of, and that we simply do not 'project' our feelings onto the music in the way described by the arousal theory. There have, nonetheless, been a number of recent attempts to revive the thesis in both weak and strong forms. In light of the above criticisms, this seems puzzling. How and why has the arousal theory retained such popularity?

The arousal theorist appeals strongly to the simple claim that we would not describe music in terms of specific emotions unless it had the capacity to arouse those emotions in the listener, but this claim alone simply cannot account for the status currently accorded to the arousal theory. In fact, much of the theory's attraction seems to lie not in its success as an explanation of expression, but its position as a viable alternative to representational theories which seek to explain music's expressive powers by its resembling or otherwise representing aspects of human expressions of emotion.[3] In contrast to representational theories, arousal is, on the surface, a simple way to explain the fact that we describe a non-sentient thing such as music in expressive terms. At the heart of this appeal lies an over-simplistic interpretation of arousal itself, expressive language, and importantly a misunderstanding of the distinct commitments of expression, arousal and recognition of emotion as regards the listener.

4.2.1 Music and Expressive Description

The most serious problems for the arousal theory stem from the distinct aspects of reception involved. That is, confusion between the listener's aroused state, and the experience of hearing emotion *as expressed by* music. The arousal theory also involves difficulties regarding 'production aspects' of emotion — how music itself can be said to express. We can approach the problem of production from two perspectives. In addition to critiques advanced from an empirical viewpoint we also need to address the problem of what we mean when describing music in expressive terms. From an empirical point of view, the arousal theory is simply wrong to attempt to analyse expression purely in terms of arousal. With regards to auditory processing, expression is an 'output' function (a function of the sound source), whereas arousal, where it does occur, occurs at the 'input side' of the process — in the audience. Put bluntly, expression cannot be explained in terms of reception.

The difficulties of describing music in expressive terms exemplify an underlying problem for musical aesthetics. How *can* a piece of music, as a non-sentient entity, 'express' anything at all? Music after all has no emotions to express. To talk of music expressing 'emotions' as intentional states requires us to identify the intentional objects of emotions, that is what they are 'about' or directed towards and this (as seen in 1.5) is problematic. Music as a largely non-representational art form seemingly can not provide such objects or cognitive content necessary for emotional expression. As seen in Chapter 1, this problem has attracted many attempts at solution, for example, claiming that musically expressed emotions are 'objectless emotions'[4] or attributing the intentional component to the composer, listener or performer. The arousal theory is formulated in response to this problem, attributing the emotion expressed to the listener (who projects the emotion onto the music) and analysing musical expression in terms of arousal of emotion in the listener. I wish to maintain that the concept of expression cannot be analysed in terms of arousal and that attempting to do so constitutes a flawed conception of expression. I will attempt to show this by examining the problem of how intentions are involved in the emotions conveyed by music, and clarification of the distinct commitments of arousal and expression.

One such attempt to solve the intentionality problem is advanced by Alan Tormey in *The Concept of Expression* 1971. Tormey distinguishes between what it is to be 'expressing' something and 'expressive of' something. His ultimate concern is to establish intention as a necessary condition of expression and to do so he attempts to distinguish between inference warranting and merely descriptive applications of expression. The latter being marked by a difference in syntactic form.

> "The outlines of this distinction can be sketched briefly. Wherever the qualifier appears before the noun ('ϕ expression'), the phrase (*A*) is a *description* of certain observable features of a situation; and whenever the form 'expression of ϕ' (*B*) occurs, it may be taken to be an inference warranting expression, relating some intentional state of a person to particular aspects of his observable behaviour."(Tormey 1971, p.40)

Earlier in his discussion, Tormey noted that a successful explanation of the concept of expression must be able to distinguish between 'expressions' of emotion and 'signs' of emotion. However, Tormey's account is deficient here, a scream of anguish as described in this way *(B)* has inference warranting status and as such is intentional. Tormey's distinction between these syntactic arrangements is not immune to ambiguities of language use — for unless a scream is used as an instrument, such a description might merely refer to an involuntary physiological response and as such this would be non-intentional. What is missing from Tormey's account is a distinction between agent and instrument. The subject of our ascriptions of expression may be a person or an instrument — he expressed sadness by an anguished scream — his anguished scream expressed sadness. This highlights the problem with Tormey's account, that, unless the scream is used as an instrument, it cannot count as an 'expression' of emotion as expression must (on Tormey's account) be intentional. The syntactic form of the expressive description itself is insufficient to guarantee its intentional status. As Bedford noted in Chapter 1, our ascriptions of emotions to people do not logically entail that they are in any particular feeling-state. One might well say (syntactic form (*B*)) 'his trembling was an expression of (or expressed his), fear'. On Tormey's account, therefore, descriptions of behaviour such as trembling, blushing, twitching, or screaming may be inference warranting and as such have intentional implications, being linked inferentially to intentional states of persons. It would seem these would be more appropriately labelled as involuntary physiological responses — as signs or symptoms of emotion rather than intentional expressions of emotion, particularly as the subject may not be aware they are exhibiting such behavioural characteristics. (As noted in Chapter 1, an important distinction between behavioural expressions of affective state is that some may be non-intentional but mandatory while others are intentional, 1.4.2). Thus Tormey's account fails to fully realise the difference in intentional content between these two cases, failing to sufficiently account for the distinction between *manifestation* of an emotion and *expression* of an emotion. Whilst expressive language, talk of communication, expression, arousal and manifestation of emotions may be used ambiguously in ordinary use, it is nonetheless important to stress the distinct commitments of these affective modes in terms of effects on the auditor.

4.2.2 Arousal, Communication and Expression

The differences between expression, arousal and communication in terms of auditor commitments can be explained by drawing on Austin's distinction between perlocution and illocution within his analysis of speech acts[5]. Specifically speaker and audience commitments mark distinctions between content and meaning of an utterance.

> "For example, it might be perfectly possible, with regard to an utterance, say 'It is going to charge', [referring to a bull] to make entirely plain 'what we were saying' in issuing the utterance, in all the senses so far distinguished, and yet not at all to have cleared up whether or not in issuing the utterance I was performing the act of warning or not. It may be perfectly clear what I mean by 'It is going to charge' or 'Shut the door', but not clear whether it is meant as a statement or warning..." (Austin, 1962, p.98).

It is the further distinctions Austin makes which are important to us, that is between linguistic acts corresponding to various *types* of action. Austin distinguishes here between what he calls illocutionary and perlocutionary acts — the former being performance of an act *in* saying something, the latter *by* saying something. Examples of illocutionary acts are telling someone, promising something, admitting something. Examples of perlocutionary acts are persuading someone, scaring someone, annoying someone.

This distinction can serve to highlight the important issue as regards the differing status of expression and arousal, as do Austin's further comments in explaining perlocutionary acts:

> "saying something will often, or even normally, produce certain consequential effects upon the feelings, thoughts, or actions of the audience, or of the speaker, or of other persons: and it may be done with the design, intention or purpose of producing them...." (*ibid.* p.101).

Whilst illocutionary acts may make claims upon the speaker, perlocutionary acts require a certain response to occur in the auditor. In performing a perlocutionary act we bring about certain responses by saying something. Whereas one might say I argue that.... or, I advise that... One cannot say I convince you that ....or, I persuade you that...., these latter claims require a response from another party and this marks the distinction between illocutionary and perlocutionary acts. In Austinian terms expression is illocutionary, (done in saying something), whilst arousal is perlocutionary (done by producing some effect in the listener). The expression of emotion by music does not depend on whether any effect has been produced in the listener (it may or may not produce such an effect dependent on the means of expression but there is no necessary relationship here). This emphasises again why it is mistaken to analyse expression in terms of arousal as these have distinct commitments in terms of the listeners' involvement.

It might be objected that this critique is just begging the question against the arousal theorist as it requires assuming a distinction between arousal and expression. However, the arousal/expression distinction is supported through the clear separation of arousal and recognition both empirically and in terms of musical experience. Austin's distinction merely serves to highlight this. In addition, we can distinguish between communication, expression and arousal of emotion. I can express my anger by means of angry stares without anyone recognising this, but I have nonetheless expressed my anger. I can communicate my anger to a perceiver without this necessitating arousal of anger (or even a related emotion) in them. To arouse anger however, requires that my actions whether intended to arouse anger or not, produce an appropriate response in the perceiver. The failure of the arousal theory to acknowledge these distinctions is one of the most notable objections to the theory, that we do not attribute expression of an emotion in virtue of our own emotional responses. I may be angered by a state of affairs, but it by no means follows that the cause of my emotion was an expression of anger. Having clarified the relationship between expression and arousal it may be useful to return to the problem of intentionality of musically expressed emotions.

Linguistic analyses may again prove to be useful, rather than analysing the intentionality problem by attempting to attribute expression to a person e.g. in the mind of the listener or composer. We can attempt to explain the intention/emotion problem in terms of expressive description. And rather than adopting Tormey's strategy — how we use 'expression' and 'expressive' in emotional descriptions, we might focus on how we apply specific expressive predicates to works of art. In *Languages of Art* 1968, Nelson Goodman provides such an account, offering a re-conception of the expression-intention problem as essentially a linguistic one. His aim is to offer an explanation of the application of expressive descriptions to works of art[6]. Goodman explains the application of expressive terms to music as 'metaphorical' and stresses that the intention of the artist or auditor is not important and more specifically, does not define whether or not a work can be described as 'sad' 'angry' and the like. Goodman goes on to explain how music may be described in expressive terms:

> "since, strictly speaking only sentient beings or events can be sad, a picture is only figuratively sad. A picture literally possesses a gray colour, really belongs to the class of gray things; but only metaphorically does it possess sadness or belong to the class of things that feel sad" (Goodman 1968, pp.50-51).

His claim is that music expresses by metaphorical possession of expressive properties. Whilst we can say music literally possesses properties such as tone or rhythm, it metaphorically possesses properties such as sadness. Just as particular musical sequences metaphorically possess the quality of having movement because they move from high to low in our mental representation of musical content — we cannot say music *literally* moves anywhere. Goodman goes on to say that

> "Conflict arises because the picture's being insentient implies that it is neither sad nor gay. Nothing can be both sad and not sad unless "sad" has two different ranges of application. If the picture is (literally) not sad and yet is (metaphorically) sad, "sad" is used first as a label for certain sentient things or events, and then for certain insentient ones. To ascribe the predicate to something within either range is to make a statement that it is true either literally or metaphorically."(*ibid.* p.70).

Although I do not want to explain musical expression explicitly in terms of metaphor, on the point of *interpreting* expressive descriptions, I would agree at least to some extent with Goodman's account as we do have to explain in what sense we apply expressive predicates to music. Goodman's notion of metaphor and ranges of application for expressive predicates in aesthetics is useful as he explains the difficulties in the relationship between metaphorical and literal use of such terms.

> "a term like "cold color" or "high note" is a frozen metaphor, — though it differs from a fresh one in age rather than temperature. A frozen metaphor has lost the vigor of youth, but remains a metaphor. Strangely, though, with progressive loss of its virility as a figure of speech, a metaphor becomes not less but more like literal truth." (*ibid.* p.68).

Goodman's interpretation will allow us to account for the problem of intention in our applications of emotional expression to music by explaining them in terms of metaphor, although we will have to explain in what sense such metaphors might be paraphrased.

4.2.3 Emotion Terms and Central Usage

Matravers also considers metaphor as an explanation of expressive description. He describes his approach to the problem of expressive descriptions in terms of finding a link between the central uses of expressive predicates, and their extension to works of art. He comments however, that it is an 'obvious' response to interpret the problem as one of metaphor, and is highly critical of Goodman's account, arguing that Goodman does not explain what it is for a predicate to apply metaphorically. He goes on to say,

> "the problem [description of music in emotive terms] arises because judgements which attribute feelings or emotions to works of art are not reducible to judgements which do not. This means, among other things, that the problematic judgements are not metaphorical, since, as Kendall Walton has shown, metaphors can always be paraphrased. In other words, these judgements if correct are literally correct applications of feeling or emotion terms to objects." (*ibid.* p.322).

However, Matravers' case is weakened by letting Walton's explanation pass without sufficient qualification and it is not by any means clear how Matravers interprets Walton's view, having substituted 'judgements' for 'expressive descriptions' in the above argument.

To claim that expressive judgements of artworks are literally correct applications of feeling or emotion terms, requires quite some explanation. Without such, a literal substitution theory may allow the expressive description 'music is sad' to be substituted for example by 'music is upset'. The lack of explanation here is particularly unfortunate, given that, the view of metaphors always having literal substitutions is no longer widely held.[7] To claim expressive descriptions are literally correct in this way seems ludicrous. The music itself is not 'sad' despairing or 'hopeful' about anything, and neither do we respond to music as we do to expressions of emotion in central cases. As Aaron Ridley notes

> "If one conclusion of an argument is that we attribute 'sadness' to a piece of music in virtue of the pity it arouses in us, then this should tell us at once that something somewhere has gone seriously wrong. Pitying a piece of music? Feeling sorry for a series of sounds?" (Ridley 1993, p.72).

It would seem certain that Matravers does not want to make such a claim. However, he does little in the way of offering an alternative explanation and so far his bid to link central and aesthetic applications of expressive terms seems lacking. He comments further that

> "unlike metaphor, to utter 'the music is anguished' is not to attempt to cause a belief other than that expressed by the words uttered." (Art and Emotion, p.109)

Again this claim lacks qualification. Not only does it leave Matravers open to Ridley's criticism of literal interpretation, but it fails to account for context. Unqualified expressive descriptions *are* ambiguous, and consequently without further clarification, a variety of beliefs might be caused by the utterance 'the music is anguished'. For example, (a) Music is actually anguished (b) Music somehow resembles an anguished person, or (c) Our response to music is parasitic upon our *response* to an anguished person. Matravers nonetheless attempts to defend his position by noting,

> "The statement 'That piece of music is sad' is more akin to such uncontroversially literal statements such as 'That piece was long', 'That was a waltz', than to statements such as the uncontroversially metaphorical 'That music set the place alight'. (Matravers 1998, p.110

The reason expressive judgements do appear this way would however seem to be more elegantly captured by Goodman's notion of a frozen metaphor, than the claim that expressive judgements are literally correct applications of expressive predicates.

Leaving the issue of metaphor aside, Matravers examines the similarities between central and aesthetic applications of expressive predicates, with the view that aesthetic uses are parasitic upon central cases:

> "In short, our application of 'sad' to sad works of art is somehow parasitic on our application of it to people, just as our application of it to sad situations, faces and attempts at making an omelette is parasitic on this central application. Our aesthetic use of feeling and emotion terms is just as essentially linked to, and constrained by, their central uses. The problem is, that in the aesthetic case, the link is much harder to see and to explain. To find what it is, I think that we should first look more closely at those central uses: that is, at what we take people's feelings and emotions to be" (Matravers 1991b, p.323).

Again however, Goodman's account seems able to adequately explain the central/aesthetic link. The link between aesthetic and central cases is harder to see, precisely because aesthetic use of expressive predicates has become somewhat detached from central uses. Expressive predicates now have their own range of application within the sphere of aesthetics, albeit ultimately dependent upon the central reference of emotion terms to our own and others' psychological and behavioural states.[8]

But Matravers seemingly has another motive for defending the links between central and aesthetic cases. By strengthening the analogy he attempts to defend the felt response to music in relation to felt responses in the central case, thus strengthening the central claim of the arousal thesis. His argument is that the appropriate response to an expressed emotion is to *feel* an emotion, not merely to recognise it. He states,

> "I argued that it is inappropriate, when faced with a human expression of emotion, merely to form a belief to this effect. The appropriate reaction is, rather to feel some kind of emotion oneself." He goes on to say "The same is true of our reactions to expressive art. It is inappropriate merely to recognise that a work expresses an emotion and register the fact in the form of a belief." (Matravers, 1998, p.145).

But this in itself is a weak claim as appropriateness of response is largely context dependent. Whilst one might claim that someone's *behaviour* in response to expressed emotion is inappropriate, one cannot say this about their felt psychological states. It seems wrong to claim that it is *inappropriate* not to have a response — either an emotion is aroused or it is not. There may well be people in whom emotions are not aroused and whilst they may be deficient in terms of feeling emotional states, one would not say their lack of felt emotion is inappropriate. The fact that one just does not feel sad in response to a piece of music should not invite condemnation. Tormey notes that a claim such as 'That's a sad piece of music' is countered not by objections such as, 'No, he wasn't' or 'He was just pretending' (referring to the composer [or listener/performer]), but by remarking 'You haven't listened carefully' or 'You must listen again; there are almost no minor progressions and the tempo is *allegro moderato*.' " (Tormey 1971, p.105). That is to say, it is not inappropriate to justify ones expressive descriptions of music in terms of musical features, rather than ones own felt emotion. We can (quite appropriately) make expressive descriptions of music without feeling an emotion.

The explanation of expressive descriptions as extensions of central uses does not legitimate the analogy between emotional *responses* to people and to works of art. More to the point, even if one *were* able to formulate some coherent notion of appropriate responses to emotions expressed by people, it does not follow that this would be applicable in the musical case, or that it would be reflected somehow in the nature of expressive descriptions. While linguistic analyses prove useful to an extent, limitations quickly become apparent. Matravers acknowledges the difficulties of distinguishing between central and aesthetic cases in terms of a purely semantic analysis, which does not capture the distinct experience of hearing emotions as expressed by music.

4.3 The Experience of Expressive Music

In opposition to the view that arousal is a necessary condition for expression, I want to maintain that the only necessary condition of a piece of music's being expressive of emotion is that the expressive qualities should emanate or seem to emanate from the music itself. This view underpins a recurrent objection to the arousal theory, that the emotion experienced when listening to music is phenomenologically in the music and not in the listener. Contrary to the projectivist claims of the arousal theorist it would seem that it is the experience of hearing emotion *as* emanating from music that is our reason for declaring such music to be expressive of emotion. Importantly, we are not apt to make mistakes about the location of emotions: When we experience an emotion in ourselves it does not follow that we attribute that emotion or expression of that emotion to its cause. This I think is clearly expressed in Aaron Ridley's example,

> "To describe one's own reaction to something is not to describe what that thing is expressive of: if a person irritates me, then it by no means follows that his irritating action expresses irritation."[9]

Similarly I may express my anger by means of angry stares without anyone recognising that my behaviour is expressive of anger. And, whilst I will have failed to communicate my anger I will nonetheless have expressed it.

In *Arousal Theory Reconsidered,* Stanley Speck gives the standard response to this objection. Speck claims that the problem with music lies in the complex interconnection between the listener's emotion and the formal properties of music:

> "the distinction between the feelings caused by an insult or a threat, which we clearly locate in ourselves, and the feelings caused by music, which we locate in the music, is that the latter are so closely and immediately conjoined to the melodic and rhythmic contours of the tonal sequence that no separation is intuited." (Speck, 1988, pp.40-41).

This Speck claims, is why musically evoked emotions are short lived. As a result of this interconnection, musical emotions are dependent upon the music itself for their realisation, they do not and cannot persist independently of the musical experience. Speck's interpretation does not seem entirely true. There is no evidence to suggest musical emotions are 'short-lived' — no more so than ordinary emotions, and the link between our felt emotions and the musical experience can seemingly be separated. In Sloboda's study 1991, musicians were able to identify and agree upon specific features of musical extracts which provoked their emotional responses.[10] This would seem to indicate an ability to identify the cause of our emotion. If we were unable as Speck suggests, to separate our felt emotions from the cause, we would be surely unable to identify the cause of our emotion. Speck's example of feelings aroused by an insult and by music also seems to miss the mark, for we do locate the emotion aroused by music in ourselves, it is only the expression of emotions which we attribute to the music.

Further problems develop from the projectivist view. On this account the arousal theory cannot distinguish between emotions as 'evoked' or 'provoked' by music[11]. That is, emotions produced by extra-musical features or elements of performance, (the music being too loud or badly played) and emotions aroused by the musical content or formal properties themselves. It is not correct to claim that music is expressive of the emotion it arouses in every instance. Anger may be evoked by the music itself, but also anger may be evoked by the poor quality of the music or the loud volume etc. or even the failure of the piece to evoke an emotion. In none of the latter cases would we want to claim that music is expressive of the emotion it evokes. The problem for arousal theory is that it cannot distinguish between emotions as directed towards the music's formal properties, or towards beliefs about extra-musical aspects (that it is too loud, poorly played etc.). The arousalist notion of projection in fact rules out a possible method of identifying these different emotional sources with the claim that we phenomenologically locate all emotions within ourselves. In opposition to the arousal theory, it would seem that this is one way in which we do distinguish between emotions — coming from within ourselves as the result of beliefs about music (i.e. we don't like Brahms) or emanating from the music and aroused by the music's formal properties alone. To reply to this necessitates acknowledging the arousal/recognition distinction and therefore rejection of the brute claims of the arousal thesis.

4.3.1 Arousal and Recognition of Emotion

The arousal theory rejects entirely the notion that one may identify emotions by 'recognising' them and this is problematic from a number of perspectives. Bearing in mind the arousal theorists' close comparison of responses to emotion in people and music, adopting this opinion presents something of a disanalogy. We would often claim to 'recognise' emotions expressed by others without necessarily experiencing the same emotion in response. For example, we might observe an argument between two strangers, but this does not entail that we recognise anger by being made angry ourselves. (In fact, if we experience any emotion at all, it seems unlikely to be anger.) In response to this problem, the arousal theorist may claim that the emotion aroused here need not be the same as that attributed to the source (and presumably need not be of the same intensity etc.) Indeed, this is precisely how Matravers does respond to the critique. He revises the thesis to claim that "we do not usually respond to the expression of an emotion with the same emotion"(Matravers, 1991, p.325). This permits him to reformulate the thesis allowing him to reject the claim that we [only] attribute an emotion when we feel the same emotion, in favour of the claim that we attribute an emotion when we experience a *related* emotion.

There is nonetheless a more serious problem for the arousal theory, which is probably the most damaging criticism of all. Not only do we respond to emotional situations with decidedly different emotions from those we ascribe, more often than not we may recognise emotions as expressed without feeling any emotion at all. This again marks a distinction between recognition and arousal of emotion and there is empirical data to support this claim. Listeners can reliably identify emotion expressed without feeling that emotion.[12] There seem to be only two responses available to the arousal theorist which does not necessitate revising the thesis and that is to claim that the listener misinterprets the emotion aroused by the music, or that the listener misattributes a differing emotion to the work. Both these replies contradict the above claim of an inseparable link between the feelings caused by music and the formal properties of the work. Indeed, if arousal was subject to misinterpretation, it would hardly seem to be a sufficient condition for expression. In the face of this objection, and the empirical evidence which supports it[13], the original claims of the arousal thesis cannot be maintained and to reply to this objection requires a revised version of the thesis in weak form.

Matravers nevertheless attempts to respond to the arousal/recognition critique, and we will see how his reply necessitates radical revision of the thesis. He claims that

> "before we can pity someone's sadness, we need to become aware that they are sad. Such awareness may arise from direct perception: for example, we might see from their face that they are sad...."[14]

This creates problems for the notion of expression being achieved directly through arousal,[15] and seems to point towards a separation of arousal and recognition — something implicitly denied by the arousal thesis. At this point Matravers is still attempting to maintain that emotions aroused and expressed are 'real' emotions. However, this leads to further problems, not only must Matravers explain how musical emotions might provide cognitive content, but this also contradicts his explanation of the transfer of emotion terms to music. In reply, he concedes that 'we need not acquire the cognitive component of an emotion directly, we can acquire it through some pictorial or linguistic representation.' (*ibid.* p.325). Matravers acknowledges the lack of cognitive content in responses to music and what follows from this is a conception of responses to music as 'feeling components' of emotions. This requires both an explanation of 'feeling components' of emotion, and a reformulation of the analogy between music and responses to human expression of emotion.

4.3.2 Musical Emotion as 'Feeling'

Matravers' claim then is that emotion states have separable components such that (in response to music) one may experience the physiological and phenomenological components in the absence of cognitive content — a response of this kind being termed a 'feeling' and not an emotion. Matravers acknowledges that this conception of emotional responses as 'feelings' causes problems for the analogy:

> "that the appropriate reaction to expression of emotion is a feeling and not an emotion - might be thought to be in conflict with the guiding analogy between our response to art which expresses emotion and our response to people who

> express emotion. For it is certainly appropriate to respond to the latter with an emotion — that is a state with a cognitive component." (Matravers, 1998, pp.148-9).

His response is to say that, despite such differences "the basic structures of the responses are analogous", nonetheless he is forced to revise his formulation of the thesis as follows:

> "a piece of music expresses an emotion e if it causes a listener to experience a feeling α, where α is the feeling component of the emotion it would be appropriate to feel (in the central case) when faced with a person expressing e. Hence music expressive of sadness will cause a listener to feel sad (or maybe the feeling component of pity if that is a different state), and this feeling will cause him to believe that the work expresses sadness. The cognitive component is necessary neither to the arousal theory in general nor the analogy in particular" (*ibid.* p.149).

Although we might grant that components of emotions are separable in such a way, this reformulation is not without problems. Indeed it contradicts one of the underlying assumptions of the cognitivist theory of emotions — that we *cannot* discriminate between feeling components of emotions. Surprisingly Matravers acknowledges that the reformulation invokes such problems, though he believes this only serves to highlight the explanatory power of the arousal thesis. He refers to the causal relationship between the feelings and associated beliefs, adopting the position that the feelings in fact *cause* a belief that the music expresses an emotion and *not* that we must infer that the music expresses an emotion because we feel the associated feeling. Matravers however, neglects to explain how feelings may cause beliefs in the central case and indeed a belief that the music expresses a particular emotion is not to be equated with the cognitive component of that emotion. Although a 'feeling' might cause us to believe that the music is expressing *something* it does not seem plausible to accept that it might cause a belief that the music is sad, jolly, or otherwise. Indeed, if it were the case that feeling components caused specific beliefs, music would surely be able to express every conceivable emotional nuance by means of that specific feeling component causing a relevant belief. This is obviously not the case, and therefore this still leaves us with the problem of distinguishing between feeling components of emotions.

On Matravers' account then, we would have to specifically identify 'pity' by means of its phenomenological and physiological components. This would still be lacking the determinate cognitive content necessary to this emotion on the cognitivist account. (To pity X one must hold a belief that X is suffering in some way.) These problems lead Matravers to his final formulation of the thesis that:

> "A work of art *x* expresses the emotion *e* if, for a qualified observer *p* experiencing *x* in normal conditions, *x* arouses in *p* a feeling which would be an aspect of the appropriate reaction to the expression of *e* by a person, or to a representation the content of which was the expression of *e* by a person."[16]

This then confirms my claim that we would have to be aware of and identify the feeling component ourselves, for one must judge whether it is an 'aspect of the appropriate response to the expression of *e* by a person.'

4.3.3 Imaginary Emotions? Evaluating the Weak Arousal Thesis

Matravers has seemingly failed to defend the thesis in either weak or strong form, but one might think a weak version of the thesis could be interpreted rather differently. I will now offer a brief critique of weaker versions of the arousal thesis and expand upon my earlier claim that many theories of expression are wrongly labelled as weak versions of the arousal theory. The fundamental problem with weak versions of the arousal theory is the notion of aroused emotions as simulated or imagined. We will begin with Kendall Walton's account as presented in his paper *What is Abstract About the Art of Music?* Walton's explanation is that musical expression occurs as an awareness of our own feelings and auditory sensations and his notion of arousal being in terms of our own *imaginary* feelings. So emotions provoked by music on Walton's account are not actually emotions as in everyday life but the imagination or simulation of emotional experiences. This view of musical emotions as 'imaginary' is subject to heavy criticism as the 'feel' of such emotions is not sufficiently different from our everyday emotional experiences, such as to warrant this distinction.[17] Neither does it seem appropriate to adopt such a notion which construes arousal solely in terms of a cognitive process. Arousal necessarily entails some level of physiological response. Empirical evidence supports the former claim, with musical emotions producing similar physiological responses to those in everyday life. (See Sloboda). Whilst hypothesising 'imaginary' emotions (with imaginary objects) may solve the problem of music providing determinate cognitive content, this still saddles the weak version of the theory with a projectivist position and its associated problems, as well as the difficulty of explaining in what sense emotions could be 'imaginary.'

A slightly different account of arousal-expression is offered by Jerrold Levinson, his explanation of musical expression focusing on the *structure* of musically provoked emotions. Levinson explains that on his account aroused emotions are

> "something very like experience of the emotion expressed in the music" but not exactly like it. In both cases the physiological and affective components of emotion are present and in both cases there is cognitive content, but the "emphatic" response lacks *determinate* content:"[18] [my emphasis].

Levinson explains the difference between 'everyday' emotions and musically provoked emotions as exactly this difference in cognitive content. Claiming that musically aroused emotions lack determinate cognitive content, he argues that music (as non-representational) simply cannot provide such content. Music may only therefore provide an imagined or simulated object towards which the emotion may be directed, along with evoking the affective and physiological components of an emotion. Jenefer Robinson (*The Expression and Arousal of Emotion in Music*) is heavily critical of both Walton and Levinson's accounts. Indeed she criticises Levinson and Walton for their failure to show (in any detail) just how their respective accounts might work with reference to musical examples. Robinson also notes their failure to acknowledge the distinction between arousal and recognition of emotion which both accounts nevertheless seem to suggest (even if not specifically in the musical case.) As Robinson notes,

> "both writers find a connection between the presence of an emotional quality in music and the arousal of that emotion in the listener's imagination. I have urged, however, that neither Walton nor Levinson has shown how complex feelings such as unrequited passion, stabs of pain, or even sadness can be aroused by music whether in fact or in imagination."[19]

Whilst this criticism is true for Walton's account, Levinson makes an important comment which should influence how his account is to be interpreted. He states "When a person has a 'deep emotional response' to music, this is 'generally in virtue of the recognition of emotions expressed in music"[20] It is for this reason, that I would suggest his account has been wrongly labelled as an arousal thesis. Levinson himself does not call his account an arousal theory, nor does he even claim to have a coherent theory of expression and specifically Levinson does make a clear distinction between recognition and arousal. My standard objection to such versions would be that in claiming musical emotions are not 'real' emotions, this violates the arousal thesis - that music expresses X in virtue of arousing X in the listener and not music expresses X in virtue of producing simulated/imaginary X in the listener. The problem is that weak versions of the thesis attempt to use the arousalist approach to solve the problem of intention whilst proposing versions of the thesis with different implications. Introducing imaginary or simulated emotions does not counter the standard objections nor empirical findings which contradict the arousal theory.

4.4 Empirical Concerns

In addition to specific findings considered within this discussion, the empirical findings as a whole deserve further mention. Although the Arousal theory has previously managed to escape criticisms raised through conceptual analysis of the account, it seems empirical studies may allow us to finally reject the thesis. The model of music processing suggested by empirical studies shows music to be a highly independent function and recognition of emotion and arousal of emotion are shown to be separable responses. Importantly music is not dependent on language, which is an implicit assumption of the arousal theory and aesthetic accounts as a whole. Musical deficits (as discussed in Chapter 3) show a clear separation of musical feature and emotion recognition. Musical emotion (certain types) may be reliably identified in the absence of ability to recognise musical features. The empirical findings also present a picture of music cognition with different methods of emotion recognition, both direct and via extra-musical associations, which again contradicts many accounts presented within aesthetics. Importantly, music cognition, and specifically musical emotion recognition, is not dependent on language, and we should be wary of restricting the discussion of musical emotion by thinking in terms of existing emotional vocabulary. Ultimately we should consider emotions in terms of psychological states, and consider that music may naturally be an alternative medium to convey emotion than language.

To summarise, it is implausible that one could maintain a strong version of the arousal theory in light of the criticisms discussed. Reverting to a weaker version of the theory does little good, as this brings with it the problem of defining imaginary or simulated emotions in addition to its failure to counter the remaining objections. Empirical findings support this rejection of the thesis and its underlying conception of expression. As a result, to counter the objections and reply to the empirical findings necessitates significant reformulation of the original thesis, such that any attempt to revise the thesis inherently constitutes a radical departure from the central claims of the arousal theory. If Matravers is trying to propose an experiential model of music (processing) and emotional response, then his attempt is far off the mark. Matravers over-theorises in his account of musical interpretation (see *Art and Emotion* p.167) advocating a cognitive evaluation of our own emotional responses and their causes as part of the listening process. Whilst it is perhaps true that a critic attends to music in such a way, the ordinary listener does not and it is the ordinary listener and their emotional responses to all types of music which are of primary interest. Empirical studies would support such a criticism that this simply is not how we experience and respond to music. If, however, Matravers intends this to be an account of music cognition, again it is flawed as he really needs to take account of the functional separation of music and other faculties. It is all very well to hypothesise about music cognition from a conceptual viewpoint, but one can not propose (or infer) cognitive processes for music which are incompatible with functional separation of music and other cognitive functions, specifically auditory processing and other modes of expression recognition. As discussed earlier in Chapter 3, the underlying architecture of auditory processing will undoubtedly influence any model seeking to explain musical experience. Hence models of musical experience and underlying processing need to be carefully reconciled. Although arousal of emotions by music does need to be accounted for within any account of expression, it needs to be acknowledged that recognition of music as expressive does not *necessitate* arousal.

4.5 An Alternative Analysis of Expression

While the arousal theory fails as a theory of expression, it still has a certain appeal in its explanation of some instances of expression, and as noted in 4.1, and Chapter 3, arousal and recognition *are* intertwined due to the nature of initial affective perceptions. Without further discussion it might well seem inconsistent to discard the arousal theory but also to accept that auditory affective responses might mediate recognition of emotion in music. In light of criticisms of the arousal theory, and general criticisms of aesthetic theory, it would seem appropriate to offer some kind of alternative account which can encompass the varieties of expression outlined in Chapter 3. It is not that revised notions of expression call for rejection of aesthetic theories, but rather that these require appropriate placement within some kind of general framework for musical expression (and affective perception). Some further critiques of the arousal theory will highlight the deficiencies in existing accounts as *comprehensive* theories of expression. In addition to the arousal theory contradicting empirical findings, a further distinction is lacking in both weak and strong versions of the thesis. The theory fails to offer a sufficient distinction between music's formal and expressive properties. In particular, the arousal theory cannot offer a unified account of music's expressive properties (neglecting to account for those properties which are not emotions themselves but are nonetheless expressed by music). For example, we can clearly distinguish between formal and expressive features (Table 4.1). However, within the group of what one might term 'expressive' properties, there are further subdivisions - expressive descriptions of states which are not 'emotions'. For example, object characteristics and character traits are typically included within the category of 'expressive' descriptions.

Table 4.1
Formal and Expressive Properties of Music

Formal	Expressive
Pitch	Happy
Tempo	Sad
Tone	Calm
Key	Courageous
Rhythm	Threatening
Harmony	Menacing
Orchestration	Hasty

If the arousal theory were true, claims about the expressive character of music would implicitly be claims about the normal effects of such music on an audience. E.g., calling a work sad would imply that 'when played it will make people feel sad.' This analysis highlights a continual flaw in the investigation of musical emotion. Empirical studies show, (and surely introspective analysis supports this), that subjects (under normal conditions) may consistently recognise a work as expressive without necessarily feeling that emotion oneself. That is to say, discussions of musical expression continue with increasing detachment from the issue of listeners' *actual* responses. As seen in Chapter 1, theorists are quick to involve themselves in the details of musical works and their powers of representation, without first considering broader relationships between listener and sound, and indeed the nature of expressive descriptions. This is supported by the fact that expressive descriptions are not typically explained in terms of listeners' felt responses but rather by referring to formal properties of the work. As noted above, a claim such as 'That's a sad piece of music' is countered not by objections such as, 'No, he wasn't' or 'He was just pretending' (referring to the composer [or listener/performer]), but by remarking 'You haven't listened carefully' or 'You must listen again; there are almost no minor progressions and the tempo is *allegro moderato*.' " (Tormey 1971, p.105).

Imitative accounts (Davies 1980; Putman 1985; Budd 1995), arousal theory, and representational accounts (Karl and Robinson; 1995) all make much of relating specific musical features to expressive descriptions of music. Cooke's language of music, for example, explains expression by relating formal properties (particular musical phrases) to expressive properties. Although I have criticised Cooke's account for its formulaic approach, the distinction between formal and expressive properties still needs to be outlined. Moreover, I would wish to draw the distinction in such a way as to accord with the two-stage model proposed in Chapter 3. One cannot simply construct (as in Cooke's account) formulae for creating specific emotional responses, but nonetheless there are causal relationships between formal and expressive properties which need to be accounted for. In fact, it seems there are strikingly different relations between formal and expressive properties, for the *natural* and *acquired* modes of expression. The problem for aesthetic accounts is that they do not present this distinction in sufficient detail. Expression theories offer us competing explanations of how music's formal properties *might* 'express' emotion, rather than accounting for the varying ways in which formal properties *do* cause (or allow us to attribute) different kinds of expressive properties to music. This can be seen as a result of philosophers focusing on '*aesthetic*' properties as a whole, rather than *expressive* properties. As a result, expressive properties become subsumed within generalised attempts to defend the objectivity of aesthetic properties and value claims.

What is required then is a means of effectively capturing the relationships between formal and expressive properties, allowing a distinction between these categories in terms of their differing perceiver relationships. A method by which these relationships might be outlined is by reference to a distinction between primary and secondary qualities. That is, a distinction between those qualities which are intrinsic to an object (e.g. size and shape,) and those which are in some sense related to perceiver responses (e.g., smell and colour).[21] Though this distinction can be traced back to Galileo, perhaps the most famous historical source is John Locke's treatment (*An Essay Concerning Human Understanding* bk. ii Ch.8). Locke describes primary qualities (solidity, extension, figure, motion or rest) as

> "utterly inseparable from the body, in what state soever it be; and such as in all the alterations and changes it suffers, all the force can be used upon it, it constantly keeps." (EHU bk. ii Ch8.9). He goes on to describe secondary qualities as "such qualities which in truth are nothing in the objects themselves but powers to produce various sensations in us by their primary qualities, i.e. by the bulk, figure, texture, and motion of their insensible parts, as colours, sounds, tastes etc. These I call *secondary qualities*." (EHU bk. ii Ch.8.10).

Subsequently, many attempts have been made to formulate this distinction, though there is still quite some disagreement about how best to do so.[22]

There has nonetheless been some discussion of whether aesthetic properties can be treated in a way analogous to colours, and this may be useful in relation to the analysis of expressive properties. Hume uses the primary/secondary distinction to support his account of beauty, by drawing an analogy between secondary qualities (e.g.) colour and aesthetic qualities (e.g. beauty). In his attempt to define beauty, Hume maintained that beauty

> "is such an order and construction of parts, as...is fitted to give a pleasure and satisfaction to the soul ....beauty is nothing but a form, which produces pleasure, as deformity is a structure of parts, which conveys pain; and....the power of producing pain and pleasure make in this manner the essence of beauty and deformity".[23]

Hume's account can be seen to stem from Locke's primary/secondary quality distinction, indeed his idea of beauty as a 'power' relates strikingly to Locke's comments that secondary qualities

> "are in truth nothing in the objects themselves, but powers to produce various sensations in us; and depend on those primary qualities, viz. bulk, figure, texture, and motion of parts." (EHU bk. II ch.8.14).

Still, there are difficulties for Hume's comparison. In the case of secondary qualities (colour for example), one cannot be argued or persuaded into altering one's colour perception, (e.g., be argued into seeing something as a different colour). However, one can be persuaded or shown that a painting is graceful or beautiful, where one did not previously see these qualities in the artwork. That is to say, there does seem to be a possibility of educating tastes, in a way in which it is not possible to "educate" colour vision. This highlights a problem for the comparison, that one is comparing perceptual judgements (e.g. for colour) with evaluative judgements in aesthetics. There is typically no evaluative element in colour perception and the standards for application of colour concepts are relatively rigid, being fixed by the reflective properties of surfaces and the nature of human vision.[24] It is perhaps the failure of the analogy between secondary qualities and aesthetic qualities which has deterred theorists from continuing this line of thought. However, there may still be scope for the primary/secondary distinction specifically in relation to expressive properties. The focus within aesthetics has been the objectivity of 'aesthetic' properties as a whole, rather than just expressive properties. Indeed Hume's idea that objects are disposed to look a certain way to us, that "Some particular forms or qualities, from the original structure of the internal fabric are calculated to please, and others to displease" (SOT, Hume's Essays p.238) has been assimilated with attempts to identify formal properties as necessary and sufficient conditions for aesthetic properties (and in turn objectify value claims e.g. artwork x is aesthetically valuable because it has properties a, b, and c). The problems with this view are summarised by Bender's comments:

> "there seems to be no entailment relations connecting the aesthetic and the non-aesthetic. Nor are there any universal, empirical, psycho-aesthetic generalizations, such as "all paintings with smooth curving lines and lightly saturated colours are delicate and balanced," under which to subsume given instances" (Bender p.31).

Whilst this might perhaps be true in the case of *aesthetic* properties, this is partly because much depends upon what falls within the realm of 'aesthetic'. The case for expressive or even more specifically *expressive* properties would seem clearer cut. For example, there would seem to be less room for dispute regarding whether something is sad, happy or angry as opposed to being 'balanced' 'gaudy' or 'graceful'.[25] Despite the problems for *value claims*, then, one may still be able to draw on the analogy in relation to *expressive properties*.

Turning back to emotion, its recognition and arousal would indeed seem to be more closely analogous to colour perception than judgements of beauty. Applications of emotive concepts being relatively well fixed in relation to music and (at least in many cases) showing more direct relationships to formal properties of the object in question than value claims or ascriptions of beauty. Yet despite these similarities, and the fact that we do seem to ground emotive descriptions on objective formal properties, emotive descriptions of music, like aesthetic judgements, are notoriously subject to dispute. At the heart of the issue in aesthetics has been the paradox that on the one hand emotive judgements are *subjective* whilst on the other hand they are justifiable in terms of *objective* properties and normative standards. The simple solutions to this problem would be either to identify objective features which are necessary and sufficient conditions for attributing emotional expression or to allow that emotive descriptions are subjective. Neither view alone is sufficient as there are both subjective and objective elements to the arousal and recognition of musical affect as recognised in Hume's sophisticated subjectivism. Whilst Hume's analogy between aesthetic and secondary properties, is subject to criticism, there is still an inherent appeal in the idea that beauty (or in our case expressive qualities) is a 'power' of an object's formal properties to act on us in certain ways such as to cause a relevant perception. If one thinks back to the chill responses, discussed in Chapter 3, this seems markedly plausible. In light of these considerations, disputes between 'subjective and objective' seem misdirected. As seen in Chapter 3, the disagreement can be explained in relation to the *mode* of expression, degree of specificity relating to that mode, and the supervenience relationship of primary and secondary modes of expression. What one can provide, then, is an analysis of expression in terms of *relational properties* which can encompass all these variables.

The primary/secondary quality distinction alone though, does not seem sufficient to encompass the relationship between formal and expressive properties. An alternative means might be to analyse music's expressive properties in terms of 'response-dependence'. Response dependence has chiefly focused on the problems of colour, and as yet very little attention has been devoted to sound (or emotion). Yet response dependence is surely a very widespread phenomenon indeed. A very large number of the attributes that we recognise and ascribe to objects, events, people, and performances are really response dependent. As there are different kinds of things that can have response dependent features and can have them in different ways, we should be ready to allow that there can be different varieties of response dependence. Giving an overall account of response dependence that can encompass all varieties of the genus is really a task that goes beyond my purposes in the present work. However, if I offer a rather permissive and inclusive account of response dependence in general, it should be possible to say something a bit more detailed and substantial about how the specific forms of response dependence exhibited by the expressive properties of music fit into this general account. It turns out that response dependence provides a powerful framework for understanding the expressive powers of music; and the varieties of response dependence, even in this particular modality, help to clear up a number of puzzling things about music's expressive capacity. There may still remain some conceptual difficulties with the notion of response-dependence, but it seems undeniable that it can serve as a useful way of analysing and understanding expressive properties and modes of expression. This has advantages over other accounts of expression in addition to the arousal theory. Importantly such an analysis can account for cultural and social variability, allows examination of supervenience relationships between primary (formal properties) and secondary (expressive properties) qualities, and will allow us to comment further on implications the revised model of expression entails for aesthetic accounts.

4.5.1 Response Dependence

Response dependent properties generally conform to the notion of secondary qualities (e.g. colour and taste) and differ from primary qualities in that they causally implicate the perceiver, having an a priori connection with observer responses. Philip Pettit highlights the species-specific nature of response dependent properties as he explains:

> "Secondary quality concepts implicate subjects in a way that primary quality concepts do not. Consider the concepts of smoothness, blandness, and redness. They are tailor made for creatures like us who are capable, as many intelligences may not be, of certain responses: capable of finding things smooth to the touch, bland to the taste, red to the eye. The concepts, as we may say are response-dependent. They are fashioned for beings with a capacity for certain responses and it is hard to see how creatures which lacked that capacity could get a proper, first-hand grasp of the concepts."[26]

A basic formulation for response dependent properties, is that whether an object is or is not blue for example is determined by whether an object x looks or is judged to be blue by normal observers in normal conditions. (See McGinn, 1983; Tye, 1995; Johnston, 1989).

In general it has been thought that in the case of response dependent concepts, whether an object x is or is not ϕ is determined by whether or not it is judged to be ϕ by an observer competent in applying that particular response dependent concept (ϕ). We can clarify this by giving a standard formula (or, as it turns out, a first attempt at such a formula) for response-dependent properties thus:

RD1: A property ϕ is response dependent iff it is necessarily true that if x is ϕ, then x seems (or is judged to be) ϕ to normal observers under normal conditions.

It seems then that music's emotional properties do fall within the category of response dependent properties and indeed the standard formula may be re-written to apply specifically to musical emotions. However, the above formulation, requires some revision before looking specifically at the musical case. A particular problem is that the response dependent property (ϕ) appears in both the analysis and the claim to be analysed so that the claim of response dependence seems to reduce to 'x is ϕ iff it is judged to be ϕ'. But doesn't this result in a circularity that is vicious?[27] It would, if analysis in terms of the most fundamental concepts required us to substitute in accordance with the formula RD1, within the right-hand side of that very formula itself; i.e., if what was to be understood as ϕ within the phrase 'judged to be ϕ' was to be analysed in terms of the biconditional 'x is ϕ iff it is judged to be ϕ'. This is a consequence which a number of analysts have tried to resist by arguing that in the case of colour concepts the most basic and primitive concepts in terms of conceptual analysis are not *red, blue, green,* etc., but rather *looks red, looks blue, looks green,* etc. (See Jackson F, *Perception* 1977; McGinn C, *The Subjective View,* 1983).

That may have some plausibility in the case of colour concepts. But if that's so, then it only goes to show that concentrating on the case of colour is liable to stand in the way of developing an adequately general account of response dependence. The idea of a 'happy event' (a wedding, the birth of a child) involves a response dependent concept. It may well be that happy events are those which will normally be judged to be happy. But it seems very clear in this case that 'judged to be happy' cannot be a primitive concept from the point of view of conceptual analysis: what is judged to be happy must be judged so *in virtue of* perceived tendencies of events and occasions to make people be or feel happy. In other words the judgement needs to track a psychological state or response which is not itself a judgement. In the case of emotion, the claim that 'music p *evokes* an emotion of sadness in x' (or even causes recognition of sadness in x), does not equate to: x forms a *judgement* that music p is sad. So perhaps a better, and more inclusive, formulation of response dependence would be the following:

RD2: A property ϕ is response dependent iff it is necessarily true that for any x, x is ϕ iff normal perceivers in normal conditions would have some particular response, R, to x.

For music then, sadness is response dependent iff it is necessarily true that for any music, the music is sad iff normal perceivers in normal conditions would have some particular type of response R to the music.[28] My main concern is not to provide a full account of response dependence, but rather to show how an interpretation of the expressive features of music as response dependent can be used to help provide an account of musical expression. Indeed, many other applications of response dependence will not be closely analogous to the musical case. However, the musical case is sufficiently far removed from the case of colour concepts to move us from RD1 to RD2, which is clearly a movement in terms of greater generality. So there is some hope that a formulation like RD2 may be useful as an umbrella which covers a large variety of forms of response dependence.

One point worth noting at this stage is that an account of musical expression in terms of response-dependence seems to be capable of "trumping" the Arousal Theory, in something like the way in which hypothetico-deductive accounts in the philosophy of science outflanked an inductivist view of scientific method. According to inductivism scientific theories were arrived at by a process of generalisation from regularities noted through a mass of observations. Hypothetico-deductivism insisted that we should distinguish between the context of discovery and the context of justification: the value of a scientific theory was determined by the way in which it stood up to testing, not by the way in which it came to be suggested in the first place. It might occur to scientists as a hypothesis worth testing for all sorts of different reasons. One way in which it might emerge as a hypothesis, of course, was through being suggested by a series of observations and regularities detected therein. So hypothetico-deductivism effectively swallowed any positive case that might have existed in the history of science that had previously appeared to be favourable to inductivism. Similarly, a general account in terms of response dependence can absorb any instances that might seem to bear out Arousal Theory, by the simple expedient of allowing that in some cases, for some expressive features, the psychological response R in the audience can be feeling or experiencing some emotion.

So if there was ever any merit in the Arousal Theory, that can be retained by a suitable characterisation of the response R in a response-dependent account. In fact, there are rather few expressive properties of music for which this works at all well: one might perhaps cite *happy music* and *calm music* as examples where the expressive power does seem to be a matter of a tendency to make listeners *feel* happy/calm (rather than *judging* anything to be the case). The important point is that the response dependence account is capable of both explaining (and explaining away) the lingering attachment exhibited by theorists to the Arousal Theory as being due to instances of expressive power that can equally well be accommodated in terms of response dependence, with suitable R.

4.5.2 Recognising the Scope of Response Dependence

Leaving what the response R is to be so open in this way makes for a very broad conception of response-dependence. Although I might be accused of providing a very loose account, I think this looseness is in fact all to the good, in that it enables us to recognise *many different varieties of response-dependence*. I cannot hope here to do justice to all the different varieties of this widespread phenomenon, but will at least try to show that even in the field of music, different forms of response dependence need to be acknowledged. Although I can only do a little in the way of showing the complex of varieties of what is a large subject, the present treatment may serve as a corrective to accounts of response dependence that are built around more familiar examples. The danger is that an account of response dependence that relies too heavily on a particular example will become too narrow, and in fact turn into an analysis of a particular variety of response dependence. Arguably, this is just what has happened in relation to the philosophers' favourite example of colour.

By contrast, the permissiveness of the formulation RD2 enables us to see the full generality of response dependence and at least to make a start on differentiating some of its many varieties. Considering that formulation again:

RD2: A property ϕ is response dependent iff it is necessarily true that for any x, x is ϕ iff normal perceivers in normal conditions would have some particular response, R, to x.

We can see that the permissiveness of RD2 consists in the fact that it allows two 'degrees of freedom', two aspects in which different specifications many generate different varieties of response dependence. These two degrees of freedom are realised in the answers to the questions:

1. What is normal — in the way of both perceivers and conditions?
2. What is the response R?

In order to show how answers to these questions can produce a number of varieties of response dependence I will go on to consider how normal conditions and normal perceivers are to be specified (and, importantly, how these relate to actual conditions).

4.5.3 Requirements for Response-Dependence: What are Normal Perceivers and Normal Conditions?

Examining what we take to be normal conditions and normal perceivers allows us to make distinctions between responses to music as universal, culture specific, natural or conventional (acquired), distinctions which were notably lacking in existing accounts. The model of expression I have proposed in Chapter 3 suggests that recognition of musical expression involves separable components (relating to extra-musical and intrinsically musical features). Clarifying the concepts of normal conditions and normal listeners here will help to explain expressive properties both in terms of 'natural' and 'acquired' responses. To recap, my account of emotional expression involves two stages: First, there are natural (mandatory) physiological responses' to music created by direct effects of the music on our auditory systems. These responses allow expression of very basic positive and negative 'affective states'. Second, music may build on such physiological responses by use of extra-musical associations, by means of music imitating or otherwise representing gross aspects of emotional behaviour, by extra-musical features (lyrics, visual imagery etc.), familiarity with musical works and deeply embedded socio-cultural influences (e.g., types of music *accompanying* particular social events, or conventionally used to *represent* certain events).

It seems appropriate to begin by saying that a 'normal perceiver' should be free from perceptual defects, and that standard conditions should entail that musical works are perceived without other auditory distractions (speech or environmental sounds, except where these may be part of a composition). These conditions however, need expanding in quite some detail. In addition to the 'normal perceiver' having no perceptual defects, it seems natural to add that they should have no extraordinary musical experiences, nor suffer from a complete lack of such experience, and this will be reflected in the notion of standard conditions. For example, one would not expect someone who has been deprived of musical exposure to be a normal perceiver.[29] There needs to be a reasonable awareness of, and exposure to musical norms of a society, e.g. Gamelan, or western tonal music. And one would expect a normal perceiver to respond in accordance with such norms even though they themselves may not be consciously aware of them.

In the case of emotional response dependent properties of music, it is also necessary, in order for someone to qualify as a normal perceiver, that they have an understanding of the relevant concept being applied. Thus, we should exclude from the group subjects with emotional disturbances, and those judged not to have a sufficient grasp of the relevant emotion concepts. Young children, for example, may well not have a full grasp of cognitively complex emotions such as regret or grief as these are dependent on understanding of relevant situations, beliefs and desires of both the emoter and others.[30]

One can see immediately that 'actual conditions' and 'actual perceivers' differ significantly from 'normal conditions' and 'normal perceivers.' Within the range of what would be classed as 'normal' auditory perception, there are variations (thresholds of hearing vary across subjects both for range of pitch (frequency) and intensity of sounds). Also it is difficult for us to assess others' understanding of emotion concepts, and listeners may well experience temporary changes in emotional states which disturb them and affect their sensitivities. There exist no strict boundaries as to what is regarded as 'normal musical exposure' and it is certainly a rare occurrence for music to be perceived in an environment free from other auditory distractions. Hence our actual musical experiences and emotion-attributions must allow for such discrepancies rather than attempting to 'idealise' our notions of standard conditions and perceivers to minimise error. Indeed, as Holton explains in his discussion of response dependence, the standard conditions should not be such that they do not allow for error. He holds that standard conditions are trivialised if we make them ideal conditions. This would be the case for musical emotions if we were to restrict the category of normal perceiver to a particular school of professional critics. Although within such groups a very high degree of consensus may be reached as regards emotional content, this will be largely a result of conditioned responses and musical knowledge and would not reflect 'normal perceivers' responses. Janet Wolff comments on a similar point, that we should focus on musical emotion as it is *experienced* (by normal perceivers) and to make a careful distinction between emotional ascriptions as such and emotional ascriptions as *value judgements* which might be made by particular groups of 'institutionally and structurally located' perceivers. Indeed, given the breadth of RD2, you can perfectly well have expressive properties *for the elite* which differ from the expressive properties for a more numerous group of normal perceivers.

The main point here however, must be that, although actual and normal do not exactly coincide, they must not fall too far apart. In general, we do not want complete fragmentation of response dependence. With this in mind one would readily understand a critique that the formulation of RD2 might be *too* broad and include just anything. Johnston also acknowledges this problem in relation to broader formulations of RD such as my own, and his reply provides a succinct answer to such criticisms:

> "[For the formulation:] x is C iff in K, S's are disposed to produce x-directed response R (or x is such as to produce R in S's under conditions K.)

> ......for the concepts in question such a biconditional will not hold simply in virtue of a reading of K, S or R which makes the biconditional trivial, imposing thereby no constraint on the concept C. Such a trivialising reading would be any reading which overtly or covertly specifies the conditions and subjects as whatever conditions and whatever subjects are required to get it right, or any reading which overtly or covertly specifies R as whatever response is truly C-detecting under the conditions specified. Given a 'whatever-it-takes' reading at any of these three points, the a priori truth of the biconditional so read indicates nothing in the way of the conceptual (inter)dependence in which we are interested." (Johnston, 1989, p.145).

4.5.4 Expressive Properties and Intrinsic Possession.

There are nonetheless, objections to the response dependence thesis and these are readily comprehensible given the way secondary qualities *appear* to us as properties of objects. This notion is put forwards by Michael Tye, who comments,

> "The obvious view, suggested by our color experiences .... is that the colors we see objects and surfaces to have are simply intrinsic, observer-independent properties of those objects and surfaces." (p.144).

On this 'objectivist' account secondary qualities are if you like intrinsic properties of objects in the same way as primary properties. Tye criticises the response dependence thesis further, by claiming that it cannot accommodate the fact that according to perception, experience of redness, say, is an experience of the property as intrinsic to the object — that we experience colour as non-relational. But experience is not always an accurate guide to how things actually are, optical illusions and indeed Tye's own examples of phantom limbs are typical examples (see, Hardin, 1993; Tye, 1995.) By reverting back to an argument from experience, Tye seems to undermine the attempts he makes to cite 'objective' colour properties.

It would also appear that Tye's notion of perceiver independent properties is more appropriate to his example of colours than secondary properties in general (and expressive properties). Whereas colours *can* seemingly be located in an object's surface, 'sadness' in music has no such analogous (spatial) location. Perhaps the most powerful argument against the strong objectivist approach is that even where we relate colour (or sadness) to specific formal properties, it does not follow that we can identify a further property 'redness' say, in the object, but only an arrangement of formal properties which produce certain effects in us. For example, whilst one can objectively measure the frequency of an acoustic signal, there is no intrinsic property 'pitch' which one may identify. One simply cannot say that properties are intrinsic because we perceive them to be so. Whilst intrinsic properties are unchanging regardless of adaptations to our perceptual systems, secondary properties are ultimately relative to our perceptual abilities, they would alter in accordance with changes to the human perceptual system.

Going back to question 2 above, 'What is the response R?', problems do arise for our conception of emotional responses if component parts are examined individually. Although physiological affective responses (chill responses) are component parts of emotional responses to music, they do not seem to conform to the standard conception of response dependent properties. As Johnston claims

> "for response dependent concepts, subjects' responses essentially and intrinsically involve some mental process (responses like sweating and digesting are therefore excluded)"[31]

Physiological affective responses to music are responses to certain auditory signals and as such are not even dependent on perceptual recognition of music *as* music. The music does *cause* the response but this does not mean we will necessarily call such music sad or happy if it lacks higher-order emotional components such as to produce relevant cognitive content or representation of emotional behaviour. Rather, what is going on in this sort of case is that music causes a physiological response which we *may or may not* relate to a particular emotional state. Musical 'chills' alone, are distinct from the ability of works to produce either a conceptual recognition of emotion or a feeling of a *specific* emotion.

The worry here is whether chill responses and the like are psychological states or purely physiological states, and it is not clear that they are either, due to the interwoven nature of cognitive and affective responses. It certainly seems that affective responses can induce cognitive responses, and may even involve some basic cognitive aspect — for example, a recognition of one's state, or that perception is directed towards the cause of the affective response. It is not possible to entirely separate the purely physiological aspects of affective responses from their associated mental processes, and in light of this Johnston's criteria for response dependent concepts is clearly insufficient.

That is a problem for Johnston, but it is not a problem for the broader account of response dependence, reflected in RD2, advanced here. While we cannot perhaps distinguish purely physiological and cognitive aspects of affective responses, this should not prevent us from analysing them within the response dependence account. All we need to say is that there are some fully psychological forms of response dependence in which the response R is clearly a psychological state. There are also some purely physiological varieties of response dependence in which the response R is simply a physiological state: the property of being poisonous (to humans) is an example of that. There are also mixed examples in which the response is both physiological and psychological — e.g., the property of being nauseating (of things tasted).

This goes to show that the point that in relation to response dependence in general, the fact that our question 2 above (What is the response R?) is an open question, admitting of different specifications for different varieties of response dependence (rather than a single one-off, definitional answer), is really a strength, rather than an analytic weakness, allowing us to recognise the full scope of response dependence. In this connection there is an important distinction to be drawn within the range of psychological responses. This is that response dependent properties can be subject to focused and unfocused intentionality. Something can seem x to a perceiver, as in the case of evaluative responses to music, or something can just produce effect x in the perceiver, without the perceiver having a conscious awareness of the exact cause. (For example, music as a whole may just produce a response in the listener without them necessarily attributing the response to music *or* sadness may be attributed to particular passages, the way certain sections are orchestrated, harmonic progressions etc. See Sloboda 1991). This distinction is perfectly compatible with the given formulation of response dependence RD2, which requires only that perceivers have some response R to x, which might perfectly well be a largely physiological affective response or an evaluative response. It makes no claims about the type of response in the listener and therefore supports the wide range of emotionally affective states which may arise in response to music.

4.5.5 Natural and Acquired Response Dependence

Within the two stage model of expression then, one may assert that listeners from any culture should be able to recognise[32] expression of emotion belonging to the first stage, this being the result of basic physiological responses to auditory input mediated by primitive neural circuitry. The second stage of emotion recognition will be influenced by culture and musical knowledge, (e.g. conditioned responses to types of music used in particular social settings).

It seems that culture specific emotionality is very strongly ingrained. Conventional uses of music for certain social events, lullabies, folk songs etc. create strong affective associations which may well be able to supervene upon basic physiological responses to music. For example, it is certainly plausible that a piece of music evoking a 'positive' physiological affective response might be used in a different context to accompany a 'sad' event, and as a result, conventionalised or conditioned responses to the piece as 'sad' might override the initial physiological response.[33] Over-familiarity is certainly a possible factor that might lead to suppression of initial arousal. For example, a piece that might on first hearing have produced a positive affective response may have been heard so many times that it produces irritation instead. Another example might be that music produces the relevant conceptual associations (e.g. a funeral march), but that it has been so over-used (e.g. commercially, and within fictional contexts) that it looses its direct affective powers. Indeed it may well be that attention is an important factor here. For example, music only being subject to secondary processing if it is allocated auditory attention. I.e. if we have become habituated to music in the background it is easy to ignore.

Explaining emotional properties as response dependent allows us to account for cross-cultural variation, and changes in response to music over time. A 'normal' observer of the 18th century under standard conditions would be familiar with musical language of the time, and would recognise particular tunes as expressive of particular emotions and representing complex states of affairs (without undertaking any detailed musical analysis). An example of such acculturation can be found in Mozart, as many of Mozart's operas and some of his instrumental works contain musical 'jokes' and references to the different social classes. Most commonly Mozart used different types of dance music which were representative of the upper and lower classes, but also techniques such as using a string quartet in the background, which would refer to the upper class, whilst a lively gigue with alternative instrumentation would be a reference to the lower classes.[34] He also used different types of music such as Turkish music and religious music to set scenes. These features, whilst self-evident to the audiences of Mozart's era, are not always apparent to today's listener without prior knowledge that Mozart used such techniques and an understanding of their significance.

For such reasons, one would not assume that a piece of music which is labelled 'sad' at present will necessarily be considered 'sad' in a few centuries time and this corresponds with historical examples. We no longer find Gregorian chants 'awe-inspiring' or even in most cases expressive of emotion. Nor do we find many works political or nationalistic, as they were ordinarily interpreted by the listeners of the day. Obviously this is not due to a change in the music, but to a change in the listeners' responses and the ability of extra-musical modes of expression to supervene upon physiological responses (where present). On the other hand though, physiological affective responses, as responses to formal properties or a conjunction of formal properties of music, may consistently produce a positive or negative 'sad' or happy' emotional arousal, and will consistently be produced in listeners with the same physiology as we have today. This seems to present us with different expressive properties, those relative to certain categories of perceiver (e.g.., 17^{th} century listeners), and a category of universal properties which act on any perceiver with a normal auditory-perceptual system.

We therefore need to recognise two different modes of response dependence, *natural* response dependence and *acquired* response dependence. Natural response dependence is analogous to colour concepts and will not change over time. In the case of acquired response dependence listeners' responses are relative to their cultural and social contexts, familiarity and musical knowledge. This is consistent with views of artworks in context, and as products of certain social and cultural institutions.

As an example of 'natural' response dependence, physiological affective responses would seem analogous to colour perception. We do not require any explicit tutoring (other than general developmental exposure to colours and language) to apply colour concepts, and this is also true (if not more so) in the case of affective responses.

Only basic expressive distinctions may be made in a sense analogous to colour concepts. That is, affective distinctions which show a high degree of consistency in application and have direct causal relationships to formal properties. However, the fact that that there are at least some causal relationships between formal properties and our perception of music, may offer something to the thesis that certain objects are just aesthetically pleasing due to their formal properties. This provides an interesting perspective to aestheticians as regards objectivity of expressive judgements. For example, it may allow us to explain certain enigmas as regards music's value. Why high classical music is still held in such high esteem may be in fact due to its exploitation of certain, melodic or harmonic properties which play directly on our perceptual systems.

However, this is not to say that analysing the formal properties of a work is sufficient for us to determine its emotional effects, just as an analysis of the surface of an object is not sufficient for us to determine its colour (an object might have formal properties that would typically produce a red response when in fact the object looks blue). (Hardin, 1993 provides many examples of optical illusions for colour). If a coloured object were to produce physiological responses consistent with observing a red object (whilst the normal observer *perceives* the object to be green under normal conditions), this is not sufficient for us to attribute redness to the object. For example,

> "A circular disk that is half-red and half-green looks yellow when it is spinning to normal observers under normal lighting conditions. But such a disk does not become yellow when it spins" (Averill, 1982, p352)

The perception of yellow is not sufficient for us to say the object is surface-yellow. Similarly the formal properties of an object are not sufficient for us to determine what colour something will *appear* to normal observers. This applies equally to emotion seen as a 'property' of music. Musical expression of emotion must be considered under the conditions outlined above — not as exclusively determined by formal properties, despite the fact that there is clearly a causal relationship between some music and physiological /affective responses in the listener. Janet Wolff comments similarly about sociological roles in the arts,

> "The very products which aesthetics and art history posit as 'works of art' cannot be uncritically taken as somehow distinguished by certain intrinsic features, but must be seen as produced in that history by specific practices in given conditions"[35]

It does nonetheless seem, that problems of perception should be given a little more weight in aesthetic accounts of expression and, leading on from this point is something which I noted in

Chapter 3. Whilst affective responses themselves and physiological explanations are straightforward enough, what is problematic in any explanation of expression is the subsequent interaction of these basic pre-cognitive responses, with evaluative judgements of works of art. To what extent cognitive responses supervene upon these initial reactions might be something subject to further empirical testing. This indeed is an interesting question, as many responses to music may be conditioned responses, but at the same time, deeply ingrained, fast responses which may themselves not be the result of any conceptual analysis.

4.6 Summary

The response dependence analysis then, is both consistent with the two stage account of expression presented in Chapter 3, and offers advantages over traditional accounts of expression. It does seem that response dependence is in many cases inherently acknowledged, although the idea has not been explicitly outlined in aesthetics.[36] A response dependence analysis then allows causal and associative (natural and acquired) modes of expression to be reconciled within a broad architecture which is also compatible with empirical claims regarding auditory and affective perception, and also accounts for cross-cultural variance in responses to music. So long as claims regarding the *specificity* of expression are consistent with the *mode* of expression, causal and associative accounts may be reconciled within a global model of expression.

In light of how little is known about the interaction of affective perception and affective cognition, it would seem necessary that both modes of expression are considered conjointly. Initial affective responses may colour subsequent cognitions. But also acquired modes of expression may be sufficiently strong to override initial affective responses. If aesthetic accounts allow for both natural and acquired modes of expression, this in turn allows many theories to be reconciled with empirical findings. However, this is not to say that just any aesthetic account may be reconciled, there has to be consistency between expressive claims and the mode of expression. Response dependence does not legitimate claims for expressive powers which depend on misconceptions of underlying processes. The formulation of response dependence in terms of seeming ϕ to "normal observers" under "normal conditions" can be used to anatomise the expressive properties of music, distinguishing between those that depend upon nearly universal physiological and psychological responses, and those that depend upon highly trained ears attending in quite specific cultural settings. Importantly though, in light of empirical findings, one can specify to some degree the range of expressive powers falling under each of these modes, allowing reconciliation of both opposing aesthetic accounts and empirical findings. In addition, it seems that the range of 'natural' expressive responses relates to those functions which are modular in nature, being universal, mandatory responses and it is this modular nature of musical expression and cognition will be the main focus of part II.

Notes

[1] That is, emotions not varying in any significant way from emotions experienced in response to everyday events.

[2] John E. MacKinnon 'Expression and the Claims of Arousal Theory' p.278.

[3] Representational theories cover a variety of sub-categories of expressionism. These can be roughly divided into three groups, music imitating or otherwise representing: a) objects or causes of emotion b) people in an emotional state and c) The feelings associated with an emotion. The important distinction being that these are recognised without necessitating arousal.

[4] As I discussed in Chapter 1, describing musical emotions as 'objectless' reduces them to the status of moods or feelings, neither of which reflect the nature of musically aroused affective states, and neither category being any better defined than the category of emotions.

[5]Austin's concern was to distinguish between constative and performative speech acts, that is to distinguish between utterances where something is done rather than merely stated- in saying something we are actually doing something, as opposed to just 'fact-stating.'

[6] Goodman's concern lies with the *application* of expressive terms themselves to works of art as opposed to Tormey's concern with the syntactic form of such statements. This allows Goodman to avoid problems caused by ambiguous use of 'expression' in ordinary language which invariably undermine Tormey's account.

[7] For persuasive argument on this issue see Black, M 'Metaphor' Proc. Arist. Soc. (1954-5), Ortony A, (Ed.) *Metaphor & Thought* Cambridge, 1979; Davidson, D. 'What Metaphors Mean' in *Inquiries into Truth & Interpretation* Oxford 1984. I would agree with Black's interaction theory of metaphors - that they are variously interpreted by the reader/hearer. This replaces substitution theory (as advocated by Walton) as a literal paraphrase would have to command agreement amongst the community of language users as regards what it expressed.

[8] A further criticism here is that whilst discussing central application of emotion terms Matravers does not make it clear whether he is referring to third-person ascriptions of emotion or both first and third person ascriptions. John MacKinnon offers a fairly detailed critique of this point in Artistic Expression And The Claims of Arousal Theory (1996).

[9] See Speck, Arousal Theory Reconsidered, p.40.

[10] This might seem to contradict the responses of amusic subjects which do not require recognition of musical features. Although we have responses which are not dependent on recognition of musical features. We also have conventionalised responses to musical structures. E.g. cadences, harmonies and resolutions etc. & we can identify which aspects, or where in the music relates to emotional responses. Conceivably amusic subjects might be able to indicate when in a piece of music they feel particularly aroused, despite being unable to identify the musical structures at work.

[11] See Allen's discussion of this problem in The Arousal and Expression of Emotion by Music

[12] See Sloboda 1991 Lehmann, 1997 and my own empirical tests (Chapter 5). Listeners can identify emotion in music without feeling the emotions themselves, and measuring brain activity, heart rates, and skin temperature etc. can confirm that they are not physiologically experiencing any emotion whilst listening.

[13] In evolutionary terms it would hardly seem to be a well adapted survival aid if, in order to recognise and respond to emotions expressed by others, we were first required to feel and consciously identify emotions in ourselves.

[14] Matravers p.325 Art and the Feelings and Emotions

[15] This seems to be contradicted by empirical evidence that we may experience an emotion, and even respond to emotional stimuli without conscious awareness. See example of the split brain patient in Chapter 1 and discussion of nonconscious affect.

[16] Matravers, *Art And Emotion* p.140.

[17] See Empirical studies comparing emotional response to music and in everyday situations: W. Gaver & G. Mandler (1987) Play it again Sam: On Liking Music, *Cognition and Emotion* 1(3) 259-282.

[18] Robinson, The Expression and Arousal of Emotion In Music, *Journal of Aesthetics and Art Criticism* Vol. 52: 1, (1994) pp. 15-16.

[19] Robinson, "The Expression and Arousal of Emotion In Music" p. 18.

[20] Robinson, "The Expression and Arousal of Emotion In Music" p. 15.

[21]It might be argued that formal properties of music do not equate to primary acoustic properties of sound. While there are strong relationships between frequency and pitch, loudness and intensity, the former are objectively measurable properties of sound while the latter are subjective. There is no property 'pitch' which may be measured in an acoustic signal. And the subjectivity of 'loudness' for example, is reflected in the variation of sound (hearing) thresholds for individual subjects. Whilst one could refer to music's formal properties in terms of acoustic features it is commonplace to discuss them in terms of their subjectively perceived properties although we could very well refer to acoustic properties if necessary. Nonetheless, this point is worth bearing in mind for many account neglect to consider these issues and in such cases one might argue that music's formal properties are not in fact intrinsic properties of the music but are one stage removed, the disclaimer above may counter this objection in the present case, but this point shows that there may be some ambiguity in aesthetic discussion where the issue is neglected.

[22] Certainly Locke's own view has been both disputed and misrepresented over the years (specifically by Berkeley in The Principles of Human Knowledge). See Berkeley, Locke and Boyle. For further discussion of the distinction see: Bennett 1965; Smith A, D 1990: Averill 1982; Sandoe 1988.

[23] Hume, Treatise of Human Nature, bk.II. 8. p.299 in Selby-Bigge (ed.) 1978.

[24] I acknowledge here that there are some psychological experiments which play around with people's claimed colour perceptions (i.e. whether they say an object is blue or green). Nonetheless in normal conditions there is a marked consistency in the application of colour concepts.

[25] This would appear to be supported by the narrower range of applications for expressive predicates. As noted 4.1.3, although the application of expressive predicates has its own relatively fixed range of application in relation to artworks, this is still ultimately dependent on central reference of expressive terms to psychological and behavioural states. Descriptive terms do not have any ultimately 'fixed' central reference

[26] Pettit 1991 p.587. Significantly though musical chill responses are not human specific they are seen in other mammals and even in birds demonstrating that they result from something which is very primitive in evolutionary terms.

[27]For further replies to this objection see McGinn 1983, pp. 6-9; Johnston 1989, pp.147-148.

[28] I should stress here that I intend this interpretation of emotions as response dependent only in relation to non-sentient objects or events. I do not imply, for example, that sadness in general is response dependent.

[29] Subjects who have lacked exposure to particular auditory inputs, or for example, who have been deaf as children and subsequently regained their hearing may have different perceptual abilities from 'normal' listeners. See Ponton et. al, Snik et. al, and Sininger et.al. It might be questioned that there are notable differences between musicians and non-musicians in emotional responses. I feel however, that empirical evidence shows clearly that any difference is not at a level sufficient to warrant the claim that there are significant *perceptual* differences affecting the respective emotional responses. (Whether there are cognitive differences between musical and non-musical subjects will be dealt with in chapters 5-7).

[30] For further discussion of children's understanding of emotions see Tsukamoto 1997; Hala 1997; & Cutting 1999.

[31] In reply to Johnston however, it would seem that we may experience non-cognitive responses to music. Though perhaps this is only true to say when we are not attending to the music itself.

[32] Listeners should be susceptible to (experience) chills even if they do not consciously recognise them as such or identify them with specific emotional responses.

[33] It does seem unlikely that music which e.g., causes a strong positive affective response would be chosen to represent an event with negative emotional associations. Although, it is certainly true that 'happy' music which becomes associated with a tragic event may then take on strongly negative affective associations even to the extent of arousing sadness. It seems unlikely though that one would choose a piece which evoked a negative affective response if one wanted to convey a positive emotion. for example, a lullaby which produced a strongly negative chill response seems unlikely to be successful.

[34] In The Marriage of Figaro, Mozart used a tune from the 1750's which had remained as a popular tune with the public through to the 1780's to represent the arrival of rustic pipers. (This would have been something played at social events and therefore familiar to the audience.) See Allanbrook, *Rhythmic Gestures in Mozart*, p.143-44.

[35] Wolff (1983) p.105.

[36] Mostly this has been in relation to realism, supervenience and aesthetic properties. See for example, Mulder-Eaton, 1998; Bender 1987; Levinson, Goldman & Gould, 1994).

Part II

Music Cognition:

Autonomous Music Subsystems and Their Place Within Auditory Cognition and Perception

Chapter 5

Case Study: Dissociation of Music and Language Abilities in a Case of Severe Aphasia

5.1 Introduction

In this chapter I report the detailed study of a dissociation between language and music in a pre-morbidly musical patient. The patient presented with severe language difficulties (severe aphasia)as a consequence of extensive left hemisphere damage. Musical function remained intact and was investigated with a detailed music test battery which is described in full in 5.3. The tests administered can be broadly divided into three categories: perceptual, emotional and notational/symbolic. The findings suggest that complex musical processing is being undertaken by the right hemisphere due to the extent of left hemisphere damage, contradicting claims of left hemisphere dominance for music in musically sophisticated subjects which were discussed in Chapter 3. The findings also support a high degree of separability between music and language functions.

Over the last few years there have been a number of attempts to model music cognition and a lot of interest has arisen regarding music's role within larger models of mind. Although many such accounts do not claim to explain music processing systems themselves, they do nonetheless make inferences to the underlying cognitive architecture of auditory processing. Implicit in many accounts is a view of music as integrated with other auditory functions and ultimately dependent on language. Comparisons between music and prosodic aspects of speech are frequently made. As one author notes: "There are many similarities between prosodic communication and music. Infants respond to the rhythm, pitch intensity, and timbre of the mother's voice; all of which are part of music."[1] These shared surface features of music and language however, do not in any way legitimise inferring shared processing capacities. Such comparisons of music and prosodic features of speech lead to more general assumptions that melodic, rhythmic and emotional detection in music and speech are subserved by a general purpose auditory processing system.

The fact that music is not considered to play a vital role as a cognitive function is reflected in the small number of documented cases of musical damage and sparing, particularly if one compares with the number of case reports of aphasia. Documented cases usually involve subjects for whom music plays a central role, professional performers, music teachers or conductors. Recently however, spared and damaged musical function has been studied in both musicians and non-musicians in some detail. The main focus of studying the amusias (impairment of musical function by acquired brain damage) has been to establish hemisphere dominance for music cognition. However, both left and right hemisphere lesions have reportedly resulted in musical deficits, leading to contradictory claims for hemisphere lateralisation. This in turn has implications for music's relationship with language in terms of both physical localisation and functional separation.

5.2.1 Assessment of Language Abilities

Many of the musical and language tests administered relied on picture recognition, therefore the initial stage was to assess picture semantics, in order to establish that the patient could access semantic-conceptual knowledge from pictures. We used The *Pyramids and Palm Trees* Test (3 picture version) for this purpose. MR scored 46/52 which is just on the boundaries of normal range, showing no significant deficit in semantic picture processing.[3] Assessment of language abilities across four modalities of language use (comprehension of speech, speaking, reading and writing) revealed marked impairments at both lexical and sentence processing levels. Reading and writing were severely limited at both lexical and sentence levels. In speech input and output, sentence processing was impaired to a greater degree than lexical processing. A full summary of specific test results is given (Table 5.1).

Table 5.1 Results of Language Assessment Across Modalities.

MR Language Test Results (Feb/March-99)	
Picture Recognition & Semantics	
BORB Object decision	60/64
Pyramids & Palm Trees (3 picture version)	46/52
Lexical Input	
Auditory:	
PALPA spoken word-picture match	33/44
Pyramids & Palm Trees (3 word version)	47/52
Semantic verification task (it's a...with target/semantic distracter/unrelated distracter)	117/123
Orthographic:	
PALPA written word-picture match	31/40
Lexical Output	
Spoken:	
PALPA spoken picture naming	24/60
High Frequency	6/20
Medium Frequency	7/20
Low Frequency	11/20
Written:	
(High frequency set)	1/20
Sentence Processing	
Input:	
Auditory:	
PALPA spoken sentence-picture match	36/60
Orthographic:	
PALPA written sentence-picture match	5/20
Output	
Spoken:	Little evidence of productive syntax
Written:	Not formally assessed
Short-term Memory Span	
Digit Span Recognition test	3 items
Visual Span Corsi blocks	5 items

Test references are given below: Appendix III.1.

To provide an overview of MR's language impairments, the results are summarised in Figure 5.2. MR showed moderate to severe impairment on all modalities.

Comprehension

Auditory comprehension Moderate impairment	Reading comprehension Severe impairment
Speech Severe impairment	Writing Severe impairment

Lexical Processing

Auditory lexical input Moderate impairment	Orthographic lexical input Moderate impairment
Spoken lexical output Moderate/severe impairment	Written lexical output Severe impairment

Sentence Processing

Auditory sentence input Moderate impairment	Orthographic sentence input Severe impairment
Spoken sentence output Severe impairment	Written sentence output Severe impairment

Fig. 5.2 Summary of MR's Language Impairments

5.3 Neuropsychological Assessment of Retained Musical Abilities

General Methods and Procedure.

The test battery described here was developed for this single case study, investigating dissociation of language and musical abilities in a pre-morbidly musical (and musically literate) subject with severe aphasia. Restrictions were placed on the nature of response mode by MR's expressive deficits. However, the choice of non-linguistic response modes was also motivated by a desire to separate music and language processing wherever possible, in keeping with criticisms raised regarding current hypotheses concerning the functional and physiological autonomy of music and language cognition.

The patient also had a right hemiplegia and tests were targeted at receptive music abilities as the hemiplegia affected the preferred hand (right). Thus any attempts to evaluate expressive performance were confounded by the presence of this movement disorder. However, MR had shown retained singing abilities and it appeared that some expressive abilities remained intact.

A set of 17 sub-tests were developed, targeted at musically literate subjects (Table 5.2). As a guide, the level of difficulty ranged from grade 1 ABRSM[4] tests to diploma level aural discrimination tests which may be equated with tasks undertaken by professional musicians. The tests were divided into three categories, perceptual, emotional and notational/symbolic. Comprehension of musical vocabulary was also tested. Test results are given in each of these categories, in addition to a full summary and discussion of results in 5.4

Unless otherwise stated in test descriptions, all excerpts were composed in western tonal idiom and played on keyboard or taken from professional recordings. Excerpts were recorded onto audio-cassette and quantized to remove possible performance errors. All examples were recorded using a stereophonic cassette recorder. Transcriptions were provided for practice trials and tests were presented in an environment free from other auditory distraction and at a volume comfortable for the listener.

Table 5. 2 Summary of Tests and Categorisation.

Perceptual	Symbolic/Notational	Emotional
Sound source discrimination	Score reading and error detection.	Matching musical examples to human expression of emotion.
Detection of pitch change and direction	Recognition of excerpts in notational form	
Melodic contour discrimination	Discrimination of musical/non-musical symbols	
Tempo discrimination	Ordering musical words	
Chord analysis	Ordering musical symbols	
Rhythm discrimination	Identification of note/rest values	
Discrimination of musical Instruments	Completion of dynamic markings	
Type classification	Completion of familiar and novel melodies	

Administration

Where aural examples were presented, standard procedures were followed. A stereophonic cassette player was used and the subject was seated at a table, with speakers placed at appropriate positions. Volume and tone levels were maintained throughout test sessions. Instructions were repeated during the test as necessary or as requested by the subject. The inter-trial intervals stated below are given as a guide for response times and overall duration of each test. Where the subject was unable to complete the answer within the given time, the cassette was stopped until an answer was offered or subject was unable to offer a response. Where musical scores were provided these were presented such that the whole score was open to view during testing. Further details specific to individual tasks are detailed below.

5.3.1 Experimental Investigations: Tests of Perceptual Discrimination.

Experiment 1: Sound Source Discrimination

Materials

A cassette containing extracts of music, speech and environmental sounds was recorded. Stimuli were taken from professional recordings of music, environmental sound effects and language test batteries. Full references of recorded extract are provided below in Table 5.3 Stimuli included a further subset of 'borderline' examples: e.g. Sprechtstimme[5], music incorporating environmental sounds, and speech within the environment. These extracts have been taken out of their normal context and therefore involve finer levels of discrimination, having the possibility of being ambiguously interpreted. The set of 44 excerpts were recorded onto audio-cassette, 11 from each subset. Mean duration of extracts was 4.91 seconds.

Recording parameters (volume, tone, and sound quality) remained constant across the set. Stimuli were between 1 and 8 seconds duration and excerpts for practice trials were taken from each of the 4 categories. Stimuli were presented in random order with an inter-trial interval of 8 seconds.

Procedure

The purpose of this task was to assess discrimination and classification of sound sources. The task was to match each extract to a pictorial representation of the source. Response choices are shown in Fig 5.3 a-c. Four practice trials were given, with unlimited repetitions of each excerpt. On subsequent trials excerpts were played once only. Only spontaneous self-corrections were allowed.

Table 5.3 Sound Source Discrimination: List of Recorded Excerpts. See Appendix III.2 for full details of excerpts.

'Borderline' Sounds	Environmental Sounds
1. Sprechtstimme (Speech/Music)	12. Water: Running
2. Piano (Birdsong.) (Music/Environmental)	13. Telephone: Ringing
3. Clapping Music (Music/Environmental)	14. Bell
4. Humming (Music/Environmental)	15. Dog Barking
5. Barrel Organ (Music/Environmental) -	16. Hammering
6. Football Match -Crowd (Speech/Environmental)	17. Laughter
7. Canary Singing (Music/Environmental)	18. Traffic
8. Musical Box (Music/Environmental)	19. Dishes Breaking
9 Restaurant- Light Chatter (Speech/Environmental)	20. Sheep & Lambs
10. 'Come Out' tape loop Steve Reich, (Music/Speech)	21. Fire crackle
11. Orchestra Tuning (Music/Environmental)	22. Swimming Pool:
Speech	**Music**
23. Woman's voice	34. Choral
24. Man's voice	35. Children singing
25. Child's voice	36. Jazz
26. Woman's Voice: 'Division'	37. Orchestral
27. Woman's voice 'Frown' (Synthesised & pitch violated)	38. Solo Instrument (Flute)
28. Woman's Voice Nonsense Word 'Homster'	39. Female solo voice
29. Man's Voice	40. Male solo voice
30. Man's Voice 'it's gonna rain' Cassette Loop	41. String Quartet
31. Woman's Voice Nonsense Word 'bis'	42. Contemporary Pop
32. Man's Voice: (Tennis Umpire)	43. 20th Century Classical
33. Woman's Voice: Nonsense word 'Squirren' (distorted)	44. Orchestral

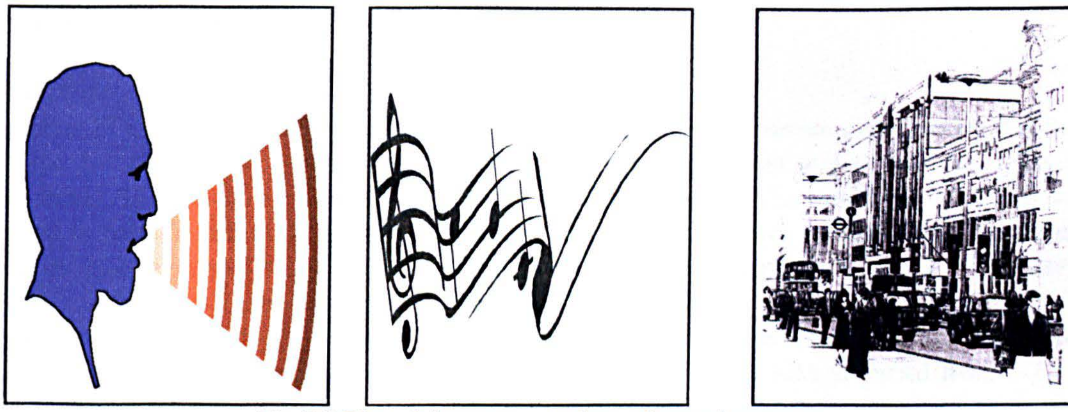


Fig 5.3 Pictorial representations of sound sources:
a) Speech b) Music c) Environmental sounds.

Experiment 2: Detection of Pitch Change and Direction

Materials

A set of 28 musical excerpts (including 3 practice trials) was recorded onto audio-cassette. Each excerpt consisted of a sequence of 2 tones, each 1.5s duration. The set was constructed using intervals ranging from a semitone to 2 octaves, (pitches ranged from F to d'''). Examples were played on a keyboard and recorded onto audio-cassette, with recording parameters constant across the set. 8 'Higher pitch', 9 'Same pitch', and 8 'Lower pitch' sequences were presented in random order. Each excerpt was repeated once after a 4 second pause and an inter-trial interval of 8 seconds.

Procedure

After presentation of each excerpt, the task was to determine whether the second note of the two note sequence was higher, lower or the same pitch. Each sequence was played twice. Response mode was from a fixed choice of musical representations (Fig. 5.4), and written notation (Fig. 5.5) was provided to accompany practice trials. Full transcription of all extracts are given in Appendix IV.1. Although a set inter-trial interval of 8 seconds was pre-recorded, extra time was allowed between excerpts if necessary.

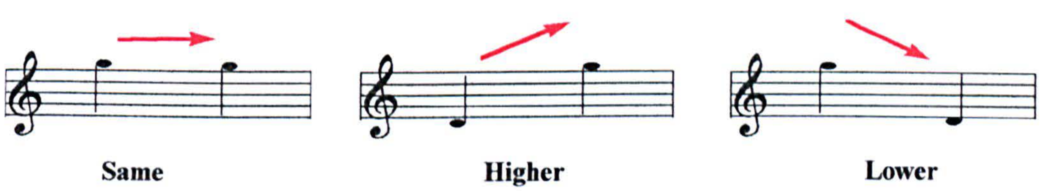


Fig 5.4 Choice of musical representations given as response mode

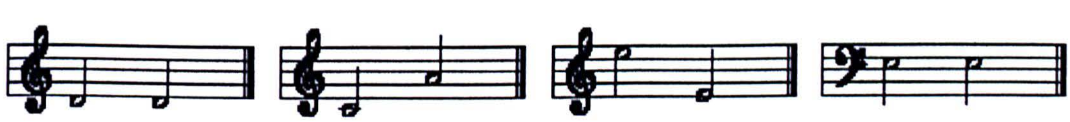


Fig 5.5 Transcriptions of excerpts as provided to accompany practice trials 1-4.

Experiment 3: Melodic Contour Discrimination

Materials

A set of 24 excerpts (including 2 practice trials) was recorded. Excerpts were constructed from simple 2-4 bar melodic phrases in western tonal idiom varying in tempo, key and rhythmic structure.[6] 12 extracts were repeated to form a 'same' subset. The remaining excerpts were varied to form a 'different' subset. Variations to melodic structure included contour-violated and contour-preserved transformations (see transcriptions of examples 6 and 9 in Appendix IV.2). Other parameters, rhythm, tempo dynamics etc. remained fixed. Mean duration of excerpts was 5.17 seconds (range 3.5-9 seconds) and melodies were varied at different points (e.g. beginning, middle and end of excerpt). The number of notes altered varied from 1-7 and the range of alterations from 1 semitone to 1 octave. Excerpts were quantized to remove performance errors which might lead to perceived rhythm/tempo variations. Same/different trials were presented in random order.

Procedure

The subject was presented with a target melody followed by a comparison melody after a 4 second silent interval. The task was to determine whether the melody of the two extracts was the same or different. The subject was required to select one of two pictorial response choices. One depicted identical melodic contours (Fig. 5.6A), the second different melodic contours (Fig. 5.6B). Two practice trials were given with unlimited repetitions of excerpts. Transcriptions were provided to accompany practice trials (Fig. 5.7). On trials, 1-2 repetitions were allowed on request. Full transcriptions of excerpts are provided in Appendix IV.2.

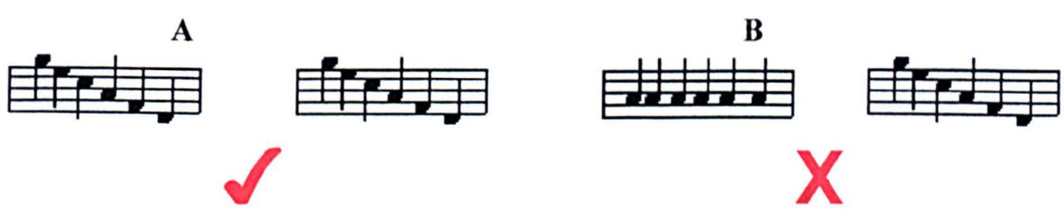


Fig. 5.6 Same/different pictorial response choices

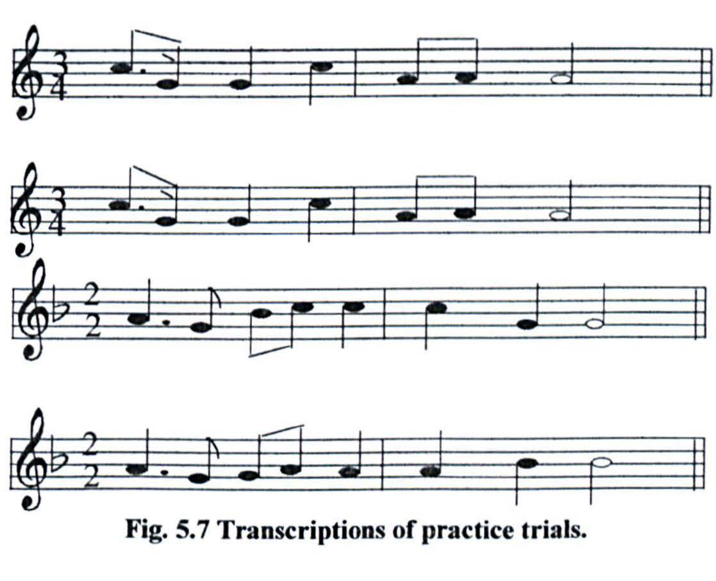


Fig. 5.7 Transcriptions of practice trials.

Experiment 4: Tempo Discrimination

Materials

A set of 24 examples, including 2 practice trials, was recorded onto audio-cassette. Excerpts were constructed using 2-4 bar melodies in western tonal idiom (excerpts were drawn from ABRSM Aural tests Allchin & Read Grades I-V). Half the trials were repeated to form a 'same' subset of comparison melodies. The remaining half were varied either faster or slower in tempo to form a subset of different comparison melodies. Target melodies were followed by comparison melodies after a 4 second silent interval Excerpt length ranged between 3 and 10 seconds (mean duration 6.02 seconds). Inter-trial interval was 8 seconds. Other parameters remained fixed and excerpts were pre-recorded in random order. Full transcriptions are given in Appendix IV.3.

Procedure

Target melodies 2-4 bars long were presented, followed by comparison melodies. The task was to determine whether the two extracts had the same or different tempo. (Tempo is defined as *overall* duration as opposed to variation of rhythm which refers to temporal variations of structures *within* the excerpt). Response mode was from a fixed choice of pictorial representations for same/different tempo (Fig. 5.8). Transcriptions were provided for both practice trials including metronome markings which were also verbally presented (Fig. 5.9). Excerpts were repeated 1-2 times on request.

Fig. 5.8 Same/Different response choices.

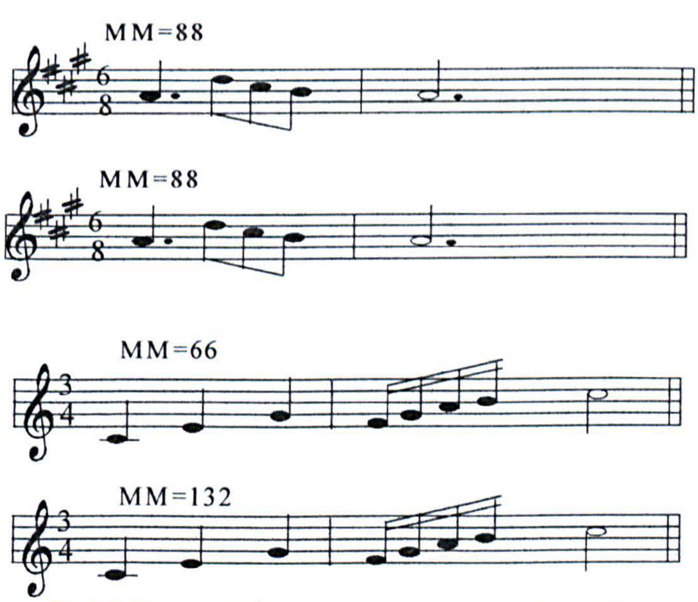


Fig 5.9 Transcriptions accompanying practice trials.

Experiment 5: Chord Analysis

Materials

A set of 25 excerpts (including 3 practice trials) were recorded onto audio-cassette. Stimuli consisted of single, two or three note tone sequences (8 seconds duration). Both consonant and dissonant chords and intervals were used. Subsets consisted of nine single note excerpts, nine 2 note chords and seven 3 note chords. Pitches ranged from F to d''. Excerpts were played on keyboard, quantized and recorded onto audio-cassette. Other parameters - dynamics and tempo remained constant across the set. Excerpts were pre-recorded and presented in random order. Full transcriptions of extracts are given in Appendix IV.4.

Procedure

The subject was presented with a tone sequence consisting of a single note or chord (4s duration), repeated after a 2 second silent interval with an inter-trial interval of 6 seconds. The task was to identify whether the tone sequence consisted of 1, 2, or 3 notes. Response mode was from a fixed choice of musical representations of 1, 2, or 3 notes (Fig. 5.10). 3 Practice trials were given with unlimited repetitions. Transcriptions provided to accompany practice trials are detailed (Fig. 5.11). On trials, only one repetition was given (as pre-recorded).

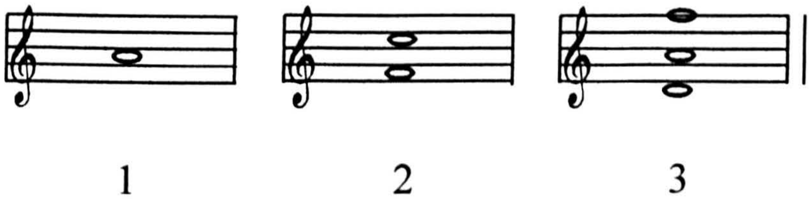


Fig. 5.10 Representations offered as response mode

Fig. 5.11 Transcriptions accompanying practice trials.

Experiment 6: Rhythm Discrimination 1

Materials

A set of 24 excerpts was created, including 2 practice trials, and recorded onto audio-cassette. Excerpts were 2-4 bars long (mean duration 6.21 seconds) and rhythmic patterns were based upon western tonal idioms. Excerpts were played on a fixed pitch (concert A) so rhythm was the only variable. Target and comparison sequences[7] were separated by a 2 second silent interval. Inter-trial interval was 10 seconds. Sequences were varied at different points (e.g. beginning, middle and end of excerpt). Rhythmic variations ranged from gross distortions, where several changes in rhythm were made throughout the sequence, to rhythmic changes involving only 2 notes. Excerpts were quantized to remove performance errors which might lead to perceived rhythm/tempo variations. Same/different trials were presented in random order. Full transcriptions are given in Appendix IV.5.

Procedure

The subject was presented with recordings of rhythmic sequences in the following format: a target sequence followed after a 2 second silent interval by a comparison. The task was to identify the second sequence as same/different for rhythmic content. The subject was required to select one of two pictorial response choices. One depicted identical rhythmic structure, the second different rhythmic structure (Fig. 5.12). Transcriptions were provided for practice trials and unlimited repetitions permitted. On trials, repetitions were offered on request and spontaneous self-corrections were allowed.

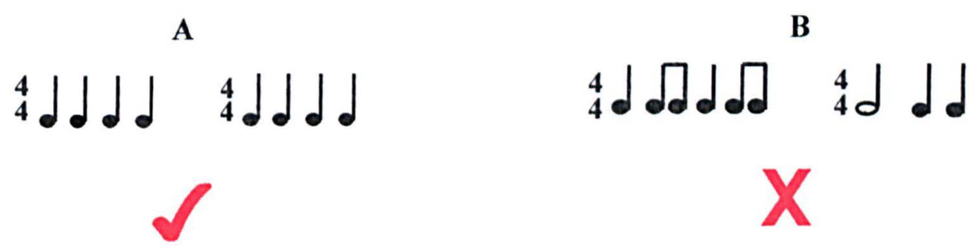


Fig. 5.12: A 'Same '& B 'Different' Response choices.

Experiment 7: Rhythm Discrimination 2

Materials

A set of 24 excerpts including 2 practice trials was recorded onto audio-cassette. Excerpts were 2-4 bars long (mean duration 6.10 seconds) and rhythmic patterns were based upon western tonal idioms. Examples were divided into 4 subsets: (1) Melody & rhythm same, (2) Melody varied, (3) Rhythm varied, (4) Melody and Rhythm varied. Sets (1) and (2) forming a 'same' rhythm subset, sets (3) and (4) a 'different' rhythm subset. Other parameters remained constant across the set. Target and comparison melodies were separated by a 2 second silent interval. Inter-trial interval was 10 seconds. Rhythmic and melodic variations ranged from gross distinctions, where several features were altered, to rhythmic/melodic changes alterations to one note only.

Procedure

The subject was presented with two successive tunes, a target melody followed after a 2 second silent interval by a comparison melody. The task was to identify the second melody as same/different for rhythmic content. The subject was required to select one of two pictorial response choices. One depicted identical rhythmic structure, the second different rhythmic structure. (As above, Fig. 5.12). Transcriptions were provided for practice trials and unlimited repetitions permitted. On trials, repetitions were offered on request and spontaneous self-corrections were allowed. Full transcriptions are given in Appendix IV.6

Experiment 8: Discrimination of Musical Instruments

Materials

A cassette of 14 musical excerpts was recorded, taking examples of familiar musical instruments from professional recordings in western tonal tradition. Excerpt length ranged from 13-19 seconds (mean duration 14.29 seconds) and were followed by a 12 second inter-trial interval. Recording parameters were constant across the set. Excerpts were presented as ordered below, Table 5.4

Procedure

Recorded excerpts were presented once only. The task was to identify musical instruments by indicating the correct pictorial representation of sound source. Response mode was multiple choice from fixed sets of 4 pictures of musical instruments. Response choices are detailed in Appendix IV.7. Distracter items varied in difficulty from gross distinctions between categories of instruments e.g. woodwind and brass, to discrimination between particular types of brass/stringed instruments. No practice trials were given.

Table 5.4 See Appendix III.3 for full list of recorded examples.

Instrument Discrimination: Examples in order of presentation	
1. Clarinet	8. Viola
2. Piano	9. Harp
3. Bassoon	10. Violin
4. Flute	11. Horn
5. Guitar	12. Trumpet
6. Harpsichord	13. Oboe
7. Drums	14. Recorder

Experiment 9: Type Classification

Materials

A cassette containing 26 extracts was recorded. Examples were taken from professional recordings and divided into 13 musical categories exemplifying different genres and cultural styles, with two examples being taken from each category. Excerpts were between 12 and 16 seconds duration (mean duration 14.92 seconds) with an inter-trial interval of 12 seconds. Examples were divided into the following categories: Jazz Quartet, Jazz-Big Band, Chinese, Hungarian, Opera, Indian, Gamelan, 'Orchestral' (classical western), 'Ballet', Rock/Pop, Schubert-Lieder, String ensemble (Quartet/Quintet), Flamenco.

Procedure

The subject was presented with recorded excerpts in the order given in Table 5.5. The task was to identify the correct musical genre from a fixed choice of 4 pictorial representations (response choices are documented in Appendix IV.8). Level of difficulty ranged from gross distinctions e.g. Flamenco/Jazz, to more subtle discriminations requiring recognition of orchestration and some musical knowledge e.g. Jazz band/Jazz quartet or Gamelan/Indian instrumental music. No practice trials were given.

Table 5.5
See Appendix III.4 for full details of recorded examples.

Type Classification Excerpts in Order of Presentation	
1. Jazz Quartet	14. Opera
2. China	15. Indian
3. Hungarian	16. Flamenco
4. Flamenco	17. Schubert
5. Indian	18. Opera
6. Orchestral	19. Jazz -big band
7. Gamelan	20. Ballet
8. Ballet	21. Hungarian
9. China	22. Rock/Pop
10. Rock/Pop	23. Jazz quartet
11. String Quartet	24. String Quartet
12. Orchestral	25. Gamelan
13. Schubert	26. Jazz-big band

5.3.2 Results & Discussion

All results are listed in Table 5.6, MR performed well on the perceptual tests. He showed no problem discriminating between sound sources,- response time was very fast, if not immediate. MR spontaneously engaged in rhythmic tapping, and some physical movement in time to music, and showed recognition of musical types/genres/specific pieces and composers, identified in many instances after hearing only a short (0.5 second) burst of the excerpt. There were no difficulties with recognition of response modes given in musical notation. On many occasions, MR offered a more detailed response than required, indicating the location and nature of errors in addition to same/different classification.

Table 5.6 Results of Perceptual Discrimination tests

Perceptual Tests	**Scores**
Sound source discrimination (music, speech, environmental sounds)	**40/41**
Detection of pitch change and direction (pair of sounds -is second	**25/25**
Melodic contour discrimination (two melodies, same/different judgement)	**19/22**
Tempo discrimination (two melodies -same/faster/slower judgement)	**19/22**
Chord analysis (identification of no. of notes 1/2/3 in a chord)	**25/25**
Rhythm discrimination 1 (two melodies -same/different judgement)	**20/22**
Rhythm discrimination 2 (two melodies -same/different judgement)	**16/28**
Discrimination of musical instruments (multiple choice picture matching)	**14/14**
Discrimination of type of music (multiple choice picture matching)	**24/25**

The result on Rhythm discrimination task 2 deserves some comment as this falls below the level of performance on other perceptual tests. This task involved discrimination of rhythmic changes according to four subcategories, (1) Melody & rhythm same, (2) Melody varied, (3) Rhythm varied, (4) Melody and Rhythm varied. On other discrimination tasks administered up until this test, only one dimension of the music was varied, e.g. *only* rhythm, melody, pitch direction etc. It is possible MR misinterpreted the task demands or followed a conditioned response to listen for change in one musical dimension only. This was also one of the more difficult perceptual tests, so it is quite possible the lower score merely reflects task difficulty and MR may fall well within normal response range.

5.3.3 Symbolic Tests

Experiment 1: Score Reading: Error Discrimination

Materials

An edited version of the reduced score piano/clarinet version[8] of Mozart's Clarinet concerto K622 was created to include 15 errors in notation (and 4 example errors); 11 changes in pitch, 3 changes in rhythm, 3 changes of pitch and rhythm; and 2 changes in dynamics.

Procedure

The task was to identify written errors by listening to a correct performance of the music. The subject was supplied with the total number of errors present on each page of the score and the nature of errors e.g. dynamics, melodic, rhythmic etc. (Information regarding type of errors present did not correspond to order of their presentation). Unlimited repetitions were allowed due to the difficulty of the task. Responses were given by marking errors detected on the score. Full transcriptions of both the original score and edited version are provided in Appendix IV.9

Experiment 2: Identification of Excerpts in Notational Form

Materials

14 Excerpts 1-2 bars long (Table 5.7) were taken from a professional recording of Nielson's Violin Concerto 1st movement (Largo). Excerpts were recorded onto audio-cassette,[9] and in addition a separate recording of the whole 1st movement was provided. The score was provided, printed on single sided sheets such that the whole score was open to view during listening. The full score and list of excerpts is given in Appendix IV.10. Response mode was to indicate one location on the score where the excerpts were taken from.

Table 5.7 Notation Identification Task, Excerpts from Nielson's Violin Concerto

Excerpts in Order of Presentation	
1. Bar 1	8. Bars 18-21
2. Bars 13-14	9. Bars 29-30
3. Bars 31-32	10. Bars 10-11
4. Bars 24-25	11. Bars 26-27
5. Bars 47-48	12. Bar 7
6. Bar 38	13. Bars 16-17
7. Bars 4-5	14. Bar 34

Procedure

The subject was first played the complete extract, (1st movement of the concerto), then each of the target excerpts were presented (pre-recorded in random order as in table 5.7). Target excerpts were presented in aural form only and not accompanied by transcriptions other than the complete score provided. The subject's task was to read the score and identify the location of heard excerpts recorded excerpts by indicating the correct bar or bars. The target excerpts were initially presented twice, though unlimited repetitions were allowed due to the difficulty of the task and other processing skills required.

Experiment 3: Discrimination of Musical/Non-Musical Symbols.

Materials

A set of 24 picture cards was created. The set divided into 2 subsets: 12 standard musical symbols and 12 non-musical symbols: mathematical symbols, letters of the Greek alphabet, punctuation marks etc. (Table 5.8).

Procedure

Cards were presented in random order. The subject's task was to identify symbols on presentation, as musical or non-musical by reference to pictorial representations Fig.5.13. The purpose of this task is to examine recognition of musical symbols out of context. No practice trials were given.

Table 5.8 Musical and Non-Musical symbols

Musical Symbols	Non-Musical symbols
𝄢	⌑
8va..........	❧
♭	√
dim. ⟩	╣
♯	%
𝄾	⧉
tr~~~~~~~~	⊘
♮	£
ff	¶
𝄞	✣
p	⑊
:‖	π

A B

Fig 5.13: A Musical & B Non-Musical Symbols.

Experiment 4: Ordering Musical Symbols

Materials

3 sets of picture cards were created showing sets of ordered musical symbols. Dynamic markings (8 items), Musical Notes (7 items), and Rests (7 items). Dynamic markings ranged from quiet to loud, and notes and rests in order of duration. Symbols were pictured as they would typically be found in a musical score (e.g. dynamic markings given in italics). (Table 5.9)

Procedure

Each set was presented in random order, the task was to order these correctly, e.g. ppp, pp, p, mp, mf, f, ff, fff. (or reverse order). No time limit was placed on responses.

Table 5.9 Musical symbols in order of duration/Dynamic Strength.

Dynamics	Notes	Rests
ppp	𝅝	𝄻
pp	𝅗𝅥	𝄼
p	♩	𝄽
mp	♪	𝄾
mf	𝅘𝅥𝅯	𝄿
f	𝅘𝅥𝅰	𝅀
ff	𝅘𝅥𝅱	𝅁
fff		

Experiment 5: Identifying Note/Rest Values.

Materials

A set of picture cards was created, with a written set of 6 different values, - 1/8, 1/4, 1 2, 3, 4. Scores were provided containing a variety of notes and rests with values (duration in beats according to correct metre) corresponding to the picture cards. (2 practice trials were given for one note, and one rest value.)

Procedure

The subject was presented with cards in random order, the values given on cards (e.g., 1, 3, 1/4) were also presented verbally. The subject was asked to identify in the score either notes or rests corresponding to the given value (number of beats in correct metre). For example, when presented with a value 1, and a score in 4/4 (4 beats per bar) the subject was required to identify a crotchet note (value 1 beat). Spontaneous self corrections were allowed. (See Appendix III.5 for full references). The task could not be completed by simple matching as it required conversion of a numeric value in terms of musical notation.

Experiment 6: Completion of Dynamic Markings

Materials

Three pieces for clarinet and piano, of similar style and approximate length, were chosen. Weber Grand duo Concertant op.48 Movement 1 (bars 1-69), Brahms clarinet sonata Op.120 No.2 Movement 1 (bars 1-47), Poulenc Clarinet sonata Movement 1 (bars 1-44). All three pieces had widely varying dynamics within the sections chosen. Excerpts from these were recorded onto audio-cassette. (See Appendix III.6 for full references).

Edited versions of the scores were created with missing dynamic markings. Some dynamic markings were left intact to provide reference points (see Appendix IV.11).

Procedure

The task was to indicate appropriate dynamic markings for those missing after presentation of correct performance of each work. A choice of dynamic markings was provided: ppp, pp, p, mp, mf, f, ff, fff. Transcriptions are given, Appendix IV.11.

Experiment 7: Completion of Familiar/Novel Melodies

Materials

A set of 22 2-4 bar melodies was constructed (including 2 practice trials): half were familiar melodies (Table 5.10), the remaining half were novel melodies constructed in western tonal format. All excerpts were played on keyboard, quantized and recorded onto audio-cassette. Edited transcriptions of excerpts were created (Fig. 5.14) with missing notes indicated by an asterisk.

Procedure

Subject was presented with excerpts as pre-recorded in random order. The task was to fill in the missing notes after listening to each excerpt. Transcriptions were provided with missing notes indicated (Fig. 5.14). Difficulty of excerpts increased progressively requiring completion of up to five missing notes. Excerpts were initially played twice with further repetitions on request. Transcriptions are given Appendix IV.12. Self corrections were allowed on subsequent hearings.

Table 5.10

Familiar Melodies	
1. Rule Britannia	7. Ode to Joy
2. God Save the Queen	8. William Tell Overture
3. Frere Jacques	9. Happy Birthday
4. Eine Kleine Nachtmusik	10. Jingle Bells
5. Greensleeves	11. Bocherini Minuet
6. Brahms Lullaby	

Fig. 5.14 Response Mode as presented with missing note indicated

5.3.4 Results & Discussion

The symbolic tests were more complex and demanding due to the length of musical excerpts (up to 5 minutes) and accompanying scores. This placed extra demand on auditory memory and also motor co-ordination required for page turning. Full summary of scores is given below in Table 5.11.

Table 5.11 Summary of Test Results

Notational/Symbolic Discrimination Tests	Score
Discrimination of musical and non-musical symbols	24/24
Score reading: error discrimination	10/15
Score reading: identification of heard excerpts in notational form	9/14
Identifying note values (within a score)	10/10
Ordering musical symbols	22/22
Completing dynamic markings within a score	20/28
Completion of familiar & novel melodies:	51/62
Familiar	24/28
Novel	27/34

Table 5.12: Breakdown of Scores for Melody completion task.

Number of notes to complete	Familiar Melodies	Novel Melodies	Total Score
1	2/2	4/4	**6/6**
2	4/6	2/2	**6/8**
3	5/6	6/6	**11/12**
4	¾	10/12	**13/16**
5	10/10	5/10	**15/20**
Total Score	**24/28**	**27/34**	**51/62**

Again, MR performed very well on these tasks. Errors on the score reading tests were close to target, usually showing selection of bars with similar melodic line or orchestration to the target section. On experiments 2 (Identification of excerpts in Notational form), 6 (Completion of Dynamic Markings), and 7 (Completion of Familiar/Novel Melodies) although unlimited hearings were allowed, MR frequently gave decisive responses, some on the first hearing, the maximum number of hearings being 8. Expressive tasks, (completion of dynamic markings, and completion of familiar and novel melodies) were well performed. MR did not appear to be relying on theoretical music knowledge (e.g. typical patterns and constructions used western tonal music). This is supported by the fact that MR attended to auditory cues, preferring to hear excerpts again rather than studying the score during inter-trial intervals. In addition performance on familiar and novel melodies was comparable, (See table 5.12) including those which deviated from normal tonal progressions.

5.3.5 Emotion Recognition and Discrimination

Emotion Recognition Experiment 1

Materials

Examples were selected by running pilot tests on musicians and non-musicians to assess levels of consensus regarding emotional classification of pieces (both descriptive classification and arousal of emotion.). As a result of pilot testing, a set of 20 examples was constructed, consisting of 14 musical examples with pre-existing emotional labels (e.g., in existing critical commentary), 2 environmental sound excerpts with musical content, and 4 musical excerpts with no existing emotional labels (Table 5.13). Agreement that the pieces represented the specified emotions was then reached by two professional musicians (a performer and a composer), and by four non-musicians.[10] For 6 of the extracts, 100% agreement was reached that they expressed the stated emotions. The remaining 8 extracts listed below did not reach 100% agreement, however a high degree of consensus (5/6, 83.33%) was still obtained. Mean duration of excerpts was 44.7 seconds. Excerpts were separated by an inter-trial interval of 15 seconds. (Details of pilot testing are given in Appendix V)

Procedure

This test required the subject to indicate the emotional content (or lack of emotional content) of extracts by choosing one of 5 facial representations of emotion: Happiness, sadness, anger, fear/surprise, neutral (Fig. 5.15).

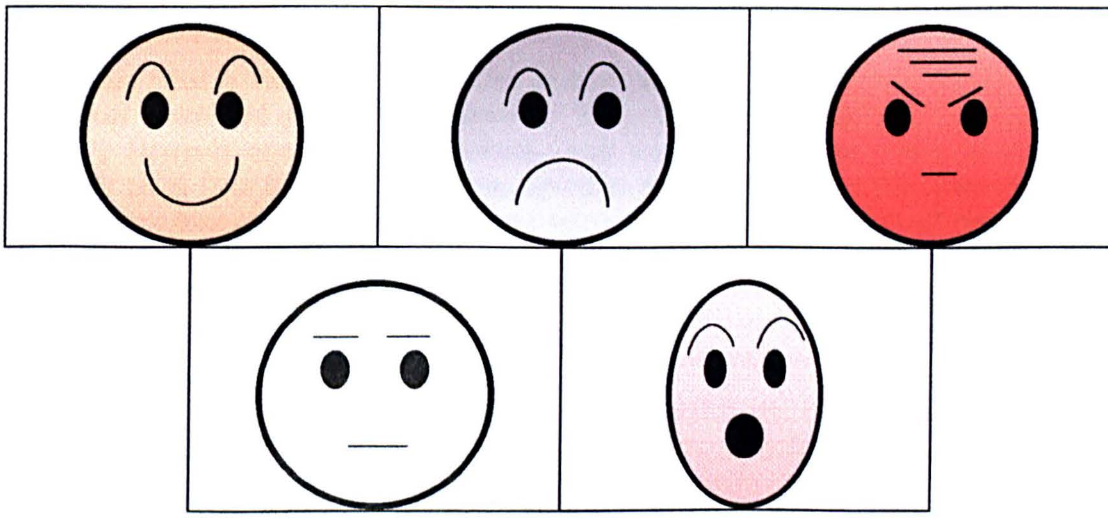


Fig. 5.15:
Representations of Facial Expressions of Emotion.

Table 5.13: List of Recorded Excerpts: See Appendix III.7 for full references.

Recorded Excerpts in Order of Presentation.

1.	Jools Holland: Lost Chord	11.	Debussy: Clair de Lune
2.	Philip Glass: Facades	12.	Steve Reich: Drumming Pt. 3
3.	Saint-Saens: Carnival of the Animals, Finale.	13.	Holst: Planet Suite, Mars
4.	Birdsong: Canary Singing	14.	Beethoven Eroica, 2nd Movement
5.	Penderecki: Threnody for the Victims of	15.	Julian Butcher: Untitled
6.	Jamiroquai: Travelling Without Moving,	16.	Dukas: Sorcerers Apprentice
7.	Schubert: Standchen	17.	Mozart: Piano concerto No. 21,
8.	Dave Brubeck: Take Five	18.	Holst: Planets Suite, Jupiter
9.	Mussourgsky: Night on The Bare Mountain	19.	Shostakovich: 10th Symphony 3rd
10.	Sound effects: Barrel Organ	20.	Prokofiev: Peter and The Wolf.

Emotion Recognition: Experiment 2

Materials and Procedure

A repeat of the Peretz emotion recognition test (Peretz, Gagnon & Bouchard, 1998) was administered. (We used the natural version of the test set: un-synthesised excerpts taken from professional recordings) Mean duration 15.8seconds, range 7 seconds to 33 seconds. This test involved discrimination between a set of 32 excerpts previously rated as 'sad' or 'happy.' The purpose of this test was to compare MR's performance with amusic and normal subjects and to establish his ability to recognise musical emotion and discriminate between felt emotion and emotional description of works. The subject was required to describe pieces as sounding 'sad' or 'happy' by choosing one of 2 facial representations of emotion as given above in Fig. 5.15. Excerpts were presented twice only, with a 6 second inter-trial interval.

5.3.6 Results and Discussion

Results are listed in Table 5.14. In the first emotion recognition test MR was 'correct' on only 2/6 pieces which had gained 100% consensus in the pilot study, with 'sad' pieces rated as 'happy'. However, emotional tests obviously carry a subjective element. Samples used were primarily taken from the classical western repertoire which MR dislikes. It seems likely that there is some bias towards liked/disliked extracts which influences emotion-labelling and MR may have shown a tendency to describe excerpts as he thought others (who enjoy such works) would classify them. Nonetheless, MR performed well on the Peretz test, scoring 30/32. This is represented as a percentage score of 94%, compared to Peretz's amusic subject, 97% and control subjects 94%, MR's score being equivalent to control subjects.[11]

MR did show a clear distinction between his own musical tastes and what he thought were 'expected' or 'typical' classifications of emotional content. In addition his use of expressive gestures to describe music was good and comprehension of expressive elements of communication seem unimpaired suggesting there is no deficit in emotion recognition for music.

Table 5.14: Summary of Results

Emotion Recognition Tests	Score
Emotion Recognition Test (Multiple choice picture matching)	11/20
Peretz Emotion Recognition test (natural subset)	30/32

5.3.7 Linguistic Comprehension of Musical Vocabulary

In a further two experiments, we investigated linguistic comprehension of musical vocabulary which seemed well preserved in light of other language deficits. Whilst also testing identification of musical features, etc., these were not encapsulated musical tasks.

Experiment 1: Identifying parts of the Score

Materials
Names of parts of a score (e.g. violin line, divided strings), and features of musical notation (e.g. Bass clef, key signature) were presented verbally in the order given below (Table 5.15). Sections of a score were selected in which all the listed features appeared on 3 pages, which were presented in isolation. This design was intended to limit the demands of visual processing required to locate items, and to minimise time and memory demands required to complete the task.

Procedure
Items were presented verbally and repeated on request. The task was for the subject to indicate the named part on the score provided, locating each item in turn as presented. One practice trial was given. The score used was Brahms Symphony no. 4 in E minor Op.98 (pp.-3 & 88-91).[12] Only spontaneous self-corrections were allowed.

Table 5.15

Items as verbally presented	
1-Bass clef	11-Crotchet Rest
2-Quaver	12-Bassoon Line
3-Key Signature	13-Minim Rest
4-Dynamics	14-Triplets
5-Violin Line	15-Crotchet
6-Minim	16-Accents
7-Trumpet Line	17-Trill
8-Alto Clef	18-Divided Strings
9-Quaver Rest	19-Crescendo
10-Staccato	20-Treble Clef

Experiment 2: Ordering Musical Words

Materials

A set of 8 cards was created each showing a musical word typically used to give tempo indications. Words were in Italian and printed in Italics, as they would typically be encountered within a score in Western classical idiom. (Italian being most frequently encountered for such musical references.)

Procedure

This task was designed to assess recognition of musical words out of context, and (in relation to tests of musical vocabulary) to compare comprehension of musical words in relation to non-musical vocabulary. The subject was presented with a set of musical words (Italian) for tempo markings (Table 5.16). These were given visually and were not read aloud by the experimenter. The task was to order these in terms of relative speed (slowest to fastest or reverse order). The items were presented in random order.

Table 5.16

Terms In order (slowest to quickest)
Adagissimo
Adagio
Larghetto
Andante
Moderato
Allegro
Vivace
Prestissimo

5.3.8 Results

On experiment 1 (identifying parts of the score), MR scored 20/20 and was clearly able to relate spoken musical terms to musical symbols, identify an interaction between language and musical processing on this task. There appeared to be slight inconsistency between MR's comprehension and production of musical as opposed to non-musical vocabulary. Nonetheless MR does show a slightly surprising ability to access a musical words (both receptively and expressively) given his general level of language processing. However, one might consider that words which would ordinarily be low frequency in a standard (non-musical) vocabulary may function as high frequency words within MR's individual lexicon.

On experiment 2 (ordering musical words), MR scored 7/8, showing an ability to comprehend relations between written musical words. On a similar language task (ordering non-musical words - speeds, temperatures and lifespan), MR scored 21/22, (where words were read aloud) which would not be a predicted outcome given his generally poor performance and e.g., performance on the PALPA written sentence -picture match (5/20). However, his performance for orthographic input (PALPA word -picture matching) was slightly better at 31/40, and this is comparable with the orthographic input for musical word ordering.

5.4 General Discussion

Due to the level of spared musical capacity seen in MR, from a neuro-anatomical point of view music cognition in this case may be physically separable from language processing areas, as well as functionally distinct. In the case of MR, we might suggest that the extent of left hemisphere damage makes it unlikely that retained left hemisphere processing is capable of carrying such complex musical tasks, which in turn suggest shared hemisphericity or right hemisphere dominance for musical function in this case. The findings from MR suggest that receptive and some expressive music processing is seemingly functioning as an autonomous system in terms of complex symbolic processing.

Indeed, perhaps the most interesting dissociation seen here is that between symbolic processing for music and language. Despite extremely poor performance on linguistic tasks, MR performed well on tests of symbolic music processing. He showed highly complex music reading abilities, that is, not only the ability to read musical notation out of context, but to read in the context of a score, follow individual parts, and recognise and interpret specific aspects of the score. MR showed a high level of precision in following music as demonstrated by page turning at appropriate points. And as noted above, errors on score reading tasks were close to target. Whereas MR had difficulty with phonological working memory for speech, musical memory was functioning effectively (allowing retention of 12-15 second extracts with ease). Although MR had difficulty with word reading, and profoundly impaired performance on comprehending written sentences, he demonstrated no difficulty with recognition of musical notation including fairly complex scores. This is particularly interesting because as symbolic systems music and language are organised in very similar ways. Both are highly structured, 'grammatical' rule governed systems involving symbolic processing across modalities, and exhibiting analogous levels of decomposition: Musical/linguistic phrases, words/melodic motifs, and individual notes/letters with corresponding visual symbolic representations. Yet dissociated symbolic processing suggests that both in terms of auditory comprehension, and orthographic input and output, there is processing autonomy for decoding musical and linguistic structure.

5.4.1 Implications of Case Findings: Hemisphere Dominance

As discussed in Chapter 3, recent work (Peretz and Bever & Chiarello), has favoured the view that the left hemisphere (or language dominant hemisphere) is dominant in musically experienced listeners and the right in musically naïve listeners. With this hypothesis in mind, one can see the importance of establishing laterality in studies of amusia. To reiterate the points made in Chapter 3, the conception of music processing (as being variably lateralised), can be seen to stem from more general claims that left and right hemispheres exhibit different processing styles or strategies. The left hemisphere mediating analytic processing, and the right hemisphere mediating holistic processing. It would be fair to say that this conception of 'divided processing' is both fairly crude, and fast becoming outdated, yet nonetheless it does appear to gain support from evidence that musicians refer to local (or internal) features (intervals, harmonic structures etc.) and therefore use analytical strategies which are claimed to be mediated by the left hemisphere. Non-musicians refer to global features such as contour and therefore employ holistic processing strategies which are claimed to employ predominantly the right hemisphere (Peretz 1990). In light of these findings the analytic/holistic conception requires some further comment.

The case of MR provides strong grounds for rejecting this hypothesis (as do findings by Milner, 1962; Kimura, 1964; and McFarland & Fortin, 1982). MR is seemingly using local information and analytical processing strategies which are necessary to perform some of the musical tasks. MR is a musically sophisticated subject, and was pre-morbidly strongly right handed and right footed which supports a left hemisphere dominance for language and this is obviously supported by extensive language deficits following left hemisphere lesion.

It therefore seems highly unlikely that complex musical functions are being undertaken by the left hemisphere due to the extent of damage, particularly in the region of the auditory cortex. Such evidence therefore undermines the view that analytic processing for music is undertaken by the left hemisphere in *all* musically sophisticated subjects. In addition much of the evidence used in support of the analytic/holistic hypothesis relies on cases where laterality is not well established. One can see the implications of this for example, in the case of MR. MR might equally be subject to re-interpretation if laterality were not well established. For example, one might well suggest that MR was left handed and therefore did not conform to the typical pattern of cognitive organisation for right handed subjects. Clearly, while there do seem to be differences in processing strategies employed for musicians and non-musicians the gross local/global distinction does not map neatly onto brain hemispheres, and there is certainly not a necessary relationship between formal musical training or musical exposure and hemisphere dominance.

This supports the critique offered in Chapter 3, that claims for hemisphere dominance of music have been wrongly and very weekly made on the strength of Bever & Chiarello's unreplicated study, and single case studies where laterality is not clearly established. Claims of hemisphere dominance are clearly misplaced, and focus is turning towards bilaterally distributed processing. Even for language, which perhaps exhibits the strongest example of hemisphere dominance, there is evidence for bilateral distribution of some tasks.

The reason MR displays analytic processing strategies because he is a sophisticated music listener and uses analytic strategies for decoding music in terms of a complex symbolic 'code'. Although I have been at pains to stress the autonomy of music and language, in terms of their construction as symbolic systems, there are similarities which have bearing on how one de-codes and analyses the information, and in this way music is analogous in many ways to language which also uses analytic methods. Music has its own 'grammatical' structures, particularly within western tonal music which has strict harmonic rules involved in its construction at many levels of organisation, from the structure of a few notes or chords, to musical phrases, to the construction, ordering and harmonic progressions of a whole work. in many senses this is analogous to language, in terms of ordering phonemes, words, and sentences into a global structure. An unsophisticated listener might not analyse music in such a way. Rather, they seem to analyse music in terms of its gross auditory patterns using melodic contour, for example, as opposed to whether a melody conforms to 'correct' grammatical phrase structure within the western tonal system. In relation to hemisphericity, the left hemisphere *appears* to operate with analytic strategies, because it is dealing with language, a highly structured, symbolic system, and likewise the right hemisphere may appear to employ holistic strategies due to the processing tasks at hand. But what one is seeing is not some abstract hemispheric property but a strategy which is a consequence of the input being processed. This gains further support form the dissociated symbolic processing exhibited by MR. I.e., one sees damage to specific functions, and not in terms of any abstract processing strategy.

Nonetheless, investigation of hemisphericity for musical function has been revealing. We now have the opportunity to hypothesise regarding differences in processing strategies, in relation both subjects' differing levels of musical exposure, and the processing requirements of tasks themselves (e.g. temporal versus melodic). The findings from MR do support a largely autonomous music processing system. However, they also support my earlier claims regarding the need for caution in assuming any fundamental relationship between music and language, and the need to accommodate variation across musical and non-musical subjects, when modelling music cognition.

The findings from MR also contradict claims of common processing capacities made on the basis of co-occurring aphasia and amusia. It is also quite likely however, that there are some music and language functions which are subserved by common processing mechanisms — functions which might depend, for example, upon shared perceptual functions.[13] For example, temporal processing, and melodic contour processing may not be music specific, and, for example, it is unlikely that a non-musician would have any music-specific motor processing skills, which appear to be observed in musicians.. Importantly, examining *equivalent* tasks across auditory modalities will allow us to determine which are modality specific and which are general purpose auditory processes. Similarly, distinguishing between receptive, expressive, apperceptive and associative music disorders, would be a distinct advantage in attempts to subdivide music cognition, localise musical functions and to make valid and substantial comparisons of single case studies. At present many claims are subject to wide interpretation due to the lack of standardisation, failure to determine laterality, and lack of distinction between expressive, receptive, perceptual and evaluative musical functions. Nonetheless one can still hypothesise, albeit carefully regarding autonomy and subdivision of musical function. In Chapters 6 and 7 I will use the findings presented here and in Chapter 3 to develop a broader model of music cognition, and to offer further criticism of existing accounts.

Notes

[1] Storr (1992) p.9

[2] It is debatable whether MR should be classified as a Global Aphasic Howard & Hatfield describe this as "An Aphasia in Which language is very severely affected in all modalities. In the most extreme cases there may be no evidence of any real knowledge of language remaining. Auditory comprehension is usually the least severely impaired modality." Howard & Hatfield (1987, p.148). On this categorisation MR would qualify however, on a more sophisticated diagnosis he has too much lexicon to be classed as global -hence the description as a 'severe' aphasic which I have chosen.

[3] For the Pyramids and Palm Trees test, normal performance is gauged by a score of 90% or above, (which would be equivalent to 46.8/52) MR scored 46/52, exhibiting near-normal performance.

[4] Associated Board of the Royal Schools of Music examinations. Level of difficulty for Aural comprehension ranged from Grade 1 to diploma level tests. ABRSM Aural Tests Grades 1-8 Parts I-III ©1972, ABRSM. ABRSM Aural Tests Part IV, Allchin B. C. & Read, E. © 1952 ABRSM.

[5] The literal translation being spoken song, sprechtstimme is a hybrid between speech and singing., e.g. Schoenberg's Gurrelieder 1900-1911 and Pierrot Lunaire 1912.

[6] Excerpts were drawn from Associated Board of The Royal Schools of Music Aural tests. ABRSM Aural Tests Grades 1-5 (Part I) ©1972, ABRSM.

[7] I have chosen to use the term 'sequence' here to refer to excerpts as opposed to 'melody' which implies pitch variations within the example.

[8] Mozart Clarinet concerto k.V.622 © Boosey & Hawkes Ltd. 1946.

9 CD, Nielson Violin Concerto, Op.33, Dong Suk Kang, Myun Whung Chung, & Gottenberg Symphony Orchestra ℗&© 1987, BIS

[10] Further support for existing emotional classification of these works may be found in critical commentary. The Penguin CD guide, Gramophone, critical reviews, Grove Dictionary of Music and Musicians, Meerum Terwogt M, & Van Grinsen F, '*Musical expression of Moodstates*, Psychology of Music 19, 99-109 1991.

[11] These scores are determined by 'correct' classification of excerpts as sad/happy according to pre-determined emotional labels for excerpts.

[12] Brahms Symphony No.4 E Minor. Op.98 Eulenberg edition, Eulenberg Ltd, London.

[13] Subsequent testing of MR has revealed specific perceptual deficits which may be relevant in the assessment of general purpose acoustic discrimination abilities. In making same/different judgements of phonological input (two sounds presented -are they same or different), MR showed discrimination problems where the items were presented by different speakers. But intact performance where the items were presented by the same speaker. This suggests there may be a problem with abstract phonological recognition. Thus, where the make up of the acoustic signal is altered (by introducing a different speaker). MR has difficulties, i.e. not only does he have to recognise the acoustic pattern (words) as same/different but also other features of the acoustic signal, which contribute to the identity of the sound source.

Chapter 6
Music and Modularity: An Introduction

6.1 Introduction

Parts I and II of this thesis have now provided a wealth of empirical data from both impaired and normal function, regarding affective processing, music processing, auditory processing and the integration or independence exhibited by these systems. It is clear that knowledge of certain empirical facts bears heavily on the type of model one might propose for auditory processing and our conceptualisation of its subdivision. In the course of the discussion I have made some preliminary observations about the nature of auditory and affective processing and cognition. The task now is to assimilate these findings in terms of a unified model of music cognition and a pertinent question is to consider what type of cognitive model might be constructed, and how this might fit within a global cognitive architecture.

Evidence from neuropsychology clearly lends support to a broadly *modular* cognitive architecture: that there are independent departments or sub-departments of the mind with both their own special subjects or *domains*,[1] and relatively isolated processing that proceeds quite irrespective of what is stored or going on elsewhere in cognition. A few modular accounts have emerged, targeted specifically at music (Peretz and Morais, 1989; Gardner, 1983; Jackendoff, 1987).

Strong critiques have been raised against assumptions of modularity and the application of such theoretical models within the neurosciences, and as a result certain conceptual problems need to be addressed before attempting to construct such a model. I do not feel that the criticisms discussed here are necessarily targeted at the modular hypothesis itself, and indeed this would be inappropriate given the very broad formulations it allows. In light of this, I do not wish this chapter to be interpreted as a defence of modularity, but rather as an explication of (and an attempt to answer) some of the criticisms surrounding its applications and the methodologies of empirical investigations which are used in its support. To begin, the discussion will outline the principal themes of modular hypotheses and the development of the contemporary modularity thesis.

6.2 The Rise of Modularity

Broadly, modularity proposes that some or all mental functions operate independently (whether functionally or neurologically distinct) as opposed to cognition being a globally interactive process. In general terms, a module is conceived as an independent sub-component of any cognitive architecture. However, modules are assigned different properties depending on the modular architecture in question. That is, whether modularity is postulated as a property of general human cognition, or merely underlies specific functions. There is incontrovertible evidence for distinct information processing systems at the level of perceptual processing, but a more problematic issue is how perceptual systems interact to perform higher-level mental processes. This is perhaps the source of most conflict between modular hypotheses — to what *extent* is the mind modular? Here we see a variety of views. Fodor for example, argued that input systems are modular, but that higher mental processes, reasoning and fixation of belief are non-modular. Marslen-Wilson and Tyler (1987) suggest that complex language processes (beyond mere perceptual processes) are modular, and others e.g. Marshall, 1984, (and see Shallice 1988 p. & p.271.) argue that impairments of knowledge and reasoning suggest the mind may be modular across higher cognitive functions too.

Modularity has an interesting history and its roots can be traced back to particular theorists, such as the anatomist and psychologist Franz Gall (1758-1828). It was commonly accepted within 18th century psychology that cognitive processes were interactive and involved sequential processing, a serial flow of information through various faculties. This tradition, known as 'horizontal faculty psychology', stemmed from the thought of Aristotle (perhaps also from folk psychological preconceptions, as reflected in using a single verb — 'judge', 'remember' — across several cognitive domains) and was ingrained in psychological thought and experiment well into the 18th century (Soemmering, 1796; Wolff, 1679-1750; Reid, 1764). The faculties of memory, attention and perception were assumed to be invariant from one domain to the next. For example, the faculty of judgement dealt with such diverse domains as the aesthetic, moral, legal etc., and mental processes were characterised in terms of the faculties recruited to complete a particular process. On such accounts, "Mechanisms are individuated by what they do, not what they do it to." (Marshall, 1984, p.213). They assumed that sensory information underwent initial processing and conversion into a common code, such that the nature of sensory information was irrelevant in subsequent processing. Horizontal faculties therefore, were individuated by their effects on input, not by the nature of input. The faculty of memory, for example, would function irrespective of content, whether memory for peoples' identities, language, music or whatever.

Fodor expands on this division of faculty psychology:

> "....faculty psychology exhibits two versions of the doctrine according to the axis along which the mind is sliced. According to the most familiar version — which I shall call 'horizontal' faculty psychology — cognitive processes exhibit interaction of such faculties as, e.g., memory, imagination, attention, sensibility, perception and so forth; and the character of each such process is determined by the particular mix of faculties that it recruits." (Fodor, 1983, p.11.)

So, although there was no disagreement over the division of the mind in terms of distinct faculties, there was controversy surrounding the way in which these divisions were drawn. Gall disagreed with the idea that one might have 'generalised' faculties for judgement, memory, attention etc. Rather, he supported a vertical faculty psychology, proposing that, where we have aptitudes (or competences in a particular area[2]), these are distinguished by their subject matter. For example, mathematical aptitudes differ from musical aptitudes and these therefore are subserved by different psychological mechanisms. Gall commented,

> "there are as many different kinds of intellect as there are distinct qualities.....One individual may have considerable intellect relative to one fundamental power, but a very narrow one in reference to every other......a special faculty of intellect or understanding is as entirely inadmissible as a special faculty of instinct" (Hollander, 1920, p.240).

Despite his fairly persuasive positive thesis for modular function, Gall's own critique of faculty psychology creates something of a stalemate. Gall argued that, if there were merely unitary faculties of memory, judgement, attention, imagination and the like (which operated across domains), then these capacities should show correlation across tasks. For example, if one has a good memory, (and memory is a horizontal faculty) this ability should be applicable across all domains and consequently one should have a good memory in any application. If this were the case, claimed Gall, horizontal faculty psychologists should be able to demonstrate the correlation of memory across cognitive domains. But this is not a particularly strong argument against horizontal faculty psychology. There is no reason (unless *tasks* are identical) why the same faculty should not be strong in one application and weak in another, and indeed horizontal faculty psychologists might have evidence both of correlation and against correlation across domains, varying according to individuals, which does little in the way of supporting either argument.

Nonetheless, the need for task identity across modalities is an important point and one we find reinforced in contemporary neuropsychology. One cannot compare performance unless tasks are identical in all ways except for the parameter being tested. Music test batteries provide a notable example of this issue. Many tests of rhythmic processing require subjects to tap, in response to a musical input, and yet have been used as measures of receptive function. It is clear, however, that these results cannot be compared with rhythm *discrimination* tasks as they involve motor co-ordination and expressive rhythmic function, which are not measures of receptive processing.

This is an important issue and carries over to comparison of tasks across domains such as language and music, for tasks to be equivalent they need to relate to equivalent levels of subdivision within these domains. For example, environmental sound discrimination would not seem to require the same discrete levels of discrimination as phonemic discrimination in language and speaker identity. (One can identify whether two sentences were spoken by the same voice, even if the speaker is unfamiliar, but one doesn't (unless perhaps trained) have the ability to discriminate individual dog barks or duck quacks). The same applies to comparison of other tasks across domains — the requirements of memory, attention etc., may be dramatically different across domains (see further comments on this in 7.6.)

In an attempt to distinguish between vertical faculties, Gall made reference to individual differences, arguing that differing aptitudes for music, mathematics and the like, demonstrate that these are distinct vertical faculties. Whilst this divergence in aptitude is a correct observation, it adds little to the argument against horizontal faculty psychology. Gall seemingly confused arguments of individual variance with arguments for domain specificity and had a tendency to misdirect the relevance of individual differences in aptitude as noted above (see Fodor, 1983, p. 17). Whilst Gall's account explicitly outlines several themes central to contemporary modularism (such as *domain specificity*, *neural localisation* and *autonomous processing*), certain misguided arguments, coupled with Gall's other beliefs, clouded his theoretical work. Gall held that the development of the mind was proportional to brain size, and that the size of the brain related directly to the size, shape and irregularities of the skull. This account was adopted by phrenologists, and so widely misrepresented that many of Gall's other writings were subsequently tainted with the claims of phrenology too. Horizontal faculty psychology continued to hold sway.

6.2.1 Modular Hypotheses Explored

Talk of 'modularity' has become fairly standard in recent philosophical and psychological debate. The aim of this brief overview of modular accounts is not only to give some idea of their diversity, but also to identify common strands regarding criteria for modules, the nature of their processing capacities and their operation within a global cognitive architecture. While there is no standardised notion of what constitutes a modular architecture, major variants of modular accounts may be summarised in terms of a tri-partite division of modules, giving associated possibilities for modular hypotheses:

1) Modules as *innate* or *developed*

2) Modules as *neurally dedicated* or functionally *multiply realised*

3) Modules as *peripheral* or *central* (i.e. massively modular architectures.)

The rise of cognitive neuropsychology and its broadly modular assumptions of cognitive architectures must be partly responsible for the resurgence in modular accounts. The study of selective cognitive deficits offered much support to modular hypotheses and, for the first time since Gall, the modular theory found new interest across a range of fields such as linguistics, psychology, philosophy and computational theory (AI). Modular hypotheses were consequently offered by Simon (1962), Marr (1976), Chomsky (1980), Morton (1981), and perhaps most famously in Fodor's *The Modularity of Mind* (1983).

Marr's computational view (Marr, 1976) outlines perhaps the most basic argument, the 'evolutionary programming argument' for modular organisation, founded mainly on general considerations of evolutionary design as applied to cognitive engineering. Were the mind constructed as an interactive system, utilising general processing capacities, any changes to the system would require overhauling the whole mechanism. Whilst not advantageous in evolutionary terms, neither does such an architecture match the patterns of breakdown and patterns of normal processing demonstrated across a large number of cognitive domains. As Marr states,

> "Any large computation should be split up and implemented as a collection of small sub-parts that are as nearly independent of one another as the overall task allows. If a process is not designed in this way, a small change in one place will have consequences in many other places. This means that the process as a whole becomes extremely difficult to debug or to improve, whether by a human designer or in the course of natural evolution, because a small change to improve one part has to be accompanied by many simultaneous compensating changes elsewhere." (quoted in Shallice, 1988, p.18).

Indeed, if the mind were a wholly interactive system, it would be profoundly difficult to offer an explanation of patterns of breakdown resulting from such a system (for example, to account for amusia without aphasia, agnosia or any other deficit).

Within linguistics, Chomsky (1980) offered a modular hypothesis which, though structurally similar to Marr's account, differs in its underlying claims for modular organisation. In striking contrast to Marr, Chomsky places little reliance upon evolutionary considerations, and is strangely agnostic on the question of whether human linguistic capacities are the product of an evolutionary process. This is perhaps because postulating innate knowledge — as Chomsky does, for example, in the domain of syntactic knowledge — has serious implications within a framework of evolutionary biology. As Jackendoff notes

> "the Innateness Hypothesis has provoked various degrees of astonishment, disbelief, and outrage since the time it was proposed in its modern form by Chomsky (1965)" (Jackendoff, 1987, p.88)

This gives some idea as to the complexities of the modular account in relation to postulating biological endowments of any degree, and indeed relates to the more general issue of tying structure to function. Both of which I will return to in some depth below.

Putting this problem aside for the moment, both Chomsky and Marr are concerned with processing strategies of specific subsystems (language and vision respectively), and both identify three analogous levels of analysis.[3] Chomsky noted that rules for linguistic competence are specific to linguistic domains (dividing language into conceptual, computational and pragmatic elements).

> "The simplest way to explain this relative independence of our competence in a particular domain is to assume that it is the product of a subsystem that is itself relatively independent of other subsystems." (Shallice p.19).

Whilst offering valuable insights regarding the nature of specific modules and their operation, neither Chomsky nor Marr's account attempts to answer some pressing questions concerning the modular hypothesis as a whole. (1) Which cognitive systems are likely to be candidates for modularity? And (2) How do such modular functions interact with broader (central) cognitive processes? For the musical case, these are issues I wish to address. In addition to producing models such as Marr's and Chomsky's, which are independently valid as explanations of specific processes, I am concerned with the validity of modularity across cognitive domains. Some input systems can be treated as modular without any particular commitment to the extent to which other parts of cognition are also modular.[4] For music though, any successful account must also explain its relationship to other functions such as language and emotion, and be capable of distinguishing between which aspects of music involve mandatory peripheral processes and which involve evaluative cognition. For example, in light of the model of affective processing in Chapter 1, it will need to be made clear whether auditory affective processing of music is music-specific (and a sub-component of a music module) *or* a sub-component of general purpose auditory processing, *or* a component of affective processing. Given the autonomy (and domain specificity) of modular processes, it must fall within one category.

While Marr and Chomsky's assumptions then are equally valid for functional models of respective processes, the neurosciences can provide empirical evidence concerning underlying neural structures, to complement purely functional accounts. It is worth remembering at this point that neuropsychological accounts themselves may also be purely functional, and whilst empirically based, make no claims about the structural systems implementing the function. For example, many accounts of language make little address to brain issues and one should not assume there to be a functional/empirical divide between the neurosciences and traditionally theory-based disciplines. Biological support for a modular theory of mind may be drawn from many sources. Domain specificity (that mechanisms act only upon restricted sets of input), is exemplified in a very basic and uncontroversial sense by the traditional sensory domains. The eye and optic nerve cannot process sound information, and other sensory modalities have similarly restricted sets of input. However, neurophysiology provides further evidence through the existence of anatomically distinct subsystems: i.e., areas of cortex (such as the visual cortex, or Broca's and Wernicke's areas) with highly specific functions and which *cannot* process other types of input, responding only to restricted categories or *domains* of stimuli e.g., colour, movement, dimensions, etc.[5]

The speed of response to sensory input is also proposed as an argument for processing autonomy of modules. Responses to sensory input can be timed at around 5 milliseconds. If an interactive system were involved such speed is arguably not possible.[6] Domain specificity is well supported for non-sensory modalities too. For example, rules for grammar are obviously different from pragmatics and cannot be applied across domains, and such rules are also independent of conceptual considerations. One can sub-consciously learn and apply rules and strategies for ordering novel information, without any awareness that one possesses, or is applying a particular strategy (Berry, D, 1990, 1997; Damasio, 1996). Perhaps the most significant empirical findings for modular hypotheses are the dissociations studied within neuropsychology.[7] Dissociations between cognitive functions across a wide range of domains offer strong support for both functionally autonomous processing and, in many cases, neuroanatomical localisation too.

In addition to computational, physiological and linguistic models, a broader psychological hypothesis for modularity is offered by Fodor. Fodor's account in *The Modularity of Mind* (1983) is perhaps the most powerfully argued and influential exposition of modular theory to date. His account takes a functional approach which gives prominence to empirical findings, and it is clear from Fodor's thesis that he gives consideration to issues of underlying neural structures. Fodor attributes modularity specifically to input systems, which he distinguishes from transducers (responsible for converting sensory data, e.g. mechanical movement of the ear drum, into electro-chemical signals that can be read by the brain), and central cognitive systems responsible for higher mental processes. The distinction here is important as it marks a contrast with other modular hypotheses. Fodor explicitly denies that thought, or specifically *non-demonstrative reasoning* (and what he calls 'central processes', e.g. fixation of belief)[8] may be in any sense modular. In addition, he stresses the informational encapsulation of modules from conceptual analysis, arguing that there is no top-down influence on a module's representations. (In this sense his account differs from that of Marr, who acknowledges the need for top-down information in his model of vision. See Jackendoff, 1987 p.188)

Within the Fodorian account modules are closed computational devices, characterised by nine more or less independent properties.[9]

(1) Modules are *domain specific* (computational mechanisms which operate only on specific input). Input modules do not correspond merely to the traditional sensory domains, but to highly specific input categories. E.g. Fodor suggests visual modules for colour perception, analysis of shape, and analysis of three-dimensional spatial relations. These divisions are well demonstrated in the case of cognitive deficits, where specific domains may be selectively spared or impaired. As we have seen, many aspects of language, and music for example may be selectively spared and damaged. And as seen in Chapter 3, neuropsychological studies of amusias, highlight specific impairment of musical functions, such as, rhythm (arhythmia), melody (amelodia), and memory for music (music agnosia).

(2) Modules exhibit *mandatory operation*. We cannot help but interpret visual information as three dimensional objects, nor can we help hearing certain auditory signals as speech. The mandatory nature of processing is often explained in terms of its evolutionary necessity to the organism in question. For example, there may be a constant need to attend to perceptual stimuli and "in a hostile world, one would not want one's object recognition module "switched off" at the wrong moment." (Garfield, 1987, p.3). Studies of deficits show that speech, environmental sound, and music may be processed separately and are also 'channel specific.'[10] This means that we cannot choose how we hear a sound — it seems that our minds are 'programmed' to hear it in a certain way. For example, we have to hear certain sounds as music and others as environmental sounds. If we lose the ability to process one of these groups, the task cannot be taken on by another auditory processing module. It is for this reason that we find it so difficult to ignore background conversations. This 'mandatory processing' means that we will always hear certain sound patterns as speech.

(3) Central systems have *limited access* to modules' contents or representations. A module's representations are not open to conceptual analysis, only a module's output will be accessible to central processing.[11] There is much anecdotal evidence in support of this claim. In many cases, information is necessarily processed to complete a task, yet is not available to the individual for

report. For example, one may understand the meaning of a sentence, but fail to recall the exact words used only moments after hearing and comprehending the utterance.

(4) Modules exhibit *fast operation*. Speed of processing is tied closely to mandatory operation, and as with the neurophysiological evidence cited in (2) above, processing speed is often explained in terms of evolutionary necessity. One does not want to be deciding whether or not to blink when an object is approaching the eye at speed. This applies similarly to other non-sensory modalities, where conscious analysis would impede the efficiency of the task at hand. (e.g., conscious analysis of grammatical structure in sentence analysis). A prime example was seen in Chapter 1 for the case of affective processing — producing an aversive response to an object which *might* be harmful before one has even recognised *what* the object is.

(5) Modules have *shallow outputs*. Outputs may not be sufficient for belief fixation and require interpretation by central processing. Discussing visual and language processing, Fodor suggests outputs involve what he terms 'basic' perceptual categories which he defines as typically the most abstract members of their implication hierarchies (see *The Modularity of Mind* pp.94-95.) That is, the module delivers basic perceptual categories, e.g. horse as opposed to Shire horse or Shetland pony. Shallowness, for Fodor, seems to be principally a matter of distinguishing the way things look to a subject from the way that subject believes them to be, as for example illustrated in various perceptual illusions, such as the Müller-Lyer. Whether all modules must have shallow outputs is something that might be disputed by other modular theorists. There are also reasons for thinking that the processing of linguistic inputs is not restricted to 'shallow' outputs. Thus, it is quite plausible to suppose that, in many cases testimony can directly produce fixation of belief, without the intervention of some epistemologically sophisticated process of monitoring. (Otherwise, how could children learn from instruction before learning which instructors to trust?). It does seem that shallow outputs may be demonstrated by experiments in visual perception. Current experiments are providing more and more evidence that what we think we see (as in the Müller-Lyer illusion) is not what we *actually see* — the mind does a lot of 'filling in' using 'shallow outputs' and stored visual representations.

(6) Modules are *informationally encapsulated*. In simple terms, modules cannot make use of a subject's other knowledge and beliefs. A striking example is provided by the persistence of optical illusions, even when one knows the visual presentation is illusory (e.g., the Müller-Lyer illusion[12]).

(7) Modules are *associated with fixed neural architectures*. Fodor refers to language and perceptual deficits as evidence for neural localisation of modular functions. However, this is a controversial claim, as many seemingly modular functions cannot be assigned a specific neural localisation (music being a notable example). This is an important issue as regards the assimilation of functional models with neuroanatomical structures. Indeed, neuropsychology was disregarded for a long period due to the "diagram maker's premature — and indeed, we would argue, mistaken — attempts to express their functionally modular theories as also anatomically modular." [13]. Garfield notes

> "Even if the mind turns out to be modular, might it turn out that various modules have some but not all of the Fodorian properties? One could imagine, for instance that some cognitive function has all but neural localisation" (Garfield p.8).

At the heart of the problem is what are considered as 'specific neural structures'. Functions can still have *associated* neural architectures although these may be distributed. Or, for example, a function may have may have different (albeit consistent) localisations across different subject groups. Further implications of this position will be discussed below, although it is worth noting that Fodor does in fact concede this point.

(8) Modules exhibit *characteristic breakdown patterns* as demonstrated in neuropsychological studies of language, vision, memory etc.

And finally, (9) Modules exhibit *characteristic pace and sequencing of development*. Language, for example, develops in a systematic way which is surprisingly resistant to environmental and sensory deprivation. Deaf children of non-signing parents develop their own system of communication. Karmiloff-Smith notes that

> "even though they lacked the linguistic model available to hearing children and deaf children of signing parents, these children nonetheless invented a visuomanual system that displayed several of the constraints of natural language." (Karmiloff-Smith, 1992, p.38).

Whilst many cognitive functions do seemingly conform to Fodorian criteria for modularity, Fodor's account is often deemed too restrictive for neuropsychological purposes, and in turn has been criticised for unquestioning acceptance of empirical findings and methodologies. Neuropsychological notions of modularity may frequently entail a weaker conceptualisation, with modules conforming to some, but not all, of Fodor's criteria. Marr's weaker notion of a module seems to be more consistent with models underlying neuropsychological accounts. Marr's concept of a module is in terms of its processing capacities and the "amount of interaction between two systems" (Marr, 1982 p.356). In Marr's view, different systems within a modular architecture may vary as regards degree of modularity and, importantly, contrary to Fodor, "modular systems may require or be able to call upon some general resource, such as Kahneman's (1973) concept of 'effort'"[14]. Within neuropsychology then, there appears to be a more flexible approach towards which systems may be modular and the extent to which they accord with more rigid orthodox modular criteria such as Fodor's. This is not to say that I am searching for a unified account. Rather, my point is that differing conceptions of modularity across disciplines need to be acknowledged if we are to successfully contrast claims from these fields in the discussion of a general model for music. Importantly, Fodor claims three of the above properties are *essential* to modules: Domain specificity, informational encapsulation and shallow outputs, and these three properties are generally assigned to modules within neuropsychological theory.[15]

It is important to note at this point that both within neuropsychology and psychological theory, many accounts do not presuppose modularity as a general property of human cognition, but specific to individual systems, notably perceptual or non-evaluative processing (e.g. Chomsky: language; Fodor: input systems; Marr; vision). This can perhaps also be seen as a consequence of neuropsychological enquiries, being typically concerned with damage to a specific system. (Damage to multiple functions invariably complicates experimental procedures.)

Indeed, the main variables for modular accounts as outlined above are (1) Whether modules are innate or developed, (2) The specific properties assigned to modules themselves (functional and neural realisation), and (3) Whether modularity applies to all, or only parts of the cognitive system. Other conflicts between accounts centre upon the specifics of interpreting empirical data and methodologies within the neurosciences, which I will now consider in some detail.

6.2.2 Conflicts Between Neuropsychology and Theory

Frequent reference has been made to neuropsychological evidence in this analysis of modularity, however, the interchange of ideas between theory and empirical studies is not without problems. There are certainly strong criticisms concerning the application of theoretical models within neuropsychology, and these deserve some consideration. We should be wary of the postulation of modules for various forms of cognitive processing in an overgenerous way that would tend to bias the case in favour of "massive modularity".

For the majority of theorists working in the neurosciences and allied theoretical disciplines, the evidence provided by dissociations and the relative autonomy of processing systems is readily accepted. However, there are still some reservations and I will consider these before moving on to develop a modular account in Chapter 7. Four main areas of dispute may be outlined. First, there are wide-ranging critiques of dissociations themselves, and the way in which these are interpreted. Second, the relationship between functional models and neuroanatomical structures is disputed. This was one of the associated possibilities for modules outlined above — whether modules are neurally dedicated or functionally realised and there really are versions ranging from purely functional models to attempts to precisely localise individual functions. Many theorists are wary of making assumptions regarding the relationship of functional models to underlying neural substrates, and at the other extreme some theorists have been overly generous as regards the assimilation of function to neural structures. Fodor, for example, is guilty of this by making neural localisation a criterion for modules. In general, however, the division seems to be between those approaching from purely functional perspectives who attempt to localise broader functions, (for example — functions represented by a particular processing task, e.g. rhythm discrimination, affective processing for speech) while neuroanatomists, on the other hand, see localisation in terms of highly specific 'micro-functions', as for example in the case of localisation in the visual cortex (where groups of cells respond to input from specific parts of the visual field). Some have been too hasty to localise functions, and others resist localisation. This has led to some detachment between functional and neuroanatomical accounts, which in many cases could with a little more care have been made to complement each other.

Third, a specific criticism from neuroscientists is that the dichotomy between central and peripheral processes is too rigid. This seems a valid critique in relation to (e.g.) Fodor's account, but certainly in contemporary theory this is not the case. More and more theorists are attempting to integrate central and peripheral functions more fluidly within functional models. Indeed, there is strong opposition to the view that there could feasibly be such diametrically opposed cognitive systems operating simultaneously within a global architecture.

And finally, there is some support for interactive processing as opposed to the processing autonomy associated with modular hypotheses. However, as I will discuss below, this last critique hinges upon the commitment to encapsulation within specific modular accounts. In many cases interactive processing may be compatible with a broad modular architecture. Goldberg (1995) offers a harsh critique of modularity, which encompasses many of the prototypical positions outlined above, and so I will use his paper to exemplify these criticisms.

Goldberg presents a vigorous critique of modularity as applied to particular cortical structures, arguing on the grounds that evidence from strong dissociations is over-emphasised whilst weak dissociations are discounted. Goldberg's point is that strong dissociations do not represent the general patterns of function following brain injury. He claims that weak dissociations[16] show not a modular but a continuous functional distribution. For example, cases of impairment vary in severity, exhibiting different degrees of damage, rather than just demonstrating pure 'loss' of a particular function.

Goldberg's critiques of dissociations themselves — whilst representative criticisms, do not stand up to scrutiny. While lack of replication is admittedly a valid critique in neuropsychology, dissociations of language are surely too consistent and too frequent to be cited as examples of atypical outcomes.[17] Investigations into aphasia have been conducted for over a century and this is one area in which there is replication of tests, standardised methods across subjects and evidence of the same dissociations occurring across single case studies. As discussed in Chapter 3, it is true that single dissociations have notoriously been subject to criticism,[18] but in any case, stronger evidence for autonomy of auditory processing is readily available. Double dissociations have been well documented for a wide number of auditory functions. Double dissociations have been reported across modalities of music and language: lexical, orthographic, expressive and receptive functions. Double dissociations within musical function have been observed between expressive and receptive musical abilities, and between perception of melody and rhythm. In addition, were auditory processes subserved by a general purpose processing system, we would expect to see consistency in the recovery of function following brain insult, reflecting the respective difficulty of auditory tasks — and this is *not* what is observed.[19]

Neither do I agree with Goldberg's claim that there is a tendency to ignore weak dissociations as uninformative, as these are certainly incorporated within the general body of empirical results. He claims that

> "Once demonstrated to exist, however, the dissociation is assumed to be equally revealing of the cognitive architecture across all individuals. The combination of a specimen-invariant cognitive architecture and functional neuroanatomy, and a marksman-precision lesion, is the presumed basis of both the existence of a strong dissociation and its universality." (Goldberg, p.194).

With regard to the claim of presumed invariant neuroanatomy, I would claim that the localisationist/anti-localisationist debate has been long left behind. Whilst it is admitted that certain areas of cortex may relate to aspects of perceptual processing, few theorists would revert to the position of Gall and attempt to narrowly localise entire cognitive domains. Apart from established hardwired cortical structures for perceptual processes, (e.g. vision), there is *not* a general assumption of invariance in neurocognitive architecture. In terms of presumed invariant cognitive architectures, theorists are aware of premorbid idiosyncrasies and these are adequately accounted for within the literature (e.g., Varney et al., 1989). One of the difficulties within the neuropsychology of music is exactly this high level of premorbid variance between subjects, and lack of definition regarding musical abilities per se. Neither do theorists assume universality across normal cognitive domains, being well aware of individual differences in processing strategies. Music again offers a prime example. Processing strategies and hemisphericity varying significantly dependent on musical exposure and expertise. Musicians who have had extensive bi-manual co-ordination training in early life (e.g. as in learning a keyboard instrument) may have distinctively different neural architectures to those who lacked such interhemispheric co-ordination tasks. The auditory system in general exhibits a remarkable degree of developmental plasticity.

Previously much emphasis has been placed on hemispheric dominance for particular functions (e.g., Language to the left hemisphere, and visuo-spatial cognition to the right), but more emphasis is currently being placed upon bilateral distribution of functions and co-processing by both hemispheres. The wide variation in lesion localisation across musical and non-musical subjects exemplifies the need for caution in assuming any invariance in neurocognitive architecture. In addition to the type of musical processes examined, (e.g., receptive versus expressive), pre-morbid musical ability, and the development of musical abilities should be taken into consideration (see Ponton et.al, 1996; Palmer et.al, 1998 for discussion of the plasticity of the auditory system).

Goldberg claims that we must draw a distinction between strong intrinsic and weak emergent modularity in relation to different cortical structures. (He claims that strong intrinsic modularity is more characteristic of the thalamus than the cortex, i.e. that strong intrinsic modularity is characteristic of evolutionarily *older* neural systems, while the cortex, the 'newer' part of the human brain demonstrates interactive processing and weak modularity.) This distinction between strong intrinsic and weak emergent (acquired) modularity is indeed a source of conflict between modular theorists. Distinctions *are* drawn between type of processing and innate versus developmental modularity (e.g., purely perceptual and hardwired versus acquired functions), but this distinction has generally not been applied in terms of specific neural structures. Many accounts have adopted a functional notion of modularity and are therefore not concerned with such specific issues of localisation and consequently the nature of the cortical structures involved. Nonetheless, that the type of cortical structure could determine the type of modularity, as Goldberg suggests, is of great significance to theorists too. Goldberg notes,

> "The advent of the neocortex may have represented an evolutionary escape from strong modularity as the dominant principle of neural organisation..."[20]

This in fact would provide an adequate response to the critique often raised against the Fodorian account (and indeed any account which postulates distinct *types* of processing): That it makes no sense that central processing should operate according to such different principles. Goldberg notes that "a shift from the modular thalamic to an interactive cortical principle of neural organisation may have represented a major step in the evolution of the brain."[21] Admittedly, it is fair to say that, if one associates different types of processing with different cortical structures, then one has at least some kind of support for the case that these structures may operate in different ways (although to say they operate in *radically* different ways still seems incoherent when one considers that the structures, although distinct, are still subject to the same basic physiological modes of operation.) This is also the case for the assumption of analytic/holistic processing in opposite hemispheres. One of the biggest problems for this account is to explain why the two hemispheres should have fixed, and vastly differing, processing strategies (i.e. the left — analytic, right — holistic conception). Again this may come from assumptions of hemisphere dominance, and what is now clear is that many tasks, including language use both hemispheres. The fact that a task utilises a particular strategy (e.g. analytic) and also may be lateralised to one hemisphere (e.g. left) does not mean one can then attribute a fixed 'processing style' to respective hemispheres. Rather it is the case that different processing strategies are applied in relation to the task at hand and in accordance with individual variance as opposed to fixed processing strategies assigned to left and right hemispheres. This issue was stressed at the end of Chapter 5 in relation to case MR, who was seemingly using analytic strategies and the right hemisphere for processing music, supporting the hypothesis for task-determined processing styles rather than fixed hemispheric processing strategies.

Goldberg's next critique is that "The ordering inherent in a strong cognitive/neuroanatomic congruence would be redundant and superfluous in a brain consisting of prededicated modules."(*ibid.* p.203). His suggestion is simply that, there is no need for such ordering if modules are autonomous processing mechanisms, i.e. no need for related cognitive processes to share neuroanatomical regions. In many respects though this critique is over simplistic, and assumes a very rigid view of localisation and organisation within modular hypotheses. The critique fails on two points, firstly, it is not clear that there *is* strict ordering except where functions correspond to gross anatomical regions (e.g. some musical functions will obviously be functions of the auditory cortex as will some language functions) but this hardly counters the modularity thesis. Indeed, it would be strange if there were not ordering of major sensory functions in terms of broad regions of cortex. Whilst there is indeed no *necessity* for such ordering, it makes sense for modules sharing similar input, e.g. from auditory or optic nerves, to occupy similar locations (whether these are unilaterally or bilaterally distributed.[22] Secondly, it is not clear that ordering is *inherent* to cognitive/neuroanatomic congruence. Goldberg's point is that there are not discrete boundaries between areas of cortex (which correspond to specific functions) as suggested by modular theory and evidence from dissociations. He argues that the principle of 'continuous distributed organisation', (that is that functions are distributed across neural sites as opposed to having any boundaries),

> "stems from the fundamental observation that two neocortical lesions will disrupt cognitively close processes if, and only if, their neuroanatomical territories are close" (p.196).

But it is hard to see what Goldberg's reasoning is supposed to be, apart from a determination to judge 'closeness', both cognitively and neurophysiologically, as he chooses.

In any case, his claim does not seem to cause any distinct problems for the modularity thesis as it depends on the very weak reference to 'cognitively close' functions which Goldberg makes no attempt to explain. On such an account it seems a large number of cognitive functions could be described in some way as 'cognitively close'. E.g., with the example, of affective function, subjects with amygdala damage might seem to exhibit very close patterns of cognitive impairment in relation to subjects with frontal lobe damage. An example of markedly different neuroanatomical structures, which both cause deficits in affective processing. (see 1.4.1 for further references).

Moreover, the idea of neuroanatomic/cognitive congruence is not strictly at odds with the modularity thesis. Indeed, if what Goldberg alleges were true, it seems that it might nonetheless be entirely consistent with a rather rigid modular doctrine. To claim that modules are associated with fixed neural structures, much depends on the notion of 'specificity'. Functions can still have associated neural architectures whether these occupy a single coherent site or a distributed site (e.g. as for music). Obviously where one has two sensory transducing devices (e.g. eyes) which project to different hemispheres, one has a distributed system. The evolutionary development of modules might also support this position, (that there can still be reasons for ordering in a modular system). One could certainly imagine some process of ordering, relative to modules' respective evolutionary development.

Goldberg continues his attack, commenting that

> "the concept of modularity became so influential precisely because, like every simplistic concept, it has the illusory appeal of instant explanability (by introducing a new module for every new observation)."[23]

The latter claim is indeed one that many neuropsychologists are careful to guard against. However, it is far from the case that every new observation prompts the introduction of a new module, rather that attempts are made to understand how such different patterns of information processing demonstrated by dissociations are accounted for within broader models. Hierarchies of modules and sub-modules are perfectly feasible within a broader modular architecture and economy is a strong principle operating in the neurosciences. Even if one were to admit that there *has* been a tendency for un-replicated findings to be the basis for new models, this marks a limitation of scientists rather than a flaw in modular theory.

Goldberg's critique here is directed at a very static interpretation of modularity, despite the fact that he himself acknowledges weak emergent modularity for the neocortex (and indeed accepts strong intrinsic modularity within the thalamus). This acceptance seems at odds with the fact that many of Goldberg's critiques are criticisms of modularity as a whole, contradicting his acceptance of weak emergent modularity. A modular organisation may also encompass weak dissociations; i.e. can allow for degradation of input, which Goldberg claims is indicative of a gradiental organisation. For example, in many cases what we see is poor performance on tasks and not lack of performance at all. Outputs of modules must be integrated at some level, and damage to the integration of a module's output would conceivably result in weak dissociations which, Goldberg claims, show graded organisation.

This brings us to the suggestion of non-modular 'interactionist' models (where processing systems may interact with each other unlike the autonomy and encapsulation of modular systems). Going back to my initial comments on Goldberg's account, I noted that it bears similarities to interactionist accounts as discussed by Shallice (1988 pp.249-250) and others (e.g., Faust, Babkoff & Kravetz, 1995; Posner & Carr, 1992). I do not, however, think that modular and interactive models of processing are necessarily rivals. Unfortunately, calling one's account a modular account immediately seems to invite notions of a strict Fodorian modular architecture, but this does not have to be so. As I noted above, the outputs of modules need to be integrated and subject to further processing at some further level, so in a weak sense it would be true to say that modularity comes hand in hand with at least some level of 'interactive' processing. Goldberg too comments that interactive principles of modularity may take the form of weak modularity (1995, p.193). There is certainly room for interaction of processing subsystems, though this may vary according to task demands such that some systems operate autonomously and others involve interactive principles. Any critique depends upon what level of processing one focuses upon and the specific commitments to encapsulation within a particular architecture. With regard to music, there is nothing to prevent a model of music processing from encompassing interactive components relative to the task at hand. As we will see in Chapter 7, this may be necessary to such interdependent functions as rhythm and melody, which require integration for successful music processing.

6.3 Summary

Within this discussion I have highlighted some representative critiques of modularity. What is hopefully evident from the above discussion is that often these are methodological criticisms rather than critiques of the modularity thesis. Undoubtedly there will be methodological criticisms, as there are of any experimental discipline. However, the discussion demonstrates that we do not have to concede too much to these, so long as claims made are on the basis of well replicated, reliable, and convergent findings. Although one can see the validity in criticising specific applications of modular criteria in light of empirical evidence, there seems little point in offering a critique of modularity per se when there is so wide a variation in modular hypotheses.

Nonetheless, the variability of modular hypotheses highlights problems for the development of a general model in Chapter 7. In relation to the tri-partite division outlined above, not only are there different associated possibilities for modular hypotheses but, there are degrees of variation within these — e.g. some modular processes within a cognitive system may be largely innate, while others are acquired. Some processes or sub-processes may be specifically localised, whilst others are distributed across multiple areas of cortex. And, some functions classified as domain-specific music processes may in fact be domain-general auditory processes, and these will come to light as specific empirical findings are considered. Nonetheless, this does not mean that we have no foundation for the development of a model. The empirical findings do offer a substantial guide, for example, as regards the degree of autonomy, universality, and domain specificity.

The task of Chapter 7 will be to examine in detail which aspects of music processing conform to which modular criteria, and in turn to consider how these relate to other auditory functions. The following questions are central to the development of such a model: How does music cognition subdivide? Which aspects of music are domain specific and which may be subserved by general purpose auditory functions? Are there any innate musical functions? And, are there any universals in music cognition? The discussion will also serve as a forum for challenging existing hypotheses in light of methodological criticisms and new empirical evidence.

Notes

[1] Domains do not necessarily correspond to traditional divisions in perceptual processing e.g. vision, hearing, taste etc. Modules exhibit domain specificity in that they operate only on specific sets of input.

[2] Gall's terminology is unhelpfully ambiguous, aptitude implying inclinations as opposed to competences.

[3] See Stillings in Garfield, p.383

[4] While this is true, it is worth noting that Marr's account has been criticised for neglecting to account for the relationship of vision to e.g. motor processes.

[5] These findings have chiefly related to the visual cortex -specific areas of the cortex relating to blind-spots in the visual field, but recently the auditory cortex has been subject to study. See Belin et al., 2000, *Voice Selective Areas in Human Auditory Cortex.*

[6] See Shallice p.19 in defence of this claim, and also Marslen-Wilson and Tyler (Ch.2 in Garfield) . Marslen-Wilson and Tyler suggest that central cognitive processes also demonstrate such fast rates of response.

[7]See Chapter 5 on discussion of the validity of inferences from damaged to normal cognition p.

[8] see MOM pp.38-46, & 101-119.

[9] Fodor gives examples of possible modular functions see p.47. MOM.

[10] Subjects with amusic deficits lose the ability to interpret *all* sounds formerly identified as music. Auditory domains develop fairly rigid boundaries, and other auditory faculties have set domains of input which will not interpret musical information.

[11] Fodor does later reduce the strength of this claim suggesting that intermediate levels of processing are accessible but only at a price, by imposing unusual demands on, for example, attention or memory. See Marshall's comments on this claim: Marshall p.221.

[12] See Day R.H, & Knuth H, Perception, 1981 126-149.

[13] p.140 Coltheart & Langdon

[14]See Shallice , 1988 p.21, 1984, p.247. Kahneman's proposal was that attentional capacities might be flexible, such that if one placed more demands on a subject (i.e. increased the attentional demands of a task), this might increase arousal which in turn would serve to free up more mental resources.

[15] See Moscovitch, 1995 p.167-16, However, Moscovitch also runs together two distinct ideas -cognitive impenetrability and informational encapsulation. These will be dealt with in some detail below.

[16] Goldberg does not explain what he is referring to as 'weak dissociations'. However, I assume he means such cases for example where subjects A & B are both impaired, (compared to controls) but e.g., A is more impaired than B. It might then be questionable to use A & B as convergent cases compared to normal controls, or to compare A & B's performance on tasks.

[17] It may be worth remarking that there is nothing very unusual about the use of dissociations to diagnose modularity. One might say that it is just an example of one of our most important tools of investigation into causal mechanisms, namely the use of contrastive explanation in cases of presumed independent causal histories, as typically introduced by 'Why P rather than Q?' questions. - E.g., why did life evolve on Earth rather than on Mars?

[18] For further discussion, See Shallice 1988 and Caramazza 1986

[19] See Mendez M.F. & Geehan G.R. (1988) Cortical Auditory Disorders: Clinical and Psychoacoustic Features. J. Neurol. Neurosurg. Psychiatry: 51 1-9. Motomura N, Yamadori A, et al. (1986) Auditory Agnosia: Analysis of a case with bilateral subcortical lesions. Brain: 109 379-391.

[20] Goldberg p.193

[21] Goldberg p.203

[22] See Marshall p.228 on localisation of similar faculties

[23] Goldberg p. 194

Chapter 7

Proposing a Modular Hypothesis for Music Cognition

7.1 Introduction

Evidence from both normal and impaired cognition suggests a broadly modular architecture for music processing. For example, the evidence from the case study of MR suggests that complex music processing may remain intact in the presence of severe impairments in language, strongly supporting claims that there are autonomous subsystems not only for processing auditory input but also for reading and writing music and language. Chapter 7 examines the evidence for both a modular structure of individual information processing components and a global cognitive architecture for music. The approach taken is to provide an account which is compatible with both neuroanatomical, and functional organisation. In light of empirical research, I will assess which aspects of music exhibit domain specificity and which may be subserved by auditory domain-general processes. The case findings presented in Chapter 5 also offer the opportunity to challenge existing hypotheses concerning domain specificity of musical function, hemisphere dominance, and variability of hemisphericity and processing strategies between musicians and non-musicians. Issues of localisation, and distinctions between expressive and receptive musical functions will be also be given consideration in relation to the proposed model.

My aim, in the first instance, is to outline a 'basic' architecture to account for musical functions which might reasonably be attributed to an untrained listener following typical exposure to western tonal music. Experimental psychology has been able to verify facts that have long been known — that 'normal listeners' *are* able to make a wide range of musical discriminations,

> "average 'unmusical' folk know a great deal more about music than they might give themselves credit for. They can probably hum, or at least recognise, hundreds of nursery rhymes, folk songs, and popular tunes. They can probably spontaneously clap or tap their feet in time to pieces of music they have never heard before. They can probably distinguish between a competent and an inept performance of a piece, though they may not be able to explain what makes the difference. And they can make aesthetic judgements about what pieces they like better than others." (Jackendoff, 1987, p.213).

My main concern is to explain adequately auditory receptive function (including auditory affective perception). However, I shall also consider expressive musical abilities and lexical, orthographic, and mnemonic functions. To begin, however, it would be useful to give a summary of the empirical evidence presented, and what this suggests in terms of the level of autonomy and broad subdivisions of auditory cognition.

7.2 Evidence for Autonomous Processing

As seen in Chapters 1, 3, and 5, following brain injury, auditory (and auditory affective) faculties can be selectively spared or impaired. While my primary concern is music processing, dissociations of language and environmental sound can provide a good preliminary picture of auditory processing.

The most obvious inference to make from double dissociations is to suggest that, to a large degree, music, speech and environmental sound are processed separately in the brain. For example, if one loses the ability to process environmental sound or speech, one loses the ability to process a fixed set of auditory signals. In terms of damage to receptive auditory comprehension, these subdivisions are demonstrated by: cases of pure amusia, Peretz & Kolinsky, 1993 (CN); pure word deafness (an isolated loss of the ability to comprehend spoken language), Tanaka et al., (1987), Klein & Harper (1956); and loss of environmental sound processing, Spreen et.al., (1965). As such cases demonstrate, one cannot simply choose to hear a sound in a different way, for example, to hear speech as singing in an attempt to bypass the damaged system. The processing of sounds by distinct systems is mandatory and our brains exhibit 'channel specificity'[1], that is, each subdivision of auditory processing is 'trained up' or 'programmed' to deal with a specific set of inputs. If we lose the ability to process one of these groups, the task cannot be taken on by another auditory processing 'module'. Although we see these rigid boundaries in individual subjects, it is not clear whether these are consistent across subjects and this is an issue subject to further empirical testing.

Initially, the evidence from dissociations of auditory processing would seem to suggest that music, speech and environmental sound are processed by separable subsystems, but, as I commented above, this provides only a *preliminary* picture of auditory cognition. To some extent it may be true that these categories of auditory cognition exhibit processing autonomy, but there is clearly contradictory evidence which will need to be explained. For example, whilst there is a great deal of evidence for separation of language and music, it remains unclear whether these are autonomous across all modalities (i.e. across all input and output routes - auditory comprehension, orthographic input and output, spoken output etc.). For example, it does not seem to have been made entirely clear whether or not there might still be some shared temporal or contour processing capacities for auditory processing. More specifically, one must question whether the lack of pure cases of selective damage and sparing to environmental sound processing is a result of the involvement of general purpose mechanisms, as opposed to being the result of a neural localisation which is particularly resistant to damage. And in light of such considerations one must be careful not to over-generalise about fractionation of auditory systems based on the evidence of music and language studies. The task difficulty issue is important here, particularly in relation to environmental sound processing where one does not perhaps have such fine levels of discrimination. An 'apparent' loss of environmental sound processing discrimination might just be a reflection of task difficulty in this domain as opposed to a real loss of some processing capacity.

In terms of affective processing we have seen that the model of affective processing in Chapter 1 fits well with evidence from music cognition. There is good evidence to suggest that there are distinct processing pathways for identity of musical features and processing of auditory affective cues. In light of this, basic affective processing can be maintained in the presence of musical deficits as seen in amusic subjects. More complex affective processing would appear to be a post-perceptual process. In relation to affective processing however, it still remains unclear whether auditory affective perception (detection of emotion or affect in auditory signals — speech, music etc.) is specific to each auditory category or, a general property of auditory processing.

Whilst there are a number of reservations in relation to the level of autonomy exhibited by auditory sub-systems, these should not be seen to detract from the empirical evidence which has been presented so far. Within music processing itself there are a variety of ways in which functions are subdivided. Double dissociations provide strong evidence for the autonomy of musical subsystems across expressive and receptive modalities. For expressive functions, processing subdivides into oral-expressive, instrumental-expressive, and orthographic processing. For receptive abilities, one sees subdivision in terms of rhythmic, melodic, tonal, visual orthographic functions and also associative processes — matching musical input to stored representations. Further deficits however, may cut across these modalities, mnemonic problems for example, can be specific to receptive, expressive or both areas — i.e. a failure to access stored input representations or failure to retrieve of stored output representations. In musical terms, an inability to play or sing from memory, or an inability to recognise melodies.

Whilst there are clear subdivisions in relation to specific musical features, one must be careful over attempts to pinpoint the underlying cause of a particular type of processing deficit as in the case of the receptive /expressive distinctions above. A further distinction needs to be made between *apperceptive* and *associative* deficits, and this is analogous to both language and visual processing[2]. Apperceptive deficits involve difficulties de-structuring or analysing the auditory input, and typically result in a perceptual deficit, e.g. an inability to discriminate between aspects of auditory input. Associative deficits involve post-perceptual processing, a failure to link the results of perceptual processing to stored musical knowledge, or simply a failure to access stored musical knowledge at all. Apperceptive deficits typically result in an inability to recognise music as familiar or novel, or an inability to retrieve items from musical memory.

In support of such existing studies, case MR (presented in Chapter 5) provides evidence of autonomous processing for a variety musical functions, and raises questions regarding many implicit assumptions in the literature on musical deficits. Perhaps most importantly, MR suggests that many complex musical functions do not depend on any form of language-processing. Whilst auditory memory for speech is poor, musical memory functions effectively allowing retention of 12-15 second extracts with ease. MR shows remarkable sparing of highly complex musical abilities in the presence of severe language deficits. Whilst MR is severely impaired for sentence reading, he has no problems reading an orchestral score and detecting errors in performance, exhibiting a dissociation between the grammatical processing (or ability to decode the structures) of language and music. To recap from Chapter 5, the retainment of analytic processing strategies as demonstrated by MR refutes the suggestion that there are abstract processing strategies associated with left and right hemispheres. The extent of left hemisphere damage suggests that MR is processing music almost exclusively in the right hemisphere and also using analytic strategies, contradicting the suggested analytic/holistic dichotomy. Case MR also provides clues as regards neurological differences between musicians and non-musicians, not only does MR contradict current thoughts on lateralisation, but also allows us to suggest that there may in fact be no differences at the gross level of lateralisation for musical and non-musical subjects.

In light of earlier criticisms, it is important to note that unlike many cases of musical deficits, MR is well replicated in the literature, and indeed, by some very high profile cases of musical sparing. The Russian composer, Shebalin lost all language abilities after suffering a stroke, yet managed to continue composing highly acclaimed works. The composer Ravel lost written and verbal language abilities, but was still able to enjoy music, teach students and criticise compositions and performances of his contemporaries. Whilst both these cases are of professional musicians, other well documented replications of MR appear in the literature (see Morgan & Tilluckdharry, 1982; *Two Cases of Aphasia Without Amusia*; Assal, 1973, *Aphasia*

Without Amusia in a Pianist). It therefore is surprising that claims that musicians use the left hemisphere to process music have been sustained in the face of this contradictory evidence.
To summarise, by drawing carefully from empirical evidence, one has a good basis upon which to begin building a general model. One can see for example, that there is a clear fractionation of music cognition in terms of melodic, rhythmic, mnemonic, and tonal functions, and clear division of expressive and receptive functions, analogous to the subdivision of language. Apperceptive and associative deficits also provide evidence for distinct perceptual and post-perceptual processes. The dissociation of affective processing from the capacity for identification shows different routes for perception of affect and identification of musical features. The evidence therefore suggests both separate processing routes for different types of information, and separate phases of processing within a route (associative and apperceptive).

Contradictions in the literature are also useful in terms of modelling music cognition. For example, there is *not* clear evidence for differences in hemispheric lateralisation of music for musicians/non-musicians, and in light of this, I would not adhere to an account offering variable hemisphericity in relation to musicality. As discussed in Chapter 3, attempts to lateralise music have been misdirected, and whilst it is not appropriate to attempt to lateralise gross musical function, it may be possible to lateralise and localise in relation to different types of processing tasks or different types of input. While this is highly speculative, finer divisions do need to be drawn between types of musical processing tasks if one wants to attempt to localise functions.

7.3 Discussion: Assessing Music as a Candidate for Modularity

The evidence that there are autonomous functions for different aspects of music processing fits well with Fodor's idea of domain specificity: that the sensory modules are likely to be 'highly specialised computational mechanisms'[3] tailored to process specific sets of input. But whereas Fodor's account operates at the level of macrodomains, the evidence goes beyond Fodor's notion into micro-domains, and thus we need an account with further fractionation of functions. Whilst Fodor's account only touches on music as a possible module, other accounts have gone further to offer specific conceptualisations of music as a candidate for Modularity: e.g., Peretz and Morais, 1989; Gardner, 1983; and Jackendoff, 1987. Several theorists have even gone so far as to suggest that music serves as a good model of cognition as a whole. Peretz comments,

> "Since music data are systematic, relatively clear and accessible, it is theoretically and methodologically advantageous to study music as a way to study the mind"(1989, p.279).

> Jackendoff raises a similar point,

> "The examination of musical processing ought to be of more than parochial interest: the issues it raises concerning musical processing bear on larger questions of the brain's overall "style." "[4]

It needs to be examined then, in what sense musical processes are candidates for modularity and which modular characteristics are observed. Although I am not advocating a strictly Fodorian model, it may be useful to assess music in terms of the modular characteristics Fodor expounds in *The Modularity of Mind.* This comparison allows us to see not only how music conforms to orthodox modularity, but also, to what extent music deviates from the orthodox modular thesis. In Chapter 6, I also noted that one could construct a basic tri-partite division of associated possibilities for modular hypotheses: Modules as innate or developed, Modules as neurally dedicated or functionally multiply realised, and Modules as peripheral or central (i.e. massively modular architectures). In light of this I would like to evaluate the empirical findings in relation to these divisions, which allow us to characterise the type of modularity proposed, i.e. as in Goldberg's comparison of weak emergent and strong intrinsic modularity.

7.3.1 Modules as Innate or Developed: Evolutionary Plausibility and Modularity

The channel specificity observed in auditory dissociations offers strong support for mandatory processing of music. However, as I noted in Chapter 3, this presents specific problems for the musical case. This is because the mandatory nature of processing is usually explained in terms of its evolutionary necessity to the organism in question. And whilst one can see the advantage of mandatory processing for most sensory domains in terms of recognising threats in the environment, one is hard pressed to explain the mandatory nature of music processing in terms of any such evolutionary advantage. This has been a recurrent concern in attempting to offer evolutionary explanations of musical function comparable with language, or vision. In light of this, one might be tempted to equate music with functions such as reading, which are not acquired without explicit tutoring. As Jackendoff notes, "Thus music tends to be regarded as one of those specialised learned skills like chess or tennis or mathematics." (1987, p.213). However, one should not equate acquired functions with those requiring explicit tutoring. Functions can be acquired with minimal input, and the view of music as a 'specialised, learnt function' misrepresents the variety of functions encompassed by music cognition, many of which are acquired with minimal auditory input e.g., natural preferences for tonal scales. Jackendoff comments on this problem for music, whilst acknowledging that there are both innate and acquired aspects to the function as a whole:

> "There appears to be no evolutionary justification for such a capacity: unlike language, it is hard to think of convincing reasons why such a capacity should be adaptive. However, the principles and representations organizing the cognition of music are in part peculiar to music, and all of Fodor's criteria for input modules apply to music perception. Thus it appears that one must acknowledge a separate specialization in this capacity as well. Music shares with language a culture-dependent component: one must be exposed to the music of one's culture to fully comprehend it. That is, the ability to understand pieces of music is in part acquired." (Jackendoff, 1992, p.71).

As noted in Chapter 3, a typical response to the evolutionary problem is to cite the social role of music, (e.g. Peretz, 1993; Dowling & Harwood, 1986; Sloboda, 1985), suggesting that music has evolutionary plausibility in terms of its adaptive advantage to the *social group* as opposed to the individual, allowing shared social activity, emotion, group cohesion and perhaps refinement of motor and vocal skills.

I criticised this 'sociological' argument in Chapter 3. However, I also noted that there is a tension between claiming music has colonised pre-existing auditory systems, and also claiming that it is music per se that is selected for in evolution. I offered a tentative solution to this problem, but this deserves further comment here and I would like to defend my earlier critique by offering a more detailed account of music in relation to evolutionary development. This issue is particularly important in relation to a modular architecture as regards whether the modules postulated are innate or acquired. If one postulates innate capacities, then one does need to account for these in terms of their adaptive advantage. As noted in relation to

Chomsky's account, there is a fine balance between postulating innate abilities and conforming to a framework within evolutionary biology.

One can resolve this tension if one considers that some functions which appear to be music specific processes are in fact auditory domain general processes. Not every response to music will be music specific. For example, auditory affective responses and startle responses seem more likely to be domain general processes (albeit ones that require further explanation). There might seem to be some confusion here as regards domain generality and this point will bear a little further explanation.

There is certainly plenty of scope for confusion over what is meant by 'a domain', and consequently for misleading disagreements over what is 'domain-general' and 'domain-specific'. One point that needs attention in relation to division by domain in evolutionary arguments is the distinction between *proper* domains and *actual* domains. For example, certain spatial abilities might originally have functioned in their adaptive environment to enable hunters to track down their quarry. But that may be a far cry from the functions to which such cognitive specializations are applied by modern humans — navigating their cars through city streets, for example (part of the actual domain). The proper domain is what a cognitive capacity was selected for in evolutionary history, the actual domain is the range of deployment of that capacity in current processing and behaviour. Naturally these two sorts of domain may differ in extent. So we need to consider whether music is to be taken as the proper domain of certain processing systems, or the actual domain of systems which evolved for other purposes.

A second source of confusion arises from the fineness with which domains are discriminated. By 'domain-general' processing one *might* intend only some form of processing that can be applied across any domain whatsoever. Domain-generality in this unrestricted sense is probably something of a straw target for the advocates of modularity. When neuropsychologists talk of 'domain-general' processes they usually intend to refer to processes that are general *within* some fairly substantial division of cognition (e.g. auditory or visual processing) and are general *across* a number of quite finely discriminated capacities within that domain. So for example, affective and startle responses might be general within auditory processing (across music, speech, environmental sound), or even within any form of perceptual input processing. The sense of domain generality I refer to in relation to 'auditory domain general' is just this general purpose processing within a particular cognitive division and not domain generality in terms of an abstract processing strategy which might apply across any cognitive domain.

Returning to the problems of affect, affective cognition for music has been seen as a sub-component of music processing, possibly due to the misconceptions of confounding affective perception with other forms of cognition. Indeed, post-perceptual processing of music will depend on recognition and evaluation of musical features. Nonetheless, the direct effects of music on our auditory systems may be a function of a general purpose auditory affective mechanism (and as yet, there *is* no evidence this system is music specific). One might see music specific *responses*, but this does not imply a music specific system. Rather that it is an auditory domain general system, which responds with different associated possibilities for different acoustic inputs.

What is adaptively advantageous are fine-tuned auditory processing abilities, in addition to an auditory-motoric conversion ability (e.g., startle responses to sound, affective responses to sound, imitation of sounds and an ability to tap to rhythmic patterns). With these mechanisms in place, one can *acquire* an endless variety of complex capacities, including the subsequent development of some music specific predispositions and input specific response patterns. Put simply, nature equipped us with a number of general purpose auditory processing mechanisms and mandatory processing of music may be inherited as a by-product of mandatory processing for other auditory input.

To resolve this case fully, one would need to examine the evidence for innate pre-dispositions and universals in music cognition. I have noted the general lack of investigations into music processing, and correspondingly there are even fewer attempts to investigate the music processing abilities of infants. Nonetheless, some studies have been conducted, and the results replicated, such that we may begin to develop hypotheses regarding music processing predispositions. Despite the obvious limitations imposed on experimental procedures, studies of infants' responses to music have revealed a number of processing predispositions and similarities between infant and adult music perception are striking. Adults who have had significant exposure to musical stimuli perform no differently in basic perceptual discrimination abilities from infants who have had minimal exposure to musical stimuli.

> "For example, infants and adults focus largely on the pitch contour and rhythm of novel melodies, reflecting a disposition to attend to relational pitch and timing cues rather than to specific pitches and durations. Moreover, infants and adults retain more information from sequences whose component tones are related by small-integer ratios (2:1, 3:2) than by large-integer ratios (45:32). Infants remember the component tones of scales more readily when the scale steps are of unequal size (e.g. tones and semi-tones), as in the major scale, rather than of equal size.[[5]] Furthermore, they encode more details of a melody when its rhythmic arrangement is conventional rather than unconventional." (Trehub, 2000, p.427).

The majority of tests have been conducted on infants around 6-8 months old with 'minimal musical exposure', but one could argue that such infants have already had sufficient exposure to develop processing strategies for music. In response to this critique, convergence of evidence across tests would seem to refute this suggestion, in favour of pre-dispositions to attend to certain aspects of sound. If infants were to develop their own idiosyncratic methods of processing, there are a variety of musical features they might attend to in order to facilitate memory and comparison of musical structures. Added to this, the degree of variation in musical cultures and exposure to music would also suggest that one might see a significant variation in the patterns of infant responses, but this is not the case.

In light of the findings Trehub, (2000) proposes three processing universals:

> [1] "the priority of contour over interval processing; [2] the priority of temporal patterning over specific timing cues; and [3] the relevance of gestalt principles of grouping."

For example, with regard to [3], pauses inserted *within* groups of tones are detected more readily than pauses *between* groups of tones. i.e., one naturally groups notes into categories, so a pause between categories is not as readily detectable as a pause inserted in what would typically form a whole musical unit.

To add further support to her claims, Trehub notes the relationship between the favoured processing cues and universals in cross-cultural structuring of music:

> "The proposed processing universals that were derived from infants' perceptual abilities have their counterparts in universals or near-universals of musical structure. Indeed, examination of music from different regions and historical

> periods reveals greater relative emphasis on global features (e.g., contour, rhythm, than on local details (e.g., specific pitch levels and durations)"

Trehub presents a compelling case. But do universals and infant competencies really reflect specifically on music or on the more general auditory processing capacities? None of her evidence rules out the possibility that the responses seen are auditory domain general as opposed to music specific. In contrast to evidence from double dissociation, the fact that the stimulus is music does not necessitate the response being a function of a music specific system.

Whilst the relationship of processing predispositions to universals in music is biologically plausible, it also highlights a paradoxical situation in relation to musical universals. Are the cross-cultural universals in music due to processing predispositions? — e.g. a superior ability to remember or discriminate certain types of auditory structure? Or, have the processing predispositions developed from their constrained inputs i.e. the universal structuring of musical systems around naturally occurring sounds and ratios? Whilst this does not cause any complications for the model being proposed, it does call for caution in relating musical structures or auditory structures to processing: i.e., one should be cautious about making claims regarding the development of musical cultures, based purely on evidence from processing predispositions. One could then be subject to criticism for tailoring stories of cross-cultural and evolutionary musical development to fit the results observed.

Developmental psychology also provides some evidence regarding *pace and sequencing of development*. The study of developmental stages in language may provide an interesting parallel with music. Within the study of language development, changes in task parameters have allowed experimenters to reveal and lower the ages at which significant developmental stages are reached. For music, the same revision of developmental stages might certainly be seen, subject to suitable task parameters. Nonetheless, the evidence is still not conclusive as regards whether there is a fixed sequencing for the development of tonal knowledge, (awareness of 'correct' and deviant tonal structures within the musical system one is exposed to), and other musical capacities. In comparison with language, where there may be some degree of variation between children in reaching developmental stages, this may well be more exaggerated in music. Nonetheless, there is some strong evidence that encoding pitch information in terms of tonal scales occurs without explicit tutoring in the early stages of development.[6]

In light of the empirical evidence, I would argue that there are at least some basic predispositions specific to the auditory domain and, whilst I am not convinced these are music specific, they may nonetheless have bearing on the acquisition of music specific functions. Indeed, the predispositions outlined by Trehub would seem well placed to fulfil something like Karmiloff-Smith's notion of domain-specific predispositions:

> "That nature specifies initial biases or predispositions that channel attention to relevant environmental inputs, which in turn affect subsequent brain development" (Karmiloff-Smith, 1992, p.5)

Indeed, in postulating domain-specific predispositions, one is not postulating innate, hardwired modules, which follow their own developmental agenda, but rather, that all that is needed is an initial bias in favour of certain attentional preferences. Despite the initial bias, the system should still allow for flexibility in attentional preference, and in relation to environmental stimuli. Examples of 'perfect pitch' demonstrate that one can override the initial attentional bias (e.g., in this case an ability to focus on specific pitches as opposed to pitch as a relational property.) Notably some musical systems (e.g., Gamelan,) do place more emphasis on individual pitch than on pitch relations, and it would be useful to examine attentional biases in such cultures. This leads us on to the next issue in the development of a modular thesis: whether there are localised structures for music. For if one allows for a process of gradual modularization, one then has scope to account for the diversity of neural substrates associated with music.

7.3.2 Modules as Neurally Dedicated or Functionally Multiply Realised

This brings us to perhaps the most controversial and indeed problematic issue in developing a modular account of music — whether music may have *specific neural localisations*. Obviously music strongly exhibits *characteristic patterns of breakdown* and *domain specificity* for those areas subject to selective damage and sparing. In terms of functional separation then, there are distinct subdivisions in processing and relatively rigid boundaries between domains. It is certainly feasible to develop a functional model irrespective of neuroanatomical correlates, but underlying neural hardware might well place constraints upon its corresponding functional processes (e.g. as we have seen in the case of affective processing). Nonetheless, there does seem to be some level of correspondence between function and structure, and I aim to develop a functional model which, though valid in its own right, is also compatible with (and indeed supported by) neuroanatomical findings. In addition, I will examine evidence for specific localisation of functions.

As previously observed, one of the main aims of studying amusias has been to establish hemisphere dominance for music cognition. However, both left and right hemisphere lesions have reportedly resulted in musical deficits, leading to contradictory claims for lateralisation. I want to suggest that there may, however, be discernible reasons for the observed differences in lateralization of music processing. The debate about lateralisation for musical function might be resolved by referring to specific subject differences (e.g., developmental influences), and to specific musical capacities, and it is more likely the case (as noted in Chapters 3 and 5) that gross musical function cannot be systematically lateralised in the same way as language processing has been. The 'dominance' debate, however, is beginning to be somewhat archaic. There is much more emphasis on co-processing by hemispheres, e.g. a highly lateralised function like speech is also bilaterally organised — with for example, right hemisphere involvement in prosodic processing and possibly also the perception of vowels.

Whilst issues of hemisphere dominance are still unresolved, more recently attention has turned to attempts to localise specific musical functions. Receptive musical deficits have been broadly associated with damage to the temporal lobes and selective damage to musical components does suggest specific neural circuitries in operation for music. Indeed the problems of hemisphere dominance and gross lateralisation of musical function are not a problem for the notion of specific neural localisation. The issue here is specified neuronal systems, but no necessity that the *total* function is mediated by processors which are anatomically adjacent.[7]

There is nonetheless a particular need to distinguish between type of musical deficit when attempting to lateralise musical function, and, whilst this would seem obvious, it is all too often ignored. It seems likely, for instance, that expressive musical functions may exhibit quite some variation in terms of lateralisation. For example, expressive musical abilities may involve motor co-ordination, which is left hemisphere dominant, (the left hemisphere being responsible for co-ordinating motor activity) but if one plays an instrument, which requires fine motor co-ordination of one hand, it is reasonable to assume that this motor ability will nonetheless be affected by damage to the contralateral hemisphere. In addition it has recently been suggested that melodic and temporal processes may be lateralised to right and left hemispheres respectively (e.g., Peretz, 1985). Many of the problems for lateralisation perhaps relate back to the problem of using expressive responses to measure receptive abilities.

Whilst lateralisation is concerned with gross musical function, these concerns apply to issues of localisation too, and surprisingly contemporary studies still do not appear to offer sufficient distinctions between expressive and receptive deficits.

However, there is little point arguing specifically about localisation until one has a good body of evidence, i.e. cases where pre-morbid laterality, lesion localisation and premorbid musical ability are well established, co-occurring deficits are documented, and equivalent tasks are being compared across subjects. One also has to allow for subject variations in task processing, as not all subjects will process tasks in the same way. Given the above evidence of processing predispostions and suggested attentional biases, one could move towards more accurate assessments of hemisphericity and localisation. Indeed, if processing predispositions are innate, then it is perhaps these that should be the focus of localisation studies, although merely because they are innate tendencies does not guarantee rigid invariance in cognitive architectures. The case for gradual modularization may in fact account for the variability in localisation.

I commented earlier that one needs to examine responses to specific input to establish neural correlates, (as has been the case in studies of visual processing). Some investigations have adopted this approach in relation to affective responses which are known to have some associated neural structures. The resulting studies have succeeded in relating positive and negative affective responses to music to different neural structures, but these are still widely distributed across hemispheres and regions of cortex (see Blood et.al, 1999). The lesions acquired by accidental damage are often diffuse rather than lesioning precise anatomical structures. And for this reason it is often difficult to determine whether all or only some of the damaged structures are responsible for resulting deficits. A different method is to examine the deficits resulting from exact surgical excisions, providing a further source for convergence of evidence. Such studies also allow for testing of musical function before surgery, so an accurate comparison of functions can be made.

Liégois-Chauvel et. al, 1998, examined musical functions in epileptic subjects who were due to have specific surgical excisions in order to control their epilepsy. They found that removing certain parts of the temporal lobes did correspond to the occurrence of specific music deficits. Right-sided temporal cortectomies were detrimental to processing contour and interval. Left-sided cortectomies were detrimental to interval processing, but not to contour processing. The findings suggest that the posterior part of the right superior temporal gyrus is critical in melodic processing. The anterior portion of the superior temporal gyrus (left or right) led to deficits in judgements of metre (grouping of rhythmic structure), also providing evidence of a double dissociation between metre and rhythm (see Peretz, 1990; Polk & Kertesz, 1993). These findings do indicate that looking at specific musical tasks and processing strategies may be revealing in attempts to identify neural substrates. However, whilst this seems to be pressing evidence, it is contradicted by case MR, who does not exhibit interval processing deficits, whilst exhibiting severe damage to the left temporal lobe. In the above study subjects were non-musicians, and the proposed hypothesis was that,

> "a right hemisphere lesion, by disrupting the processing subsystem required for representing the melody contour, deprives the intact left hemispheric structures of the anchorage points necessary for encoding interval information. Thus, unilateral brain damage in either hemisphere can affect the extraction of interval information. In the case of damage to the left hemisphere structures, the neural circuitry necessary for dealing with the interval features would be

> disrupted while leaving intact that involved in building the global melody representation in the right superior temporal gyrus." (Liégois-Chauvel et. al, 1998, pp.1863-1864)

In light of case MR, it is perhaps the case that musically sophisticated subjects perform differently, or that in some cases interval processing may also be localised in the right hemisphere. This highlights the need for caution in assuming invariance in cognitive architectures across subject populations.[8]

7.3.3 Modules as Peripheral or Central? Independence and Interaction of Perceptual, Post-Perceptual and Evaluative Cognition

The next question I wish to address is to what extent 'music modules' exhibit autonomy from other cognitive systems. *Informational encapsulation* is perhaps the most debated aspect of modularity, and the aspect that Fodor deems essential to any modular architecture. It is important, however, to distinguish informational encapsulation from cognitive impenetrability. The former concerns a module not being able to make use of something 'known' elsewhere in cognition. The latter concerns representations *within* the module not being available to the rest of the system — there is *limited central access* to a module's representations. These distinct ideas are run together by Peretz and Morais (1989). For example, they cite Shepard as providing some evidence for cognitive impenetrability for tonal encoding of pitch,

> "First, Shepard (1982) has noted that the application of the knowledge that we have about musical scales appears mandatory and cognitively impenetrable. Phenomenologically, when listening to the eight successive tones of the major scale (*do, re, mi,....do*), we tend to hear the successive steps as equivalent, [this is a good introspective experiment!] even though we know that two of these intervals (*mi-fa* and *ti-do*) are only half as large as the others." (Peretz & Morais, 1989, p.288). See Shepard & Jordan[9] for evidence of this phenomenon.

In fact, the example given can be used to exemplify both cognitive impenetrability and informational encapsulation, but as Peretz and Morais present it, (and compare it to optical illusions), they use the example to exemplify informational encapsulation as opposed to cognitive impenetrability by demonstrating that the module does not access information held elsewhere (i.e. regarding our knowledge of the division of pitches in a scale). The proposed 'module' for tonal encoding of pitch is informationally encapsulated. The module's representations cannot access (or make use of) our knowledge that the percept is otherwise, in an analogous way to the Müller-Lyer illusion (i.e. we know that the scale is not equally divided but we *cannot* hear it otherwise, just as we know that the two lines in the illusion are really of equal length.)

The example could also be used to exemplify cognitive impenetrability, but here one should stress the inability to access *the module's* internal representations, (i.e. we hear the steps in the scale as equivalent, and we know they are not equivalent, but we cannot access *the internal analysis of pitch relationships*).

Peretz and Morais add further confusion when they later comment that tonal knowledge is modular but that the module's internal representations must be accessible to central processing. They note,

> "Assuming that the output of such a system [tonal encoding of pitch] is a representation of pitches coded in terms of scale steps, music listeners, unlike speech listeners must still have access to the "uncategorized" frequency information, that is to early encodings in terms of pitch height. Otherwise, a chord, for instance, could not be heard as out of tune, by less than the smallest musical unit." (Peretz & Morais, 1989, p.290. Bharucha and Stoeckig, 1986, 1987, provide some evidence for this phenomenon).

Peretz and Morais argue then, that if one only had access to the module's output then one could not hear a note as 'out of tune' as the output only provides us with a percept in terms of an equally divided tonal scale. And in fact we are quite sensitive to hearing discrepancies in tuning of instruments. (We all know what an out of tune piano and an off-key singer sound like).

That may be so, but it would seem that Peretz and Morais are mixing their modular functions. The tonal encoding of pitches in terms of internalised musical scales (i.e. relating pitches in terms of their relationships within a sequence) does not necessitate discrimination of discrete pitches and may only require mapping of musical scales and pitch patterns onto existing internalised representations. This would seem to be a post-perceptual process concerned with perhaps utilising contour information *in addition* to internal pitch relationships. If this were the case, then so long as scales mapped onto contour representations, they would be heard as 'correct' in terms of their global relationships, whether or not specific intervals were deviant. It would be more likely that a pitch perception (interval processing capacity), or melodic processing module would deal with pitch height relationships which might then feed into a tonal encoding module. An appropriate analogy might be to consider a melody played on an out of tune instrument. One can still access tonal relationships, e.g., harmonic progressions and key changes (and thus recognise a familiar tune) whether or not the pitches are exactly right.

This hypothesis would seem to be supported by one of Peretz's own subsequent cases GL., (Brain, 1994) who demonstrated intact pitch discrimination in the presence of a tonal encoding deficit. One can then have access to pitch information from a perceptual interval processing capacity, and this does not have implications for the cognitive impenetrability of a tonal encoding 'module'.

Returning to the issue of cognitive impenetrability, developmental evidence would seem to provide further support. Children naturally learn and abide by tonal contours through exposure to music but, while having this capacity available when singing and recognising melodies, they seemingly cannot access this information and employ this implicit knowledge of tonal structures in discrimination tasks (Peretz and Morais, 1989). This also relates to the issue of *Shallow output*. It is difficult to determine what levels of representation different subsystems (or modules) might produce, given the complex breakdown of musical structure, and as noted above, the necessity for access to specific information at some stages in the analysis.

Speed of processing has been used as an argument for modular as opposed to interactive processing. It is argued that the speed of processing demonstrated by perceptual processing systems would not be possible in an interactive system. There have been few tests specifically targeted at determining the speed of musical responses. Nonetheless, empirical evidence does seem to suggest patterns of response which correspond to those in visual and language domains. Subjects are quick to distinguish music from other auditory events as Peretz notes,

> "One surprising finding in the present study concerns the rapidity with which subjects perform the happy-sad distinction. Subjects were found to be able to distinguish happy from sad music with as little as a half-second from the beginning of the music."[10]

This latter claim might be interpreted as ambivalent evidence, as it is not as yet clear whether emotion recognition is a domain-general as opposed to music-specific function. Direct evidence though is seemingly provided by the music listening process itself, in which music is analysed as it occurs in time, analogous to the claims Fodor makes for sentence comprehension in *The Modularity of Mind:*

> "the recovery of semantic content from a spoken sentence can occur at speeds quite comparable to those achieved in the two-choice reaction paradigm. [two-choice reactions for example being to press or not press a button in response to a stimulus] In particular, appreciable numbers of subjects can 'shadow' continuous speech with a quarter-second latency (shadowing is repeating what you hear as you hear it) and, contrary to some of the original reports, there is now good evidence that such 'fast shadowers' understand what they repeat. (See Marslen-Wilson, 1973.) Considering the amount of processing that must go on in sentence comprehension (unless all our current theories are totally wrongheaded), this finding is mind-boggling. And, mind-boggling or otherwise, it is clear that shadowing latency is an extremely conservative measure of the speed of comprehension. Since shadowing requires repeating what one is hearing, the 250msec. of lag between stimulus and response includes not only the time required for the perceptual analysis of the message, but also the time required for the subject's integration of his verbalization." (*The Modularity of Mind*, p.61).

However, I do not accept that arguments from speed of processing are necessary or sufficient conditions for supporting a modular hypothesis. First, it is hardly clear what counts as 'fast' processing, when in many cases one also has to incorporate response speed into the equation. If one considers auditory responses, it takes only 8ms for sound source to reach the brain stem, yet it may take 250 ms for us to make a response. In light of such considerations, it hardly seems an appropriate measure to determine which are peripheral as opposed to central processes (see Marslen-Wilson and Tyler, in Garfield, 1987).

Indeed, in Fodor's case the claim that non-demonstrative thought is a 'central' process seems to gain little from the notion of fast processing. We do not know the neural processes involved, (for example) in decision making, but it is perfectly plausible to suggest that a large number of modular functions contribute to the process, although each in itself may exhibit 'fast processing'. And as Marslen-Wilson and Tyler point out (at least for the case of linguistic processes), there does not seem to be any noticeable time lag between perceptual processes and those which require top-down influences.

Overall, there seems to be much support for autonomous subsystems within music cognition, and to a large degree these conform to general criteria for modularity, though not strictly to a Fodorian account. In addition to music perception, a chief concern of this study was to offer an explanation of musical affect, and as such an account of auditory affective perception and cognition would have to be compliant with the account of music and associated subdivisions in processing. In light of this I will consider the case for modular organisation of auditory affective processing.

7.3.4 Modularity of Affective Processing

As discussed in Chapter 3, processing of musical emotion occurs in distinct stages, dividing primarily into a 'perceptual' affective stage and a post-perceptual evaluative stage, giving:—

(1) Initial physiological affective responses caused by direct effects of sound and; (2) What we might more reliably recognise as 'emotional responses', incorporating physiological affect and additional cognitive components, relating to extra-musical information. It is important to note therefore, that what are often termed 'emotional' responses to music, may be largely affective or non-cognitive responses (though they may be subsequently cognized in terms of agents' beliefs and desires)[11].

In light of the suggestions for other perceptual mechanisms, auditory affective perception may be a perfectly good candidate for modularity, particularly as basic affective systems are hard-wired, stimulus-bound, and mandatory in operation. For example, non-cognitive 'chill' responses to music are direct physiological responses to sound, and play a part in an overall assessment of music as 'emotional', or in the arousal of musical emotion. In light of these considerations, some hypotheses have been offered as regards the subdivision of affective processing.

Panksepp 1982, suggests four basic modes of affect: rage, panic, expectancy, and fear, associated with circuits of the limbic system.[12] This assimilation of affective modes to primitive brain circuitries offers a conception of *affective perception*, as opposed to *conceptual, emotion processing*, and the involvement of the limbic system is endorsed by other theorists. Zajonc comments within his account that,

> "The limbic system that controls emotional reactions was there long before we evolved language and our present form of thinking. It was there before the neocortex, and it occupies a large proportion of the brain mass in lower animals. Before we evolved language and our cognitive capacities, which are so deeply dependent on language, it was the affective system alone upon which the organism relied for its adaptation. The organism's responses to the environment were selected according to their affective consequences." (Zajonc 1980 pp.169-170).

Arousal of musical emotion may involve just these basic emotional mechanisms, (the limbic system), inducing physiological responses (shiver down the spine, lump in the throat, tears, racing pulse) commonly referred to as musical 'chill.'[13] — such reactions appearing to be throwbacks to basic evolutionary mechanisms for affective responses.

Panksepp's idea of musical chill certainly has evolutionary plausibility, and music specific physiological *responses* may indeed be induced (Panksepp, 1995). The hypothesis that affect may be a direct perceptual process is given added support from neuropsychological findings in terms of separation of auditory affective responses and perceptual discrimination for music. An ability to recognise music's emotional content may be preserved in the presence of other perceptual music deficits. Peretz et. al, 1998 report on such a case. Subject I.R., a non-musician, demonstrated sparing of emotional responses to music in the context of severe deficits in music processing following brain damage. IR showed a severe impairment for recognition of familiar melodies (e.g., Happy Birthday), and performed at chance on pitch and temporal discrimination tasks, and slightly above chance (56.7%) on error detection tasks. Nonetheless, I.R. performed emotional classifications (sad/happy distinction) with ease, scoring 97%, 88% and 97% compared to controls' 94%, 93% and 95%.

Although IR could not recognise musical features, and could not discriminate between two pieces, altering certain structural features had an effect on sad/happy ratings. A common observation regarding 'emotive' music is that 'happy' (or positive emotion-evoking) pieces typically have a fast tempo and are in major keys. 'Sad' (or negative emotion-evoking) pieces typically have a slow tempo and are in minor keys. When these structural features were altered they did influence the assessment of extracts as sad/happy and when both features were altered within the same excerpt this had a cumulative affect on judgements (see Peretz et. al, 1998, pp.133-135). In light of this, it is plausible that structural features of music — mode (major/minor) and tempo, are seemingly major determinants of emotional classifications (i.e. these features may be causal factors in producing happy/sad responses, whether or not they are identified by the subject). Changing other factors such as specific instrument or natural versus synthesised sound did not produce any significant difference in response. On this account then, specific musical features may be sufficient to allow basic emotional discrimination, independent of other perceptual processing for music. There is therefore evidence that emotional affective responses to music may operate autonomously, and exhibit modular characteristics.[14]

Nonetheless, in relation to Panksepp and Zajonc's accounts of affective perception, Peretz explicitly denies that a module for musical emotion processing could be assimilated with primitive neural mechanisms. She states,

> "Emotional responses to music appear to recruit brain circuitries that are particularly resistant to damage. Such resistance should not, however, be equated with the functioning of a primitive sub-cortical system. Emotional appreciation of music requires, in all likelihood, the use of sophisticated knowledge of musical structure." (1993, p.374).

But Peretz's claims seem to lack both clarity and empirical support, and even to be countered by a subsequent case report on the same subject IR, (Patel et. al, 1998, to be discussed below). Peretz fails to distinguish between affective perception and emotional responses. She refers to the gross distinctions made by IR as 'emotional' when in all likelihood these are gross auditory affective responses. Indeed the nature of the responses seems well matched by the accounts of non-conceptual affective perception outlined in Chapters 1 and 3.

There is no evidence that such basic affective responses to music (as demonstrated by IR) require *knowledge* of musical structure. Gross features of an acoustic signal may be sufficient to trigger these responses to music via the limbic system, in the same way as gross visual patterns (something that resembles a snake, or moves suddenly), can mediate startle responses. Indeed, mode and tempo, as Peretz states, may indeed be determinants of affective responses but not due to any implicit musical knowledge as she claims, rather due merely to the properties of the acoustic signal and their direct effects on us.

Specific affective response patterns are reported for music (Panksepp, 1995), but this does not imply that music processing at this level is necessarily channel-specific. If responses may be induced by particular structural aspects in an auditory signal, these are perhaps stronger or more frequent in music as opposed to other auditory domains (but not necessarily specific to music). Indeed, if music is tapping into the limbic system due to its similarities to crying offspring —which Panksepp suggests may be the original function of this auditory pathway — then in terms of auditory features, music may certainly resemble such sounds far more closely than speech.

7.3.5 Domain-Specific or Auditory Domain-General Affective Perception?

Although it is not unduly problematic in terms of music perceptual processes, it would be useful for a modular account if one could offer firm evidence for either a domain general or domain specific affective perception system. Empirically this would not seem a challenging issue but neuropsychology provides conflicting evidence. In speech, a variety of articulatory (prosodic) cues are used for conveying emotional tone, with intonation, pitch level, and stress being primary examples. So, for example, by altering the tone of voice, stress on individual words and intonation (rise and fall of pitch contours), the phrase 'I want to see you now' may be given as a simple statement or as an angry demand. In music, melodic contour and tempo also contribute to affective content, so the question is whether the expression and perception of these affective cues in speech and music are subserved by a common mechanism, and presumably the same would be true of environmental sound cues.

On the one hand there are cases of aphasic subjects who are able to sing expressively, whilst lacking speech prosody, and this has led to suggestions of autonomy for affective processing in speech and music (see Sidtis in Gazzaniga (ed.) 1984). On the other hand, in terms of receptive processing there are subjects with preserved affective processing for music and speech, whilst perceptual aspects of music processing are impaired (Peretz, Gagnon and Bouchard, 1998). Neuropsychological evidence as to whether there are real dissociations between the same mechanisms in music and speech is conflicting. Here I will examine these conflicts and suggest that the problem really lies in a flawed experimental approach, rather than an actual conflict between empirical evidence. As one can see from the examples above, expressive and receptive aspects of affective processing are confused. Evidence of an expressive dissociation between speech and singing does not warrant the same inferences for receptive function. In any case, singing in aphasic subjects may merely represent an intact over-learnt or early acquired motor function, of which producing affective contour is merely an integral part, functioning in a similar fashion to aphasic subjects who may retain a few over-learnt phrases, whilst having little real knowledge of language remaining.

Prosodic deficits can be satisfactorily explained without positing channel-specific affective processing at the initial stages. Indeed, one needs to consider carefully the experimental methods used within such studies. Where affective aprosodia has been studied (the loss of ability to add affective contours and stress to speech), this has not been in terms of the basic positive/negative affective responses examined in music. Studies of verbal aprosodia do not offer equivalent examinations of *auditory* affective recognition: often vocal aprosodia is not examined in isolation, but in the context of studies of gesture and facial expression too, examining an overall ability to communicate affect. Aprosodias divide into many differing subcategories; global, motor aprosodia, conduction aprosodia, etc.[15] To compare affective content of language and music directly, specific prosodic aspects of speech need to be tapped which relate to those in music e.g. harmony, stress in phrase structures, melodic contours etc. Otherwise, one might be comparing only rhythmic aspects, or gross tonal distinctions, which might indeed be subserved by the same process for speech and music, but may not be comparable in terms of complex affective responses to both.

The problems inherent in such investigations are evident in the account of Patel et. al, 1998, who attempt to investigate whether melodic (intonation) and temporal (rhythmic) prosody are subserved by a general purpose auditory system. Whilst they suggest shared neural resources for prosodic aspects of music and speech, this may not relate specifically to *affective* responses as their investigations examine perceptual discrimination of musical features one might, for example, be able to discriminate the rhythmic and melodic contours of music and speech, but still be unable to decipher any complex emotional significance from one or the other.. Whilst melodic contour and temporal structure may be determinants of affect, the ability to identify these independently does not necessarily relate to the ability for affective processing. As we have seen earlier, recognition of affective content can be separated from identity of musical features.

Other tests have attempted to target specifically the affective elements. For example, Gorelick & Ross, 1987, used sentences presented in different emotional tones of voice and required subjects to identify the emotional tone (e.g., happy, sad, angry) of the same sentence presented in different affective tone (without seeing the speaker). In such studies, it may well be the case that, whilst subjects are indeed impaired at a cognitive level for complex emotional evaluations of sentences, 'basic' affective distinctions (e.g., positive/negative, for auditory input in general) remain intact. The evidence also suggests the involvement of a number of different neural locations in affective vocal processing, and notably not simply the deep brain structures of the limbic system (Gorelick & Ross 1987; Ross, 1993). Perhaps therefore, prosodic deficits in speech reflect a problem with reintegration of affective responses with semantic knowledge, as opposed to suggesting channel specific auditory affective processing for language.

Returning to the modular architecture, whether music specific or auditory-general, it seems reasonable to hypothesise an emotional processing module for auditory affect, along similar lines to models proposed for peripheral visual processes (e.g., Marr), with its output determined by specific parameters of input, e.g., melodic and temporal features of music and speech. For music this would allow a happy/sad distinction but not complex emotional descriptions which may depend upon extra-musical factors and acquired associations.

In terms of predispostions and universality of affective perception, differences between languages, (see Ross, 1993), suggest limitations on hardwiring of affective tone. When listening to an unfamiliar language, one may be able to recognise the general mode of affect but not more specific emotional intonations which can vary from culture to culture (see Jauregui, *The Emotional Computer*, 1995). This shows some similarity to the cultural variations in music and corresponds to the ability to distinguish between general but perhaps not culture specific affective contours.

As a whole such a model of auditory affective perception would seem compatible with the idea of musical structures as determinants of emotional responses (Peretz, 1998; Sloboda, 1991) and with contemporary accounts of emotional cognition and affective perception as presented by LeDoux, (1984, 1996), Panksepp (1982) Zajonc (1980) and Damasio (1994).

Unfortunately, there is a present lack of specific empirical support for an auditory affective processing module, not only due to the above conflicts as regards determining whether there is music/speech specific affective processing, but also due to the nature of affective processing substrates. Damage to such deep brain mechanisms invariably involves for example, the same blood supply to areas controlling major homeostatic functions, making survival unlikely and therefore it is unlikely that one will see cases of selective damage to this 'basic' type of affective processing. At some stage however, it seems that affective information must be re-integrated in musical analysis, and possibly a deficit could also occur at this level. Perhaps in light of this and with refined methods for testing music and speech specific prosody, the question of specificity may be resolved.

7.4 Proposing Music Modules: A Model of Receptive Musical Function.

Proposing a modular account of receptive music processing in terms of distinct *perceptual* processes then is not unduly problematic. Empirical evidence strongly supports autonomous subsystems, some innate predispositions (at least for auditory-general if not specific processes), and associated neural architectures. Initial processing of musical affect also seems to be autonomous, though this suggests a slightly different organisation.

This initial model will attempt to capture perceptual music discrimination abilities as exemplified by apperceptive disturbances (deficits in perceptual processing). I will attempt to offer a model of music processing from auditory input, to analysis and discrimination of musical features, and in light of this I will also make some suggestions for similar fractionation of other auditory domains. I will then go on to look at associative functions (relating analysed features to existing representations), musical functions in other modalities, (reading, writing and playing), interaction of music subsystems, and the relationship of music to other faculties.

Bearing in mind the variation in musical aptitudes across listeners, one must ask the question, 'What type of listener does the model represent?' I would reply that, *functionally,* the model represents any normal listener whether musically naïve or musically experienced. In terms of neuroanatomical correlates there is, as we have observed, variation across subjects, and below I will offer an explanation of the suggested differences between musicians and non-musicians.

To begin, initial perceptual analysis subdivides along two major dimensions: melodic organisation (discrimination of pitch, interval, melodic contour,) and temporal organisation (rhythm and metre). Robust dissociations support the functional autonomy of melodic and temporal processing, with amelodia and arhythmia being among the more frequently reported examples of musical damage and sparing. Further fractionation is demonstrated within these domains.

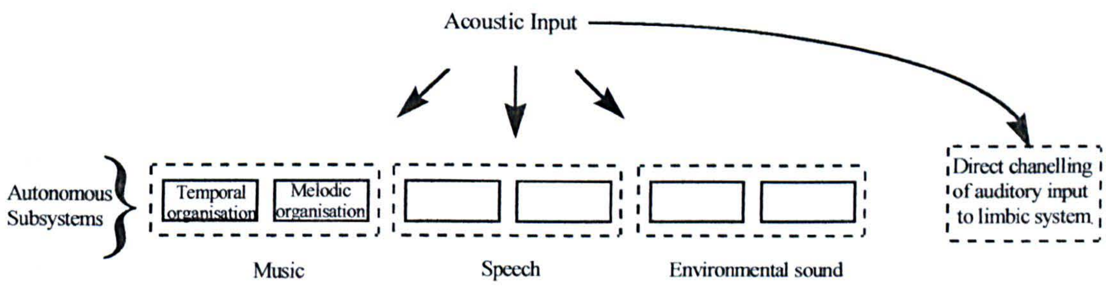
Temporal processing subdivides into processing of rhythm (internal temporal divisions) and metre (regularities in internal temporal grouping). Melodic processing subdivides into interval and contour processing (respectively discrimination of individual pitch relationships, and discrimination of the overall pitch-height contours of a melodic sequence). Again these subdivisions are supported by double dissociations, as documented in table 7.1 This fractionation of music corresponds to existing models in speech perception which is also mediated by such 'micromodules', providing good grounds for similar subdivision of musical function.

Table 7.1: Reported Melodic and Temporal Dissociations

Function Intact ✓	Function Impaired ✗	Case Reports
Rhythm ✓	Metre ✗	Liegeois-Chauvel et. al, 1998; Polk & Kertesz, 1993.
Metre ✓	Rhythm ✗	Peretz 1990
Interval ✓	Contour ✗	Peretz 1993.
Contour ✓	Interval ✗	Liegeois-Chauvel et. al., 1998.

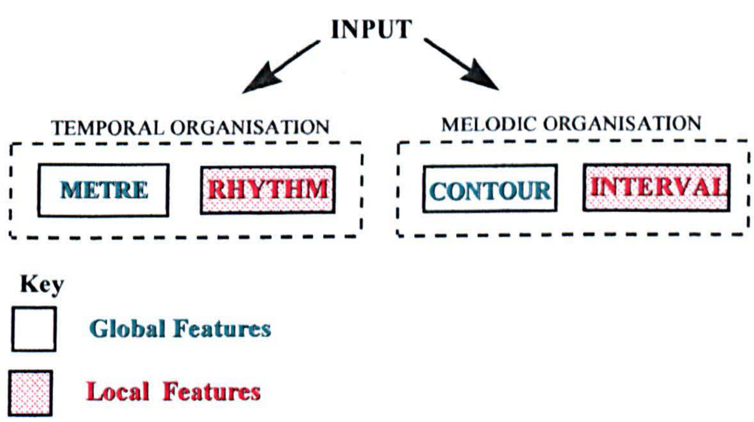
At present, this conception would provide us with a model essentially like fig.7.1. The outputs of temporal and melodic processes may then be subsequently integrated and fed into further modules/auditory lexicons.

Fig.7.1: Initial Auditory and Perceptual Processing



The fractionation of melodic and temporal organisation into metre, rhythm, interval and contour, (fig. 7.2) also relates to the processing predispositions outlined in 7.3.1: "the priority of contour over interval processing; the priority of temporal patterning over specific timing cues;"(Trehub, 2000, p.431.). Whilst the specificity of auditory processing predispositions must be left open to question, this does nevertheless allow an alternative explanation of the divergence in processing strategies (or divergence in preferred processing strategies) observed between musicians and non-musicians.

Fig. 7.2: Fractionation of Melodic and Temporal Organisation



Within the model represented by Fig.7.2 we do see a local/ global distinction, but this is not to say I wish to endorse the claims for abstract processing strategies which I criticised earlier (5.4.1). Rather, it is the case that processing strategies do differ due to the nature of the input to which they are exposed and the task demands placed upon modules. Hence one may see differences between musicians and non-musicians due to the task demands placed upon their respective auditory processing capacities. For musicians undertaking specific musical tasks either to play an instrument or in listening to and analysing music, attending to local features (perhaps in addition to global features) gives more finely tuned discrimination abilities. As in the above model, metre and contour require attention to global features, while interval and rhythmic processing require attention to local 'internal' aspects of musical structure.

In terms of processing predispositions, the attentional biases are for attending to 'global' features: metre (grouping) and melodic contour. Listeners have attentional biases for processing global features, (and hence this is perhaps why we do see musician/non-musician differences). Unless needing to apply further discrimination abilities, these may be sufficient for 'basic' music processing. However, exposure to a wider range of musical stimuli and placing more demands on the auditory system would allow further development of capacities for processing local features. The explanation of the local/global distinction in terms of processing predispositions offers a more comprehensive explanation of musician/non-musician differences in processing strategy. All listeners develop both capacities, but perhaps through training, learning the musical language (which requires one to attend to local features), musicians may more often utilise local strategies — offering a slightly different perspective as regards the differences in processing strategies between musicians and non-musicians. In relation to the modular account, both modules and *strategies* then are to some extent prespecified in terms of attentional biases e.g. to global rather than local features. These attentional predispositions are supported by naïve listeners responses, but a process of gradual modularization allows other strategies to be developed.

Peretz, (1985), and Peretz and Morais, (1989) also suggest a module for tonality, (determining whether music conforms to the 'grammatical' rules of one's tonal system e.g. western tonal music), and this does have some empirical support. In a group study by Frances, Lhermitte, and Verdy, 1973, aphasic patients were presented with pairs of melodies, their task being to judge which note in the melody had been changed on its second playing. Half the melodies were tonal (having a definable 'key' or tonal centre and conforming to rules of western tonal music) and the other half a-tonal (no key or tonal centre and not conforming to the 'rules' of western tonal construction). The aphasic subjects did not show the expected predisposition for tonal recognition, suggesting some loss of 'tonal knowledge', and the findings were replicated in a single case study by Peretz, 1993. In further support of these findings, neonates have also demonstrated preference for tonal stimuli (Trehub, 1987). Such results seem to indicate that a module for tonality might be identified in the near future, but this will require careful investigation. On my account, I would argue that tonality is a post-perceptual function i.e. the encoding of pitch in terms of tonal scales and sequences occurs after pitch discrimination, as a function of a music lexicon. That is, after initial perceptual discrimination, the percept can then be mapped onto existing representations which are consistent with the tonal constraints of the particular musical genres one has been exposed to. There may be some natural (and perhaps universal) preferences for certain intervallic or scale structures due to the nature of the auditory system, but it is not problematic for these to develop as part of a music lexicon, even perhaps as an autonomous modular or sub-modular 'tonal lexicon'.

Nonetheless, the aim of the model is explain processing from input to perceptual discrimination, but it is clearly wrong to suggest that sound input feeds directly to domain specific modules. The model must also incorporate initial acoustic analysis which is then relayed to modules. The importance of this is demonstrated if one considers channel-specificity. On the account above, (fig. 7.1), modules would be receiving all auditory input and discarding irrelevant items — not only does this seem implausible on the grounds of efficiency, but it would also require a complex explanation of how such modules come to 'choose' their inputs in this way. It seems more than obvious to suggest that one must propose some level of initial acoustic analysis. However, existing discussions do neglect this point — for example, Peretz and Jackendoff both fail to account for initial acoustic analysis in any detail.

Implicit within accounts of central auditory processing is the fact that hearing the signal can be dissociated from its interpretation. Amusic subjects still *hear* the input but cannot process it in terms of any recognisable form. The input is heard as squeaks and grates — i.e. the signal is somehow registered, but then does not get any further than initial analysis. Signals are still being *routed* channel-specifically but the music specific system cannot deal with them when they arrive. Similarly, if one posits autonomous modules and distributed sites for different auditory processes, then one must account for some initial channelling of auditory signals, which can be subject to damage, just like modality specific parts of the processing system. If this were not the case, then to explain global auditory agnosia (inability to interpret all auditory input — which is fairly common) one would have to have lesions affecting a wide number of perceptual processors for all areas of auditory processing. What makes more sense is to suggest that there is initially a simpler process, or set of 'acoustic feature detectors' which can deal with gross acoustic discrimination, and which can be damaged, subsequently preventing further analysis of acoustic signals.

Presumably, all neuropsychological accounts of auditory processing *must* allow some initial analysis, before domain-specific perceptual processing, but there is a significant lack of attempts to explain the interaction of initial sensory analysis and subsequent processing. In light of this neglect, models such as Peretz's and Jackendoff's still end up looking essentially like figure 7.1.

There is then, a need to make explicit the stages of processing involved: i.e. mechanical processing of sound, some streaming at cochlea level, and integration/contralateral processing of sound at the levels of brainstem and primary auditory cortices[16]. It should not be an implicit assumption that there is obviously some initial acoustic analysis which does not require explanation, as this bears heavily on notions of channel-specificity and the nature of domains in relation to initial processing predispositions.

A particular concern is to explain *how* sound is channelled specifically for these separate domains. As above, one could suggest that domain specific perceptual modules *all* receive *all* the auditory input, but this not only seems to go against the principles of economy behind evolutionary development, it also requires that modules 'decide' which input to respond to and this causes problems in terms of explaining domain specificity. Ultimately this problem results from a top-down approach to auditory processing. If one starts from the perspective of the auditory input, one can postulate that modules have developed domain-specificity because they have been fed specific sets of input, resulting from initial acoustic analysis.

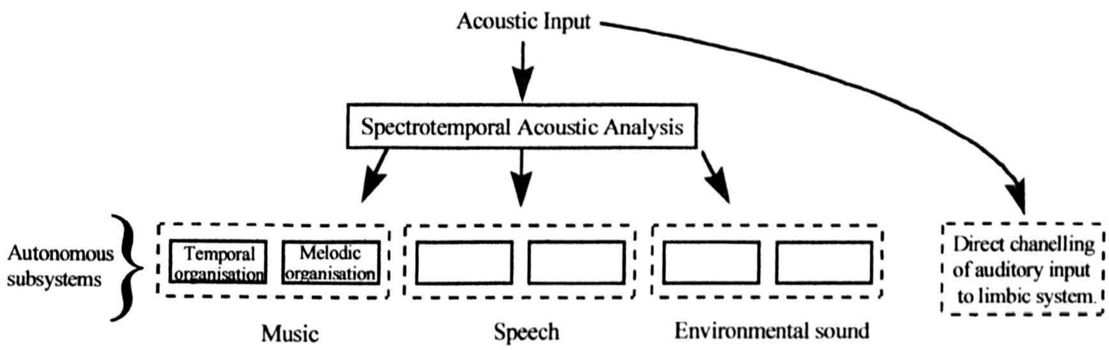
There is some evidence in support of these claims. Griffiths, for example, has investigated the intermediate processing of complex sound, i.e. the relationships between basic audiometry and central auditory processing tasks. He suggests that there are enough differences between types of acoustic signals to support some preliminary 'spectrotemporal' acoustic analysis.

> "in the crudest terms, speech contains a mixture of filtered harmonic complexes, broad-band noise and silent gaps, with accurate transitions between these three stimuli controlled with millisecond-level precision. Apart from abrupt transitions, speech is also characterised by smoother changes in filter frequency occurring over tens of milliseconds, and prosody (pitch and stress contour, and rhythm) at the level of seconds. Natural and mechanical environmental sounds may also contain harmonic complexes or noise, often without the complexity of the temporal transitions seen in speech. It does not require a detailed knowledge of psychoacoustics to appreciate that the 'moo' of a cow or the sound of a motorbike running contain many fewer changes in acoustic structure over time than an equivalent length segment of human speech. Music often contains discrete harmonic sounds with a variation of temporal 'local' structure at the level of hundreds of milliseconds or more, whilst 'global' processing of musical features might occur at the level of seconds or tens of seconds...From even this crude description, it will be apparent that there are differences in spectrotemporal structure in these three types of sound, and also that these sounds contain a mixture of different acoustic features with some overlap. Thus, a deficit in processing of a given acoustic feature might be expressed as a higher level processing deficit specific

for speech, environmental sounds or music. It may also lead to a deficit for more than one type of processing if it affects the processing of a shared acoustic feature." (Griffiths et. al, 1999, p. 373.)

This allows us to formulate a revised model along the lines of figure 7.3, with initial domain-general processing of all auditory input, which then feeds into specific domains.

Fig. 7.3 Receptive Music Processing



The failure of neuropsychological accounts to consider the early auditory pathways probably stems from a top-down approach to sound processing. There is a tendency to resort to too much in the way of modules and representations (in mature systems), without paying sufficient attention to signals — which may sculpt the system in acquisition (more on this will be said later). Looking at the processing of sound in the ascending pathway to the auditory cortex gives an idea of how initial sensory and perceptual deficits could be distributed across this system (see Griffiths, 1999 p.367). Just as we need to consider whether deficits are apperceptive or associative, one also needs to consider whether 'perceptual' deficits are due to domain-general sensory disturbances or domain-specific discriminatory abilities. Griffiths notes that,

"disorders of environmental sound and musical perception can also be caused by disordered complex sound perception. The apparent expression of these disorders in distinct cognitive domains may be a feature of differences in the acoustic structure of these types of sound" (Griffiths et. al, 1999, p.365).

That is, a perceptual deficit in analysing music-specific acoustic features might be expressed in terms of a music-specific deficit, but like the case of affective processing this may not be because the auditory feature detectors are domain-specific, but rather that music provides a specific pattern of input and has an associated pattern of specific responses. That there are basic acoustic featural detection systems might also support the associations observed between auditory deficits, e.g. aphasia and amusia — an underlying 'acoustic detection' deficit could subsequently affect both functions.

"We suggest that the marked overlap between agnosias may be due to the fact that, the underlying deficit, in many cases, is not in sound perception at the level of words, music or environmental sounds, but at an intermediate level of analysis of spectrotemporal pattern in sound." (Griffiths et. al, 1999, p.373).

There is some evidence for deficits across the spectrum of this initial auditory processing, and importantly, measures of 'deafness' (i.e. intensity and frequency thresholds) do not always reflect subsequent deficits in complex sound analysis which are a consequence of hearing loss. For example,

> "cochlear disease does not just affect the thresholds for hearing tones, but also affects aspects of auditory analysis which may impair higher level pattern recognition, even when the threshold change is accounted for by appropriate adjustment of the stimuli." (Griffiths et. al 1999 p.367).

Brainstem lesions can also cause deficits relating to specific aspects of the signal (e.g. temporal processing), but as in the case of affective processing, survival is unlikely with damage to such systems. It is certainly plausible that any initial processing deficit (i.e. damage to processes on the way to the auditory cortex) may result in an auditory domain general deficit, whilst specific damage to areas of auditory cortex may lead to modality-specific deficits. This then would explain some of the contradictions between domain-specific and auditory domain-general deficits.

In light of this model, there is a need to investigate and identify different stages of information processing within music cognition — some of which may in fact be domain-general auditory processes and others which are domain-specific. A question to be raised in relation to the findings is whether common temporal and melodic processing might be a candidate architecture? There is conflicting evidence in the neuropsychological literature, e.g. on the one hand, we have specific rhythmic and melodic disturbances for music in subjects who did not present disturbance in any other auditory function (expressive or receptive). On the other hand, we have evidence for domain-general initial acoustic analysis, and some suggestions for shared neural resources across speech and music in light of co-occurring deficits.

Peretz shows a significant change of opinion on this matter across papers, (Peretz et. al, 1994 and within Patel et. al, 1998) giving some example of the disagreements on this matter within the field. But the examples to follow also show the necessity to distinguish between perceptual and post-perceptual processing. Domain-specificity in one aspect of processing does not necessitate domain-specificity across the board. In the 1994 paper (Brain, 117), Peretz rejects domain-general auditory processing in light of an observed dissociation between good lyric identification and poor melody identification in subject CN. But both these processes operate at the level of post-perceptual knowledge stores. Domain-specificity here does not allow the rejection of domain-general perceptual processes.[17]

In the 1998 paper (Patel et. al, 1998), the aim was to examine whether there may be common processing of melody and temporal across speech and music. In this study, musical stimuli were developed to mimic the melodic and temporal patterns of speech at the global level of contour and metre. On same/different classifications for each group of stimuli (speech/music) one subject was found to be impaired across prosodic and music discrimination tasks, and the other subject to have intact performance on both, suggesting shared cognitive resources for these processes. However, while Patel et. al might be on the right track as regards the idea that there may be some shared resources, it is not clear that this is so at the level of processing they propose. The subject IR who showed impaired performance also showed a failure to hold musical stimuli in short term memory, and it may be this disturbance which is responsible for her similar performance across domains as opposed to shared temporal and melodic resources. IR does, however, suggest there may be shared mnemonic resources for holding melodic and temporal information in short term memory. The conflicts between these two studies exemplify the difficulties in isolating stages of processing and equivalent tasks across domains. But, nonetheless, there is an important attempt to equate stimuli from different domains here.

In light of these considerations, identifying interactive stages of processing is important as otherwise we will find contradictory data, as in the case of processing of pitch and temporal data (Peretz & Kolinsky, 1993). Findings will be dependent upon which stage processing tasks are tapping into, i.e., before or after aspects are integrated. Evidence would suggest integration of temporal and melodic processing is at the later decision-making stages of processing. Given that melodic organisation and temporal organisation exhibit evidence of functional autonomy, it would make sense to posit these as separate modules, even though it is unclear how the outputs of these modules subsequently come to seem to be integrated into a unified experience. With this in mind, one can see the scope for conflicting reports. There may be domain-general initial acoustic processing, subsequent domain-specific processing, and then, for later stages of music processing, integration of percepts from systems which are functionally autonomous.

Nonetheless, whilst there is room for a variety of further empirical investigation, peripheral systems, as outlined above, do conform to a strong modular hypothesis. Evidence from amelodia, and arhythmia strongly suggest peripheral processing of music is divided into autonomous and prespecified modules for these functions, with further fractionation as seen in figure 7.2. Given evidence from selective sparing and damage to other auditory functions, it is reasonable to assume that the other auditory domains — speech and environmental sound — will be similarly organised at this initial level of processing, with varying numbers of modules, dedicated to major acoustic or structural divisions for that domain. Affective processing is also represented within the model, showing the direct routing of auditory input to the limbic system. At present, it is not clear at what stage affective processing is integrated with other aspects of music cognition. There is no firm evidence to suggest that such processing is music-specific. However, where music is the input, it is true that specific response patterns are observed.

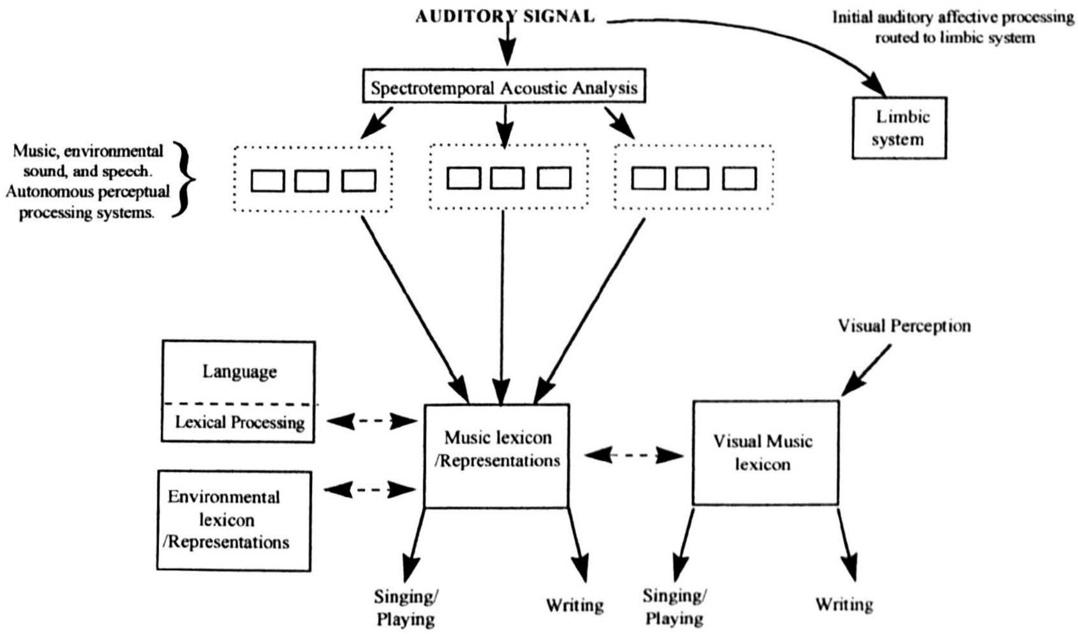
7.5 A Global Model of Music Cognition?

The above discussion and empirical evidence allows the generation of a fairly well-structured model of perceptual music processes. Proposing modularity for receptive music processing in terms of peripheral processes seems a highly plausible endeavour. Difficulties arise, however, when attempting to explain broader musical abilities and their interaction with other cognitive functions. For the present, however, it is possible to develop a general cognitive architecture for music, aspects of which will vary according to musical training and exposure.

It still remains to explain how perceptual processing as outlined above is then utilised for complex musical tasks, recognition, interaction with language, production of music, and internal musical representations. In addition to perceptual discrimination modules for interval, contour, rhythm, metre, and affect, one also needs an ability to map these features onto existing musical representations to facilitate recognition of familiar examples, and deviations from 'normal' structure. Input and output orthography (reading and writing music), also need to be accounted for in a global architecture which incorporates both expressive and receptive musical abilities. Further evidence from neuropsychological studies is invaluable here. Deficits in music writing and reading, musical alexia, and agraphia, and sparing of these faculties in the presence of language deficits (e.g., as in the cases of MR and Shebalin) provide grounds for proposing orthographic and visual music modules — grown modules which are the result of explicit tutoring, like orthographic language modules.

In addition to perceptual processing of music, there must be access to stored musical representations such that one can recognise familiar melodies, and assess novel constructs within the constraints of one's own tonal system. Evidence from damage to music recognition abilities, whilst perceptual abilities are spared, (e.g., Eustache et. al, Case 2, 1990) suggests such a music lexicon or store of musical representations. Perceptual processing may map onto these existing representations, or produce new representations within existing rules. This allows us to build on the perceptual model above to propose, somewhat tentatively, an architecture as presented in fig.7.4:

Fig.7.4: A Global Architecture for Music Processing



—Primary access
--- Secondary/Shallow access

The model presents a clear analogy with models of language processing. For example, with speech input processing — word sound deafness (perceptual level, inability to interpret speech input) and word form deafness (associative level, inability to associate sound analysis with lexical information) relate to music perceptual processing and access to the music lexicon (stored musical representations) respectively.

The idea of shallow access is not specifically problematic, but again reflects attentional biases applied in processing tasks. When listening to songs, attention is typically directed towards processing the musical rather than linguistic content. We can by choice attend to the words, but in doing so we may not fully process the musical content. It seems we cannot do both tasks at once, and there is an attentional preference for processing the musical content in this task. This is not specific to the musical domain. For example, the same effect is observed in speech, when one is attending to speech in a noisy environment, one only processes the inputs, which are the focus of attention. Auditory working memory can be incorporated into the model, but this is not best represented in terms of a specific location, rather, it consists in an ability to capture the auditory representations at different stage of processing. I.e., one can hold in memory a tune that one has heard, recalled from memory, or a novel tune that one has hummed or sung in one's head.

In classical neuropsychology, there is a distinction between apperceptive agnosia (perceptual level) and associative agnosia (access to a lexicon) and the global model for music processing must be able to account for both these types of deficit. This apperceptive/associative distinction is demonstrated in music processing by the cases of CN and IR (Patel et. al, 1998). Both apperceptive and associative music agnosias resulted in an impairment in the recognition of familiar melodies. In CN, by apparent damage to music perceptual abilities and in IR, by inability to access the music lexicon. For example, case CN, (Patel et. al, 1998) presents damage to musical 'memory' (recognition of familiar tunes) and damage to melodic perceptual abilities. However, recognition of once familiar lyrics (sung or spoken) remained intact, as did memory for other auditory domains. The melodic perceptual deficit may in fact be responsible for this music recognition deficit, an inability for the music to be processed *sufficiently* such that it can be mapped onto existing representations. This is compatible with the above account — i.e. if we conceptually lesioned *one* of the music perceptual modules, there would still be an ability to do some perceptual discrimination, but perhaps not enough to facilitate mapping onto existing representations. Damage to input systems that facilitate the mapping process may cause problems for a variety of musical tasks, both for expression of (playing, singing and notating) once familiar works, and for aural recognition.

However, the fact that CN could not sing melodies from memory complicates this scenario in terms of the relationship between expressive and receptive functions and on this issue, the above model might be subject to criticism. In other examples of auditory agnosia (e.g., for speech), perceptual processing deficits are held responsible for the inability to recognise sounds. The problem with CN's case is that she shows only very minor perceptual deficits and it might be argued that these should not prevent recognition of music (given also, that one can grossly distort melodies and still recognise them, one might argue that a minor perceptual deficit should still leave the subject with sufficient input to recognise music). However, one can reconcile these findings with the model. An explanation of CN's case may lie in co-occurring damage to the music lexicon itself, or may indeed be merely a result of perceptual difficulties leading to a degraded input to the lexicon and thus allowing insufficient feedback in singing, or simply a co-occurring expressive deficit. Interestingly, CN's perceptual problems were specific to pitch discrimination, which is seemingly a chief factor in tune recognition (see Peretz 1996). Importantly the difficulties in interaction between expressive and receptive function may be a consequence of bilateral damage to the auditory cortex. Case IR, mentioned above, had a similar pattern of bilateral damage and exhibited both expressive and receptive difficulties.

Cases such as CN, with loss of recognition in the face of minimal perceptual deficits, can be satisfactorily reconciled with the current model. However, the occurrence of subjects with intact recognition of melodies but inability to do perceptual discrimination presents a further problem (Eustache et al., 1990, case 2). It is nonetheless worth attempting to explain these findings within the model outlined. It is possible in such cases that there are sufficient perceptual abilities intact to facilitate recognition, indeed, many factors are not determinants of tune recognition — e.g., deviations in speed (tempo), key, and register do not stop us recognising a tune as familiar.[18] This might seem to contradict the explanation offered in relation to CN, above. However, the important issues here would appear to be the nature of the perceptual deficit in question, with some perceptual features of music acting as major determinants for recognition. Whereas you can test a language lexical input system by getting it to discriminate forms with small differences between them — e.g. 'house', 'mouse', 'louse', 'mouth' — changing minimal features of music does not necessarily result in a different form in melody. For example, one can hear an out of tune, out of tempo melody, played on a different instrument at an unusually high pitch with various melodic distortions and yet still recognise the melody as a familiar tune. Composers have indeed exploited this mapping ability throughout history by producing whole works which are variations on a theme, within which we can recognise the original theme throughout the work.

For music (and song), it is conceivable that a combination of shallow access from the language lexical system, (see 7.6.1), the affective system and some intact perceptual discrimination is sufficient for recognition. Indeed this would seem to be supported by severe recognition deficits seen in case IR, who suffered severe discrimination deficits for both temporal and melodic features, leaving very little, if any, perceptual information to facilitate recognition. Both the case of CN and Eustache et. al's findings invite caution about suggesting a single route of access to musical representations by perceptual analysis of sound. Suggesting separate perceptual detection systems and other access to musical representations (via language, vision, affect etc., as in figure.7.4) goes some way towards solving this problem. It is perfectly plausible given existing models of language processing, that the lexical and grammatical systems continue to process lyrics - but the output for this 'shallow' language processing does not go any further into central systems unless, that is, by selective attention, you consciously decide to attend to the lyrics of the song. This suggestion also complements the observation that linguistic ambiguities are not readily detected in lyrics

7.5.1 Music and Language

Findings from retained lyric recognition in amusic subjects may allow us to elucidate upon interactions with linguistic processes and expressive/receptive differences. A variety of hypotheses emerge for the explanation of singing, but often there is oversimplification of music and language interaction. Jackendoff 1987, claims that,

> "In perceiving singing, for instance, the incoming information must be processed both as music and as (temporarily and intonationally distorted) language" (p.232).

Jackendoff's comment, however, needs further explanation. It is certainly not the case that there is full flow of information between music and language processing. This is highlighted by anecdotal evidence from normal music cognition, suggesting shallow interaction. One often cannot remember the words or meaning of songs that one has heard, and processed, or even sung many times (hymns might be a prime example here.) Indeed, there is little dependence between melody and lyrics — one does not have to remember lyrics to remember a melody and vice versa. In the case of CN (Peretz et. al, 1994) lyrics were recognised irrespective of whether they were presented with the correct or an arbitrary melody. Further evidence may be provided by aphasia studies. For many years clinicians have reported the phenomenon of profoundly aphasic subjects who could nonetheless sing familiar songs from memory. Such findings again suggest very shallow linguistic involvement. It seem likely that spared singing abilities in aphasics are more in line with automatic 'over-learnt' motor skills than any residual language abilities.

7.6 General Discussion

A common assumption is that a modular account advocating domain-specificity and prespecified modules (as proposed here) is strictly at odds with connectionist theory. Connectionist models, however, do not really pose much of a problem for Nativist views. Although the initial aims of connectionist networks were to simulate domain-general learning, ('domain-general' referring here to functions *across* domains as opposed to functioning across sub-categories *within* a sensory domain as in auditory domain-general processing), this has not been supported by empirical evidence. Networks with unbiased weights (e.g. analogous to a system with no attentional preferences) do not simulate human learning, e.g., where a single exposure is sufficient to learn a new word. Rather, they require thousands of training attempts before success. Networks with biased weights, however, (although biased no more than innate predispositions as suggested for music) mimic human learning more effectively.[19]

Karmiloff-Smith also supports the idea that connectionism is compatible with a nativist perspective. She notes,

> "there is nothing about the connectionist framework that precludes the introduction of initial biased weights (i.e., weights that are the equivalent of innately specified predispositions) rather than random weights." Karmiloff-Smith, 1992, p.179

The conflict between domain-general and domain-specific principles is perhaps also overemphasised....

> "In favour of domain generality, connectionists stress that their models use the *same* learning algorithms for different categories of input presented to different networks. But no single network has been presented with an array of inputs from different domains (e.g., language, space, physics).......In other words, the fact that each network is dedicated to a specific type of input, in a specific learning task, turns out to be equivalent to domain specificity (or modularity) in the human." (Karmiloff-Smith, p.180-181.)

Indeed, more connectionist theories are beginning to acknowledge the role of domain-specific constraints upon processing tasks. A specific example for music is offered by Bharucha (1987), who presents a connectionist framework for music cognition. Bharucha claims that "music is (at least in part) a consequence of a general-purpose structure-abstracting process exposed to a highly structured acoustic environment." (Bharucha, 1987, p.2). He goes on to say that "domain-specific representations that are acquired on the basis of domain-general principles may function in a modular fashion." (p. 2) Nonetheless he still holds that this is at odds with a broader modular architecture. He stresses the conflict with modular theory (and the supposed support for the connectionist model), by noting that connectionist networks support top-down processing. However, this is not necessarily in conflict with a weak modular view, if one considers that top-down processing is not implicated at certain levels of representation. Specifically, it is not required at the level of perceptual/peripheral modularity that I am proposing here, and as we have noted above a bottom-up or data-driven model may be advantageous.

Bharucha's connectionist model of harmony could certainly be reconciled with a modular theory. It is perfectly feasible to suggest that a submodule or processing strategy operating *within* a modular system operates upon principles of parallel processing. And indeed modular characteristics might not be necessary at some levels of processing, depending on the task to hand. Bharucha, nonetheless, attempts to add further support to the connectionist model and appears to have assimilated modularity with serial processing, which is simply a confusion:

> "given the speed with which musical intuitions are engaged, melodies are recognized and structure is extracted, and given the sluggishness of neuronal transmission, there is strong support for a theory that posits the simultaneous

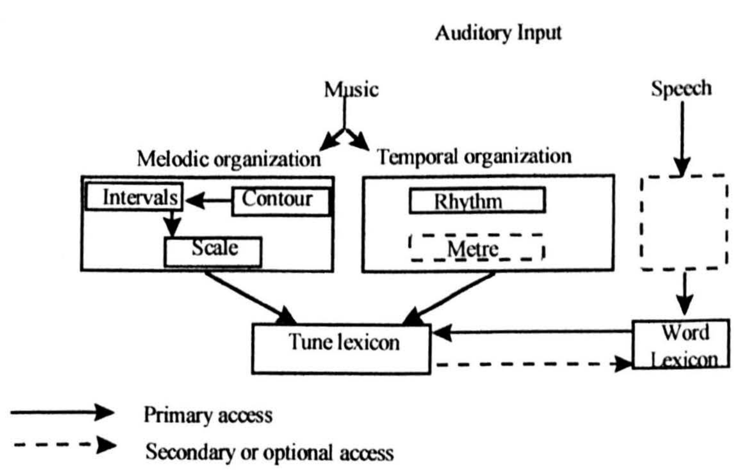
> satisfaction of harmonic constraints. Parallel processing permits the simultaneous activation of memory traces. A serial search through long-term memory would be implausible given the rapidity with which we recognise pieces we have not heard for years." p.25

Again this is not incompatible with a modular idea of a musical lexicon, the internal operation of which employs parallel processing strategies. There is no assumption of serial processing within the music lexicons outlined above or within perceptual modules themselves.
Peretz, however, offers a fairly severe critique of connectionist models. She notes,

> "according to these new models — known as connectionist networks or parallel distributed processing — the representations cannot be altered without also altering the perceptual processes." (1993, p.206-207).

This would indeed be true for a connectionist model which attempted to model broader subdivisions of music or music cognition as a whole. However, it is feasible that connectionist networks may operate *within* a hierarchy of levels of processing. Indeed within her own model (fig.7.5[20]) acoustic analysis may be performed by a connectionist network, the output of which is then fed into the 'representations' model. This, then, invalidates the critique that associative agnosias (involving perception but lack of recognition) are not compatible with connectionist models. The internal operation of these peripheral modules, though, is more problematic. Peretz does advocate parallel processing of pitch and temporal information in initial perceptual stages, but she suggests serial processing within these 'modules'. Her claim concerned melodic processing and the finding that interval processing cannot function in the presence of contour deficits: contour processing, however, may remain intact when interval processing is damaged. This may be interpreted as suggesting that melody is processed serially in the order: contour - interval - scale. Further support for this model might have invalidated the claim for parallel processing within peripheral modules. However, a subsequent finding by Peretz, showed that there could be isolated damage to interval processing without a deficit in contour processing. So parallel processing after all may be an acceptable proposal for the internal operation of modules. In any case, there is no particular reason why the advocate of modularity should object to the possibility.

Fig 7.5 Peretz 1993, Melodic and Temporal Processing



The supposed conflict between connectionist and modular theory is perhaps overemphasised as one can see there is room for both modular and connectionist characteristics within a global architecture.

7.6.1 Summary

A modular hypothesis is highly plausible for music cognition, provided that it exhibits far more flexibility than an orthodox Fodorian account. One cannot propose fixed modular characteristics which are applicable across all musical functions, nor even within for example a specific subdivision such as auditory receptive processing. Many problems are incurred by top-down conceptualisations of processing — starting with higher level processing of complex sound sources, as opposed to starting with the signal.

If one starts with the signal, taking notions like those of Griffiths' on processing of sound in the ascending auditory pathways, and also notions like different frequency components of the signal, one has a picture of auditory cognition which more closely resembles visual processing. At the subcortical level one may get different cell assemblies activating to different parts of the signal. These then relay on to particular cortical structures (e.g., in the case of spatial processing of sound, superior olive to right parietal; see Griffiths, 1999, pp.232). Different sounds will end up in different areas and there will be overlaps where sound components are common across 'domains'. However, the total network of activations obtained is likely to be distinctive for categories of auditory input — music, speech and environmental sound. This avoids as noted in section 7.5, the need for modules all sampling inputs and 'deciding' to disregard some of them.

This approach may also avoid the need for a tier of initial analysis, and as such, the above model with domain-specific music perceptual processes will be largely a functional account as opposed to correlating closely to underlying neural networks. More analysis of intermediate processing begins to suggest that the studies of behaviour in the past have not considered the detail of the acoustic signals they were using — what frequency band were they drawn from, what temporal characteristics, etc. Musical signals do form an acoustically distinctively different grouping from phonological signals. So in adopting a bottom-up conception of processing we then get our 'domains' for free as a consequence of restricted acoustic inputs — modules simply develop as a consequence of the extent of the input they receive.

To conclude, there is a real need for investigation of interacting levels of processing and in terms of central auditory processing an acknowledgement of the restraints imposed by initial auditory analysis. Many accounts of auditory dysfunction do need to consider carefully whether deficits are really at the level of perceptual processing or initial acoustic analysis. Nonetheless, one *can* begin to develop more consistent accounts of processing such as those suggested here, which are supported by robust empirical data. In terms of developing a global model, there are many empirical conflicts which could be effectively resolved. Empirical methods are available for further investigation, and systematic analysis from the bottom-up perspective of the acoustic signal may be fruitful across the domain of auditory cognition and perception.

Notes

[1] Subjects with amusic deficits lose the ability to interpret *all* sounds formerly identified as music. Auditory domains develop fairly rigid boundaries, and other auditory faculties have set domains of input which will not interpret musical information.

[2] E.g., word sound deafness is a perceptual disorder in which the listener is unable to establish the phonemic structure of inputs (analogous to apperceptive problems in music) and word form deafness is a lexical processing disorder where sound analysis can occur, but that analysis cannot be associated with lexical information (analogous to associative music deficits).

[3] See Fodor 1983 p47.

[4] Jackendoff 1992 p.125

[5] This supports an automatic model of processing which is not open to introspection, as we show a superiority for processing scales of unequal steps, although phenomenologically we hear the steps of the major scale as equivalent. (see below, section 7.3.3.

[6] See Trehub, (1987), *Infants' Perception of Musical Patterns*, Perception and Psychophysics 41, 635-641.

[7] This also provides a further objection to Goldberg above, as regards his claims for inherent ordering of functionally related processes.

[8] A point of detail here in relation to these findings, is that subjects with early onset epilepsy may not have typical patterns of brain organisation. Because the epilepsy reflects a neural abnormality, this may trigger a process of re-organisation of function and brain organisation atypical of the general population. In this way, late onset lesions (as in stroke) may enable more inferences re; normal patterns of localisation. Functional brain imaging is likely to be able to resolve some of these issues and add further insights as regards issues of localisation.

[9] Jordan D & Shepard R, (1987) *Tonal Schemas: Evidence Obtained by Probing Distorted Musical Scales*, Perception and Psychophysics, 41 621-634. Shepard R, & Jordan D, (1984) *Auditory Illusions Demonstrating That Tones are Assimilated to an Internalised Musical Scale*. Science 226, 1333-1334.

[10] p.134 Cognition 68. It is interesting to compare to emotion recognition with familiarity. Subjects need around 2 seconds to recognise a highly familiar tune.

[11] See the earlier discussion of cognitivism in Chapter 2.

[12] The idea of basic affective categories has other supporters. Ekman, Johnson-Laird agree here, but propose slightly differing groups. See Charland p.284.

[13] It has been suggested by several theorists, notably Jaak Panksepp that the emotional responses we have to music are a throwback from an early mechanism to recognise the crying of offspring. This term 'musical chill' which has now been adopted more widely was coined by Jaak Panksepp and colleagues at Bowling Green State University. Panksepp has studied both animal and human responses to music. See New scientist supplement 'Emotions' 27th April 96.

[14] In addition to mandatory operation, there is some evidence for pace and sequencing of development, but as yet this has not been experimentally verified. Peretz et. al (1998, pp.134) comment, that "sensitivity to mode via emotional judgements appears precociously, around the age of 3 years, (Kastner & Crowder, 1990)." However, other authors have failed to replicate this finding, instead suggesting that the "systematic relation between mode and emotion emerges later, at the age of 8 years."

[15] See Gorelick & Ross, 1987, for further details on specific aprosodias.

[16] See Griffiths et. al, Neurocase, 1999.

[17] There are many inconsistencies across the two papers, that the authors fail to point out to the reader, In the 1994 paper, CN is misclassified as an apperceptive agnosic, but in the 1998 paper correctly becomes an associative agnosic. CN also performs differently across the two papers in 1994 she dissociates between speech

prosody and tune pitch variation but not in the 1998 paper. This demonstrates the need for caution in comparison of studies. The authors fail to signal the change in views to readers, nor to attempt to explain the difference in CN's performance across the papers.

[18] Eustache et al's findings may be queried. One must question the similarity of the two tasks here (recognition and discrimination) In particular, did the same/different task involve working memory? If one task involves a memory component and the other does not, this result may have few implications for the model presented here.

[19] See Ashcraft, *Human Memory and Cognition* 1994 for an introduction to connectionist networks.

[20] Peretz, *Auditory Agnosia: a Functional Analysis*, fig. 7.2 p.214.

Conclusion

Throughout this investigation I have noted that there is far more empirical work to be undertaken, and theory it seems is perhaps a little ahead of its empirical counterparts. However, rather than being a daunting prospect, the scope for further empirical work promises to provide real solutions to some of the divergent explanations which have featured here. Despite the still fledgling stage of studies, there are some interesting conclusions to be drawn, in addition to specific suggestions for further research. The overall aim of my investigation was to assimilate findings from diverse fields in terms of a unified account of music and music-emotion processing. This resulted in a model of musical expression as proposed in part one of the thesis, and a broader account of music cognition, which was compatible with this account of expression.

The initial investigations of emotion theory revealed a cognitive/physiological divide in conceptions of affective states. In particular, it needs to be noted that affective terminology has become so deeply ingrained in its uses that it is assumed to be revealing of actual divisions in affective states. In truth, affective states do not conform to such clearly defined boundaries. This is reflected in the continued failure of attempts to classify moods, emotions, feeling, and affect as distinctive categories of affective state. In light of this, if one considers affective states in terms of a multidimensional continuum, varying in terms of duration, intensity, and cognitive and physiological components, it appears that cognitive and physiological accounts are complementary: they merely reflect differing explanations of constituents of affect, as opposed to being seen as contradictory accounts of differing affective constructs. Indeed, perhaps the most significant finding raised was that states which we typically refer to as emotions can be largely non-cognitive. In certain circumstances, one can have an 'emotion' without being consciously aware of, or able to verbalise, the emotion-object or cause.

This revised conception of affectivity proved to be extremely useful in terms of musically expressed and aroused emotion. Rather than cognitive and physiological accounts both failing to explain adequately musical emotion as a whole, they could be seen to offer explanations of different components of musical affect. The hypothesis I proposed here was that musical emotions are evoked both directly (by the effects of sound on the auditory system), and also by means of conditioned associations (including extra-musical associations). The hypothesis of direct affective processing of sound suggests that music taps into an evolutionarily ancient cognitive system for detecting emotion, which might have functioned as a defence mechanism and for detecting crying offspring. This direct channelling of auditory affect was shown to be independent of identity processing, in as much as one can detect emotion in a sound source without being able to identify that sound source or discriminate its individual features.

The hypothesis proved to be well supported by a variety of empirical data from studies of normal and brain-damaged subjects, and from knowledge of visual affective processing, and language affective processing. Indeed the two distinct types of affective processing proposed for music, are mirrored by 'emotional cognition' and 'affective perception' in non-musical contexts, and are also matched in terms of emotional deficits associated with different neural localisations. The hypothesis also supports the notion that one can recognise emotion expressed in music without any necessity for its arousal in the listener. Empirical studies confirm that one can recognise an emotion in music without undergoing any physiological affective response, supporting the rejection of theories which promote recognition of emotion as a by-product of arousal.

Nonetheless, there were two distinct problems for this account. Firstly, what was the nature of interaction between direct and extra-musical modes of processing? And secondly, were the auditory affective detection systems music-specific or auditory-general? In response to the first problem it seems that there is an amalgamation of cognitive and physiological affective responses across these modes of expression, and this makes it hard to detach the two. For example, recognition via 'extra-musical' modes of expression is certainly not restricted to a process of conscious analytical evaluation. Expression via acculturation can be extremely fast and ingrained as demonstrated by responses to film soundtracks and typical musical 'styles'. In addition, it may be possible that each mode of expression has the ability to 'override' the other, (perhaps depending upon the intensity of the response) and this might be something subject to further empirical study. Using subjects with differing emotional deficits, amusic subjects and normal subjects, could well offer an opportunity to examine different modes of arousal and recognition in isolation.

In response to the issue of specificity, it appears more likely that there is an *auditory-general* affective mechanism than a music-specific function, but the empirical findings on this matter are not conclusive. This is an issue which can be effectively resolved by further empirical studies. Designing equivalent tasks for the detection of vocal affective prosody, musical affect, and affect in environmental sound (cries of pain, anger, etc.) would then allow us to see whether subjects who claimed to exhibit dissociated affective prosody were really providing evidence of an affective function specific to music, language, or environmental sound specific function.

It is my hope that the model proposed represents a significant advance in contrast to existing theories. It can explain the frequently reported inconsistencies in ascriptions of emotion to music, and most significantly provides evidence that processing of musical affect is neither dependent upon recognising musical features, nor a subsidiary of processing emotion in the voice. This allows us to reject theories which claim music is expressive due to its similarities to vocal contours, and those theories which claim that identity of specific musical features are necessary for expression. This framework clearly has some strong implications for aesthetic accounts of expression. Specifically, the mode of expression that one adheres to has implications concerning the specificity of emotional response that can be claimed. If one claims that music expresses directly, then by this means of expression music may only convey a very basic range of affective responses. Expression theories, therefore, must account for the differing modes of expression which are identified by empirical studies, and are clearly wrong in so far as they claim that music expresses by one means only.

Having developed a revised account of expression in Part 1, the aim in Part II was to develop a broad account of music cognition, specifically an account of receptive music processing which was compatible with the account of expression outlined in Part I

In Chapter 3 I outlined some existing hypotheses regarding hemisphere dominance and processing strategies for musicians and non-musicians. A widely accepted notion is that the left and right hemispheres employ abstract processing strategies, with analytic processing being assigned to the left, and holistic processing to the right hemisphere. As a consequence of this conception, the *apparent* differences in hemisphere dominance between musicians and non-musicians are attributed to the employment of these different processing strategies, the claim being that musicians employ analytic strategies (and therefore the left hemisphere), and non-musicians employ 'general purpose' holistic strategies (and therefore the right hemisphere). Case MR, presented in Chapter 5, provided a welcome opportunity to reject these assumptions. The evidence provided by case MR, and other examples in the literature, in fact demonstrates that there is no necessary relationship between musical ability and lateralisation of musical function, and there are no differences at the gross level of lateralisation for musical and non-musical subjects.

The differences one sees between musicians and non musicians *are* due to the processing strategies applied. But this is not evidence of abstract processing strategies associated with left and right hemispheres. Rather, it is the case that musicians and non-musicians may differ in the strategies they *recruit* to complete the task at hand, and this may vary according to each specific task, and according to individual differences. The observed differences are not indicative of any abstract hemispheric strategy and in this respect the hypothesis gains further support from the contradictory claims for hemisphere dominance which were presented in Chapter 3 and allows us to move away from the claims that musicians and non-musicians have such radically different neural architectures. Rather, it is the case that musicians acquire the ability to apply different strategies through exposure to music and specific musical training.

Assimilating the evidence from dissociations, normal cognition and musician/non-musician variance, a clear picture of music processing begins to emerge. The auditory system as a whole is highly fractionated, with relatively autonomous processes exhibiting distinct patterns of breakdown. Auditory processing subdivides at many levels, both across input and output modalities, at perceptual and associative levels, affective perception and auditory memory. This picture is clearly consistent with a broadly modular account of cognition, exhibiting characteristic patterns of breakdown, functional autonomy, domain specificity, and mandatory operation.

The model I present is chiefly concerned to explain receptive musical function, but the findings regarding auditory subdivisions are also worthy of note. Despite assumptions to the contrary, it is not clear that music, speech, and environmental sound form entirely autonomous subsystems. Whilst some aspects of processing may be domain-specific, there may also be some shared processing capacities. For example, the neuropsychological evidence does not rule out the possibility of some shared temporal or contour processing capacities and this must be borne in mind within any proposed model. This again is an area subject to further empirical study, and holds the possibility of conclusively determining whether specific functions are auditory-general or domain-specific.

Nonetheless, the subdivisions *within* music processing itself are well documented and exhibit processing autonomy. Music exhibits clear division in terms of expressive (productive) and receptive processes. Expressive processing subdivides further into oral-expressive, instrumental expressive, and orthographic processing. Receptive functions subdivide into rhythmic, melodic, tonal, visual orthographic functions, and also lexical processing (matching input to stored representations). In addition, processing divides in terms of apperceptive and associative functions. So music is processed at two levels, firstly involving discrimination of the auditory signal (apperceptive), and secondly involving matching the auditory signal to existing representations (associative). Deficits can occur at both these levels and can occur across the subdivisions outlined.

The model represents how one deconstructs the auditory signal and this is consistent across individuals. Where one does see differences is at the finer levels of discrimination by which listeners analyse the input. For non-musical subjects it may be that some 'general purpose' auditory mechanisms are recruited for contour processing and temporal processing — though again, this is subject to further study. What is clear is that musicians are often able to make finer discriminations and employ different strategies for analysing the signal, and again this is why one observes musician/non-musician differences. The musical system is trained up to attend to different musical features and therefore applies a different strategy which may be more effective in terms of the task at hand.

In light of subject variance a major question is whether music modules are innate or developed. Very recently evidence has been presented for innate music processing predispositions. However, analysis of the findings did not provide conclusive evidence that infant responses were music specific. Nonetheless, auditory general predispositions are still relevant for a model of music. That we have biases for attending to global, as opposed to local features, matches the processing strategies observed in non-musicians and supports the claim that musicians' abilities are the result of acquired strategies, rather than any original difference in abstract processing strategies.

To summarise, we have a model of receptive music processing and auditory affective processing which is a good candidate for a modular architecture. The system exhibits autonomous subdivisions which are supported by robust dissociations. The acquisition of music processing and differences between subject groups can be explained both by initial attentional biases, and specific musical training and input, which can sculpt the system during acquisition. Looking at the auditory signal itself explains many difficulties which arise with the modular account. A particular concern is to explain how sound is channelled to specific domains. If one looks at the signal, there appear to be sufficient distinctions between the three auditory categories (speech, music and environmental sound) to allow some initial channelling of input by early acoustic analysis. It then follows that modules develop domain specificity by being fed specific sets of input. An understanding of the early stages of auditory analysis may prove to be invaluable in providing a full account of music cognition. Indeed, more work is needed in terms of clarifying the nature of auditory deficits, many of which may be occurring much earlier in the stream of auditory processing than predicted, and this will allow the much needed clarification of which functions are domain-specific and which are auditory-general.

On a concluding note, while studies of musical brain damage may give us insights into the independence of music as a cognitive function, they certainly leave us with further problems. If music and language are seemingly such autonomous systems, how do we account for their frequent interaction? Music and speech often come bundled together, singing after all involves language, and we have music with narrative, poems set to music, and music intended to tell stories or represent a situation. Environmental sounds and music are not rigidly differentiated either, music often uses sound effects such as birdsong, car horns, trains, etc., and we certainly hear music as part of the 'environment' on many occasions. I have only touched upon these problems in this account, but it is clear that empirical research has the potential to resolve some of these issues, in many cases merely by refining task parameters. One important prospect is that, as we begin to understand how music is deconstructed, how its structures act upon our auditory affective systems, and how music may influence other functions in acquisition, we may develop an enhanced level of control of the ways in which it is possible to tailor music to suit our processing predispositions, to tap into our affective responses, and to exploit the limits of boundaries between auditory functions.

Appendix I

Summary of Amygdala Function

Chapter 3 gives further consideration to the role of physiological affective responses. For present purposes, I will explain the role of the amygdala, to give a broad idea of the type of responses being referred to. The amygdala is not the only structure responsible for such responses as it seems the limbic system as a whole is involved. However, research into the role of the amygdala demonstrates that affective responses may be induced by perceptual stimuli, that affective processing is distinct from identity of perceptual stimuli, and that there are subsequent links from affective processing to evaluative thought. Importantly, studies of such responses demonstrate why there might be adaptive advantage in such mandatory affective responses. LeDoux, gives a summary of the amygdala:

> "Many emotional-processing functions are critically dependent on the amygdala. It has been known for some time that the amygdala, a small structure buried deep in the temporal lobe, plays an important role in the coding of the emotional significance of sensory stimuli (Kluver & Bucy, 1937; Weiskrantz, 1956; Gloor, 1960; Downer, 1961; Goddard, 1964). Animals with amygdala lesions respond normally to the immediately available or remembered perceptual features of objects but are insensitive to the emotional significance of the same objects (for reviews, see Aggleton, & Mishkin, 1986; LeDoux, 1987)." (LeDoux, 1994 in Ekman And Davidson, pp218-219).

Figure 1 gives a schematic account of the direct sensory routes to the amygdala. Auditory inputs function in the same way as the visual example given here. Figure 2 gives a functional representation of connections to the amygdala (further discussion is given by LeDoux, in Ekman and Davidson, 1994).

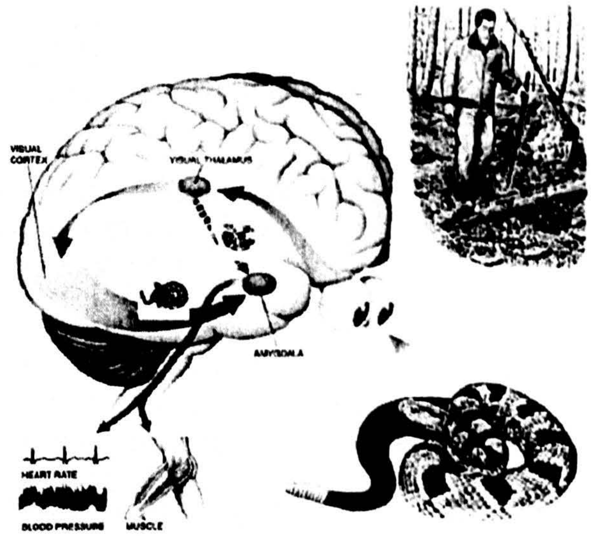


Fig.1

Brain Pathways of Defense. (Fig. 6-14 p. 166, LeDoux 1996).

"as the hiker walks through the woods, he abruptly encounters a snake coiled up behind a log on the path (upper right inset). The visual stimulus is first processed in the brain by the thalamus. Part of the thalamus passes crude, almost archetypal, information directly to the amygdala. This quick and dirty transmission allows the brain to start to respond to the possible danger signified by a thin, curved object, which could be a snake, or could be a stick or some other benign object. Meanwhile, the thalamus also sends visual information to the visual cortex (this part of the thalamus has a greater ability to encode the details of the stimulus than does the part that sends inputs to the amygdala). The visual cortex then goes about the business of creating a detailed and accurate representation of the stimulus. The outcome of cortical processing is then fed to the amygdala as well. Although the cortical pathway provides the amygdala with a more accurate representation than the direct pathway to the amygdala from the thalamus, it takes longer for the information to reach the amygdala by way of the cortex. In situations of danger, it is very useful to be able to respond quickly. The time saved by the amygdala in acting on the thalamic information, rather than waiting for the cortical input, may be the difference between life and death. It is better to have treated a stick as a snake than not to have responded to a possible snake. Most of what we know about these pathways has actually been learned by studies of the auditory as opposed to the visual system." (p.166)

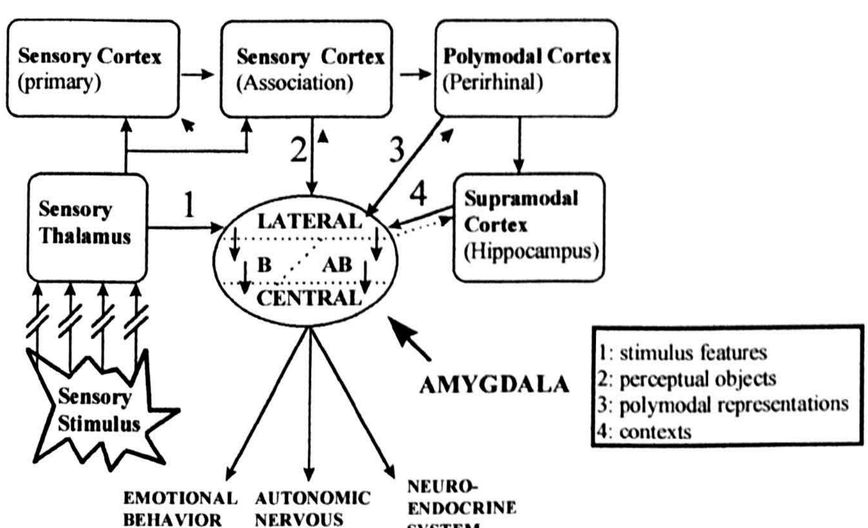


Fig.2

Schematic representation of input and output for the amygdala: From LeDoux (p.221 in Ekman & Davidson).

An important aspect to note is that the amygdala receives sensory input directly, but also subsequent *interpretations* of sensory input via the sensory cortex. This highlights the adaptive advantage of the amygdala as a defence mechanism, and again LeDoux puts this very succinctly:

> "Although the thalamic system cannot make fine distinctions, it has an important advantage over the cortical input pathway to the amygdala. That advantage is time. In a rat it takes about twelve milliseconds (twelve one-thousandths of a second) for an acoustic stimulus to reach the amygdala through the thalamic pathway, and almost twice as long through the cortical pathway. The thalamic pathway is thus faster. It cannot tell the amygdala exactly what is there, but can provide a fast signal that warns that something dangerous may be there. It is a quick and dirty processing system." (LeDoux 1996 p.163).

Appendix II

Brain Anatomy

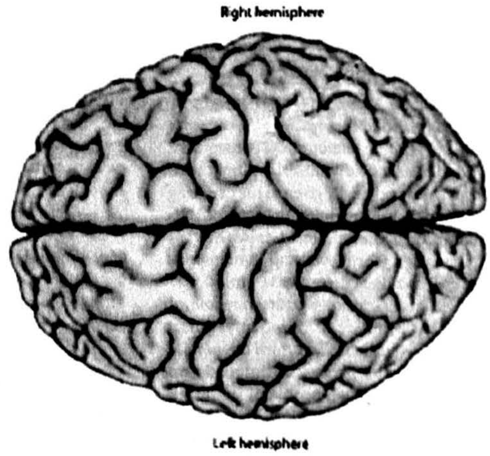


Fig. 1 Left and Right Cerebral Hemispheres.
The convolutions (foldings) seen in the cortical surface allow the large cortical surface area to be neatly packed into the skull. The fissures seen here are also known as sulci, and these separate the gyri, which mark some of the main structural divisions as seen below in fig. 2.

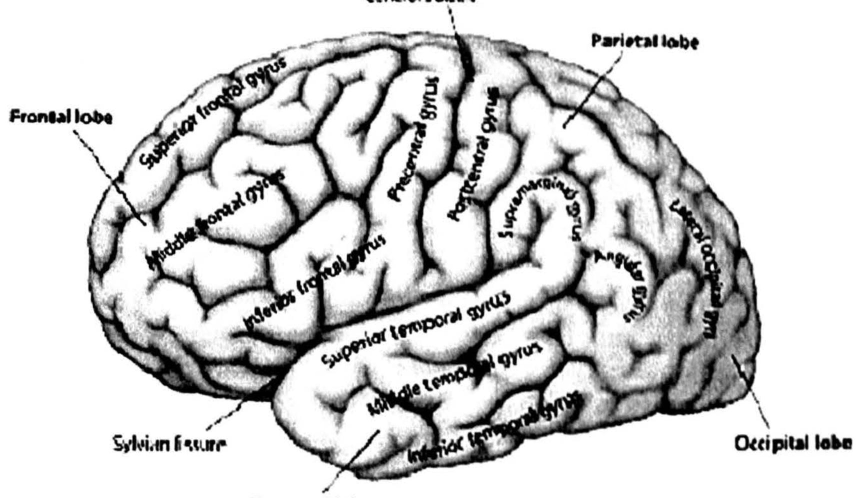


Fig. 2 Lateral View of the Left Hemisphere

shows major features of the cortex, sulci and gyri, and division into 4 cortical lobes: Frontal, Temporal, Occipital and Parietal.

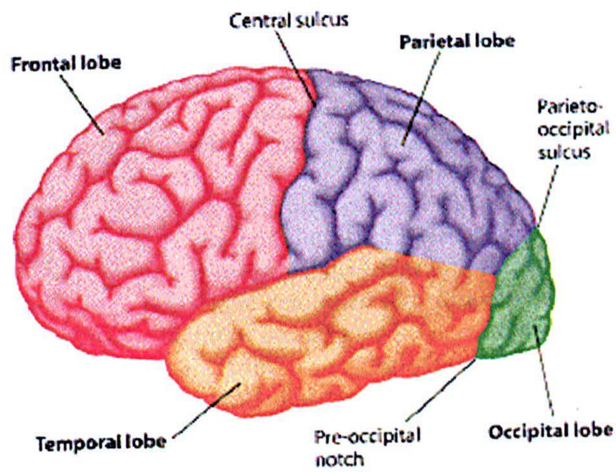


Fig.3
Boundaries of the 4 cortical lobes.

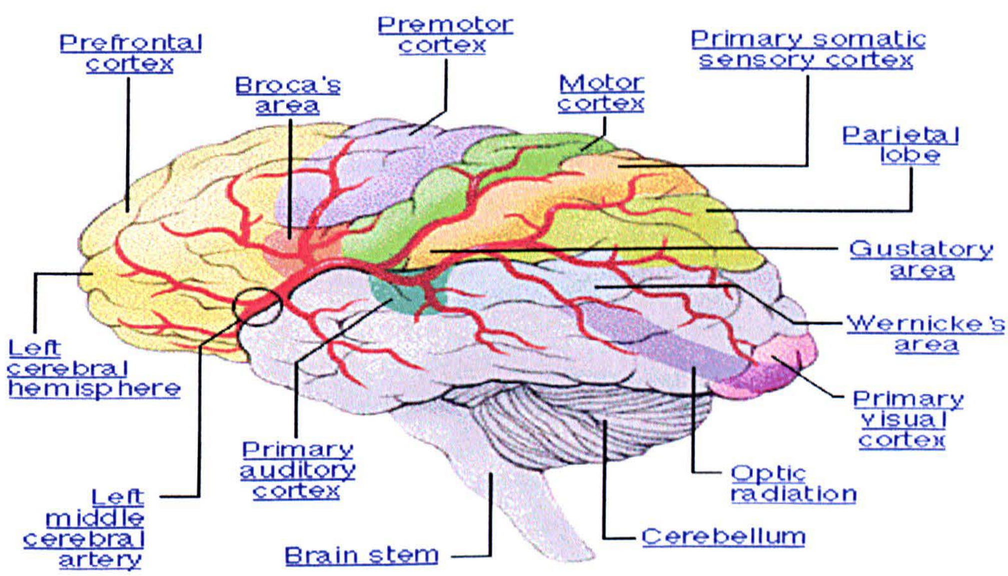


Fig. 4
Distribution of the left middle cerebral artery, showing blood supply to areas of cortex. Disruption of blood supply (stroke) may be caused by cerebral haemorrhage (spontaneous bleeding into the brain), or by a blockage in one of the arteries, cutting of blood supply to surrounding tissue.

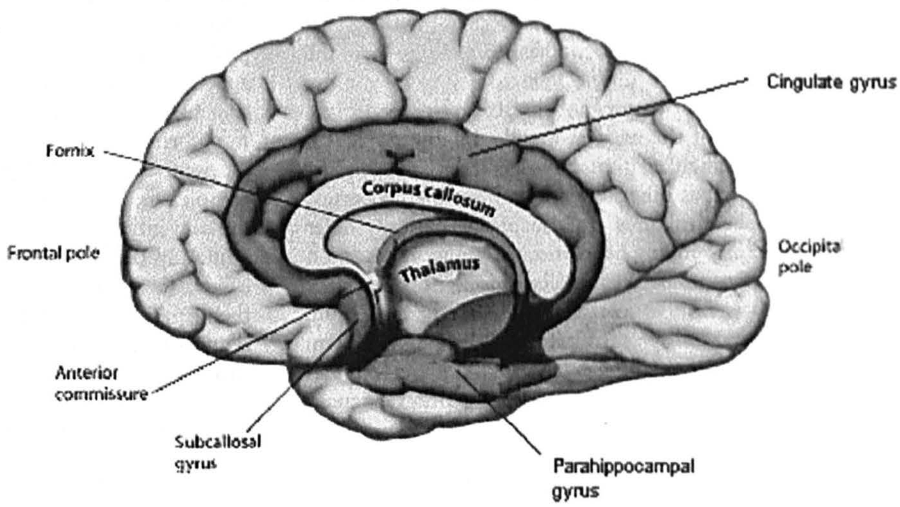


Fig. 5 The limbic system is, (indicated by the darker coloured areas) is comprised of a set of structures which surround the brainstem, the major structures are the cingulate gyrus, subcallosal gyrus and parahippocampal gyrus.

Figure Credits: Figures 1 & 5, adapted from Gazzaniga, Ivry and Mangun, (eds.) *Cognitive Neuroscience: The Biology of The Mind*, 1998. Figures 2 & 3 from Gazzaniga, Ivry and Mangun, (eds.) *Cognitive Neuroscience: The Biology of The Mind*, 1998.

Appendix III

Test References

III.1 Language Tests

PALPA: Kay, J, Lesser, R & Coltheart L, (1992) Psycholinguistic Assessment of Language Processing in Aphasia, Psychology Press, Hove.
BORB: Riddoch M. R, Humphreys G. W, (1993) Birmingham Object Recognition Battery, Lawrence Erlbaum Hove.

Pyramids and Palm Trees: Howard, D. & Patterson, K. (1992). The Pyramids and Palm Trees Test. Thames Valley Test Company: Bury St Edmunds.

Recorded Examples

III.2 Perceptual Discrimination Experiment 1: Sound Source Discrimination.

1. Schoenberg Pierrot Lunaire, Erika Sziklay Soprano, Budapest Chamber Ensemble ℗ & © Hungaroton 1987 STEREO HCD11385-2
2. Messiaen Catalogue D'Oiseaux Peter Hill, Piano, ℗1988 Unicorn-Kanchana Records, London © 1988 Unicorn-Kanchana Records, London. DKP(CD)9062
3. Steve Reich, Early works CD ℗ & © 1987 Electra/Asylum/Nonesuch Records (US) & WEA Inc. (Non-US) CD 979 169-2
4. Humming Familiar Sounds Cassette, Taskmaster Limited DLM 139
5. Side 2 Band 4a. BBC Sound effects No. 4 (Cassette). ℗1977 © 1977 BBC, London UK
6. track 22, BBC Essential Sound Effects CD ℗BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK.
7. Side 1Band 6a. BBC Sound effects No. 4 (Cassette). ℗1977 © 1977 BBC, London UK
8. Side 1 Band 5b. BBC Sound effects No. 4 (Cassette). ℗1977 © 1977 BBC, London UK
9. Track 74. BBC Essential Sound Effects CD. ℗BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK.
10. Steve Reich, Early works CD ℗& © 1987 Electra/Asylum/Nonesuch Records (US) & WEA Inc. (Non-US) CD 979 169-2
11. Concert hall Track 76. BBC Essential Sound Effects CD ℗BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK
12. Track 2 BBC Essential Sound Effects CD ℗BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK
13. Familiar Sounds Cassette, Taskmaster Limited DLM 139

14. Track 81 BBC Essential Sound Effects CD ℗ BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK.
15. Familiar Sounds Cassette, Taskmaster Limited DLM 139
16. Familiar Sounds Cassette, Taskmaster Limited DLM 139
17. Familiar Sounds Cassette, Taskmaster Limited DLM 139
18. Track 45 BBC Essential Sound Effects CD BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK
19. Familiar Sounds Cassette, Taskmaster Limited DLM 139
20. Track 20 BBC Essential Sound Effects CD BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK
21. Track 56 BBC Essential Sound Effects CD BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK
22. Track 4 BBC Essential Sound Effects CD BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK.
23. Familiar Sounds Cassette, Taskmaster Limited DLM 139
24. Familiar Sounds Cassette, Taskmaster Limited DLM 139
25. Familiar Sounds Cassette, Taskmaster Limited DLM 139
26. ADA Comprehension Battery Franklin, S. Turner, J. Elks, A. © 1992
27. ADA Comprehension Battery Franklin, S. Turner, J. Elks, A. © 1992
28. ADA Comprehension Battery Franklin, S. Turner, J. Elks, A. © 1992
29. Pulp Fiction Sound Track CD Track 9
30. Track 4 Steve Reich, Early Works CD ℗& © 1987 Electra/Asylum/Nonesuch Records (US) & WEA Inc. (Non-US) CD 979 169-2
31. ADA Comprehension Battery Franklin, S. Turner, J. Elks, A. © 1992
32. Track 24 BBC Essential Sound Effects CD. ℗ BBC World-wide Ltd. © 1990 BBC World-wide Ltd. London, UK.
33. ADA Comprehension Battery Franklin, S. Turner, J. Elks, A. © 1992
34. Medieval Music- (O Maria Maris..) Medieval Music CD Hilliard Ensemble ℗1990 Macmillan Inc.
35. Familiar Sounds Cassette, Taskmaster Limited DLM 139
36. Glenn Miller Band -From Glen Miller CD ℗1991 Pickwick international Inc. (Great Britain) Ltd
37. Verdi 'La Force Del Destino -Romantic Times CD ℗1994 Delos International Inc. ©1994 Conifer Records
38. 'Sapphire' from Cassette -Bill Holcomb - Contemporary Flute Solos in pop/jazz styles, © Musicians Publications.
39. Schubert 'Widmung' Romantic Times CD ℗1994 Delos International Inc. ©1994 Conifer Records
40. Medieval Music CD Hilliard Ensemble ℗1990 Macmillan Inc.
41. Britten String Quartet Modern Times CD ℗1994 Conifer Records Ltd. ©1994 Conifer Records
42. Space Spiders Female of the Species Gut Music Publishing Limited ℗ & © 1996 Gut Records, London.
43. Copland Clarinet Concerto Modern Times CD ℗.1994 Conifer Records Ltd. ©1994 Conifer Records
44. Grieg Holberg Suite Romantic Times CD ℗1994 Delos International Inc. ©1994 Conifer Records

III.3 Perceptual Discrimination Experiment 8: Instrument Discrimination.

1. Mozart Clarinet Concerto 2nd Movement, Josef Luptacik (Clarinet) Mozart Academy, Bratislava cond. Richard Edlinger. ℗1988 HNH International Ltd. ©1992 HNH International Ltd
2. Debussy- La Fille Aux Cheveux de Lin. Nicholas Yorke (Piano) Apollo Classics ℗Wisepack Ltd. 1995 Wisepack Ltd. 1995 105 Freston Road, Holland Park, London W11 4BD
3. Mozart Bassoon Concerto 2nd Movement Peter Hanzel (Bassoon) Mozart Academy, Bratislava cond. Richard Edlinger. ℗1988 HNH International Ltd. ©1992 HNH International Ltd.
4. Gluck -Dance of the Blessed Spirits from orpheus and Euridice. Helmut Rucker (Flute), Herbet Kegel Cond. Meditation, Classical relaxation Vol.1 ©1991 Delta Music.
5. Rodrigo, Concierto de Ananjuez, 2nd Movement, Zoltan Tokos Guitar, Budapest strings, Meditation Vol. 4 CD © Delta Music 1991
6. Scarlatti Cat's Fugue (from 30 Essercizi per Gravicembalo) Joseph Payne (Harpsichord) Baroque Times CD ℗1994 Grammofon AB BIS ©Conifer Records
7. Yeardley, D Drum Machine sample
8. Bartok Viola Concerto 2nd movement: Adagio Religioso Universal Edition, Rivka Golani (Viola) ℗1990 Budapest Symphony Orchestra. From Compilation 'Modern Times' p 1994 Conifer records Limited 1994 Conifer records Limited.
9. Britten Young Persons Guide to the Orchestra, André Previn & Royal Philharmonic Orchestra. ℗ & ©Telarc 1986 Cleveland Ohio US.
10. Vivaldi The Four Seasons, Allegro from Winter. Drottningholm Baroque Ensemble, Leader Nils-Erik Sparf. Baroque Times CD ℗1994 Grammofon AB BIS ©Conifer Records.
11. Mozart Horn Concerto No.3 3rd Movement. Sebastien Weigle (Horn) Dresden Philharmonic; Jorg-Peter Weigle Cond. Meditation Vol.5 ℗1991 Delta Music
12. Albinoni Adagio from Concerto Op.9 No.2 Ludwig Guttler (Trumpet) Christoph Kircheis (Organ) Meditation Vol. 1 ℗1991 Delta Music
13. Poulenc, Sonata for Oboe and Piano, (1962) Movement 3. Maurice Bourgue (Oboe) Jacques Fevrier (Piano). Poulenc Chamber Music ℗1973 EMI Pathé Marconi S.A
14. Vivaldi Concerto in C minor RV 441, Movement 3: Allegro. Dan Laurin (Recorder) Drottningholm Baroque Ensemble, Leader Nils-Erik Sparf. Baroque Times CD ℗1994 Grammofon AB BIS ©Conifer Records

III.4 Perceptual Discrimination Experiment 9: Type Classification

1. Feeling Good: The Very Best of Nina Simone, PolyGram TV, London, ℗ & ©1994.
2. Rough Guide World Music CD Complied by Phil Stanton, © World Music Network
3. Rough Guide World Music CD Complied by Phil Stanton, ©World Music Network
4. 1-'Ani' (J.F. Cortes/J. F. Amador) CD- Flamenco Total El Mondao Y Su Grupo, EUMC 1089 AMC Musikverlag Hamburg
5. North Indian Instrumental Music Anthology Des Musiques Traditionelles ©Audivis/IKMSD/Unesco 1980 ℗Audivis-Unesco 1972/1989
6. Beethoven symphony No.5 in C minor Op.67 1st movement. Classical Times compilation, ℗1994 Telarc International Corp. ©Conifer records limited, 1994.
7. Gamelan Semarpegulingan Tirtha Sari ensemble of Peliatian Village, JVC world sounds ℗ & ©1990
8. Royal Opera House Ballet Highlights, Orchestra of the Royal Opera House, Cond. Mark Ermler, Tchaikovsky Swan Lake, Act I No.2 Waltz ©Conifer Records
9. Rough Guide World Music CD Complied by Phil Stanton, World Music Network
10. Extreme, Pornograffitti, Track 7, Its a Monster, ℗ & © A & M, 1990.
11. Brahms, String Quintet No.2 in G major, Op.111 3rd Movement. Romantic Times CD ℗1994 Delos International Inc ©1994 Conifer Records.

12. Haydn, symphony No.31 in D major 3rd movement. from Classical Times compilation, ℗1994 Telarc International Corp. © Conifer records limited, 1994.
13. Schubert -Wintereisse D911 Peter Schreier, Tenor, Sviatoslav Richter Piano. Schubert Wintereisse CD, Phillips 4162892 © & ℗1985 Phillips.
14. Carmina Burana London Symphony Orchestra conducted by Richard Hickox IMP Productions, London (A division of Pickwick International) ℗1987
15. North Indian Instrumental Music Anthology Des Musiques Traditionelles ©Audivis/IKMSD/Unesco 1980 ℗Audivis-Unesco 1972/1989
16. Samba Sur (F.F. Cortes/J.F Amador) -CD 'Flamenco' Total El Mondao Y Su Grupo, EUMC 1089 AMC Musikverlag Hamburg
17. Schubert -Wintereisse D911 Peter Schreier, Tenor, Sviatoslav Richter Piano. Schubert Wintereisse CD, Phillips 4162892 © & ℗1985 Phillips.
18. Carmina Burana London Symphony Orchestra conducted by Richard Hickox IMP Productions, London (A division of Pickwick International) ℗1987
19. Glenn Miller CD ℗1991 Pickwick International. UK
20. Act II Danses des Cygnes, Tchaikovsky Swan Lake, Royal Opera House Ballet Highlights, Orchestra of the Royal Opera House, Cond. Mark Ermler, ©Conifer Records
21. Rough Guide World Music CD Complied by Phil Stanton, ©World Music Network
22. The Doors, Morrison Hotel, track 9 ℗ & ©1970, Elektra.
23. Feeling Good: The Very Best of Nina Simone, PolyGram TV, London, ℗ & ©1994.
24. Britten String Quartet No.2nd Movement Brindisi String Quartet from 'Modern Times' compilation p 1994 Conifer records Limited ©1994 Conifer records Ltd.
25. Gamelan Semarpegulingan Tirtha Sari ensemble of Peliatian Village, JVC world sounds ℗ & ©1990
26. Glenn Miller CD ℗1991 Pickwick International. UK

III.5 Symbolic\Notational Tests Experiment 7: Identification of Note/Rest values.

Scores;

1. Brahms Symphony No. 4 in E minor, Op.98. Eulenberg Edition (No,428) Eulenberg Ltd., London.
2. Haydn String Quartet, in B-flat Major, Op. 76/4, Eulenberg Edition (No. 56) Eulenberg Ltd., London.

III.6 Symbolic\Notational Tests Experiment 7: Identification and Use of Dynamic Markings.

Recorded Examples:

1. Weber, Grand Duo Concertant, Mikhail Pletnev/Michael Collins, ℗1990, Virgin Classics, London.
2. Brahms, Sonata for Piano and Clarinet, Mikhail Pletnev/Michael Collins, ℗1990, Virgin Classics, London.
3. Poulenc, Sonata for Clarinet and Piano, Poulenc Chamber music CD, Février, Menuhin, Fournier etc. EMI ℗1973 EMI Pathé Marconi S.A.

Scores:

1. Weber, Grand Duo Concertant, Op.48, For Piano & Clarinet, Edition No.3317. Pub. CF Peters, Frankfurt, London, New York.
2. Brahms, Sonata for Piano and Clarinet Op.120 no.2 Ed. Jost Michaels. © 1973 Wiener Urtext Edition, UT 50016. Musikverlag Ges.m. b. H & Co., K.G., Wien.
3. Poulenc, Sonata for Clarinet and Piano, 14th Edition 1993. Chester Music, London.

III.7 Emotion Experiment 1: Emotion Recognition

1. Jools Holland, Lost Chord, from CD: The full Compliment, ©1991 IRS Records Ltd. ℗1991 IRS Records Ltd. UK
2. Philip Glass, Facades from minimalists CD
3. Saint-Saens, Carnival of the animals, Finale, Cassette, © 1985, Suprahon Prague.
4. Birdsong, Canary. BBC Sound effects No. 4 (Cassette). ℗1977 © 1977 BBC, London UK
5. Krystoff Penderecki, Threnody For the Victims of Hiroshima, From compilation CD, Polish Radio and Symphony Orchestra ℗1988 © 1988 Conifer Records Ltd.
6. Jamiroquai, Didjerama. From CD, Travelling Without Moving, ©1996 Sony music (UK) Ltd.
7. Schubert, Standchen, (seranade0 Budapest Strings. Meditation-Classical Relaxation Vol.4 ℗1991 Delta Music Germany.
8. Dave Brubeck, Take Five, Cassette, 'We're all together again for the first time' ℗ & © 1973, Atlantic New York.
9. Mussourgsky Night on the Bare Mountain, CD, Strasbourg Philharmonic Orchestra, ℗1977 editions Constellat ©1987 Conifer records Ltd.
10. Barrel Organ:. BBC Sound effects No. 4 (Cassette). ℗1977 © 1977 BBC, London UK
11. Debussy, Clair de Lune, (Suite Bergamasque No.3) Kathryn Stott, Piano. Modern Times CD, ℗1994 Conifer Records Ltd. © 1994 Conifer Records Ltd.
12. Steve Reich, Drumming, CD: 'Works' 2 1965-1995, ©1997, Nonesuch Records, Warner Music Group.
13. Holst Planet Suite, Royal Philharmonic Collection, RPO and Ambrosian Chorus. ℗ Tring International Plc.
14. Beethoven, CD, Symphonies 1 & 2, Berlin Philharmonic Orchestra ℗1985 Polydor, Germany.
15. Commissioned Composition by Julian Butcher, Sheffield UK 1998.
16. Dukas, Sorcerers Apprentice, Ravel\Dukas CD, Oslo Philharmonic Orchestra ℗1990, EMI records, Hayes, Middlesex UK
17. Mozart, Andante from Piano Concerto no.21, CD 'Meditation' -Classical Relaxation Volume 1Istvan Szekely, Franz Liszt Chamber orchestra, Cond. Janos Rolla. ℗1991 Delta Music Germany
18. Holst Planet Suite, Royal Philharmonic Collection, RPO and Ambrosian Chorus. ℗ Tring International Plc.
19. Shostakovich, 10th Symphony, CD, Simon Rattle, Philharmonia Orchestra ℗1986 EMI records, Hayes, Middlesex UK
20. Prokofiev & Britten CD, André Previn, Royal Philharmonic Orchestra, ℗ & © 1986, Telarc, Cleveland Ohio, US.

III.8 Table of Test Parameters

Test	*No. of Excerpts (& trials)*	*Inter-trial Interval (Seconds)*	*Duration of Excerpts (Seconds)*	*No. of Repetitions*
Sound Source Discrimination	41 (3)	8	0.5-2.5	1
Detection of pitch change and	25 (3)	8	1.5	2
Melodic Contour discrimination	22 (2)	8	2.5-4.5	1
Tempo discrimination	22 (2)	8	2.5-4.5	1
Rhythm discrimination	20 (2)	10	2.5-4.5	1
Chord analysis	22 (3)	6	4.0	2
Discrimination of musical instruments	14 (0)	12	15.0	1
Discrimination of type of music	25 (1)	12	15.0	1

Appendix IV

Transcriptions of Test Materials

IV.1 Perceptual Discrimination Experiment 2: Pitch Change and Direction.
Transcriptions of extracts in order of presentation. Numbers 1-3 were given as practice trials.

1

2

3

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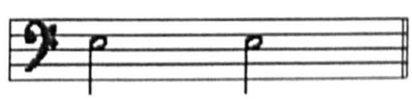

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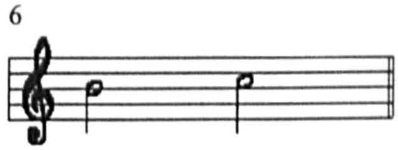

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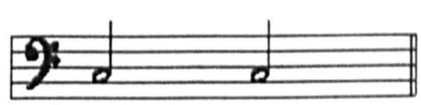

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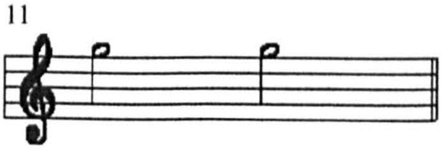

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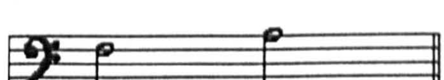

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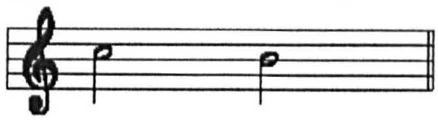

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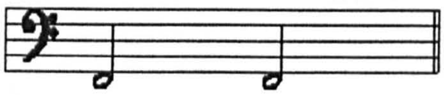

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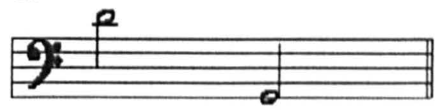

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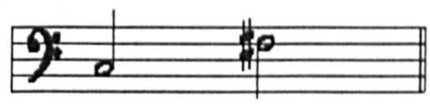

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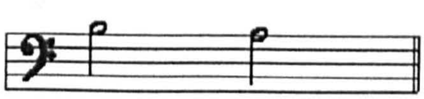

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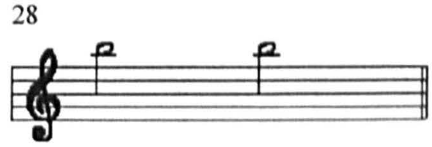


IV.2 Perceptual Discrimination Experiment 3: Melodic Contour Discrimination.
Transcriptions are given in order of presentation. Examples forming the 'different' subset are marked A & B. Numbers 1& 2 were given as practice trials.

1

2A

2B

3

4A

4B

5

6

7A

7B

8A

8B

9A

9B

10

11

12A

12B

13A

13B

14

15A

15B

16A

16B

17

18

19A

19B

20

21A

21B

22A

22B

23

24

IV.3 Perceptual Discrimination Experiment 4: Tempo Discrimination
Extracts are given in order of presentation. Metronome markings are given, For 'Same' subset, excerpts were repeated at the given tempo. For the different subsets comparison excerpts were given at tempo A & B. Numbers 1 & 2 were given as practice trials.

1- MM=88

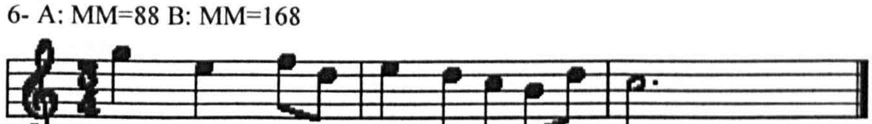
2- A: MM=66 B: MM=132

3- A:MM=75 B: MM=132

4- A: MM=144 B: MM=72

5- MM=88

6- A: MM=88 B: MM=168



7- MM=160

8- MM=90

9- MM=80

10- A: MM=80 B: MM=136

11- MM=81

12- A: MM=60 B: MM=136

13- MM=90

14- MM=108

15- A: MM=160 B: MM=80

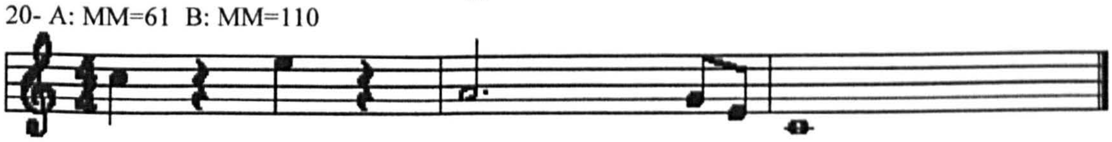
16- MM=96

17- A: MM=186 B: MM=96

18- MM=100

19- A: MM=100 B: MM=164

20- A: MM=61 B: MM=110



21- MM=104

22- A: MM=180 B: MM=69

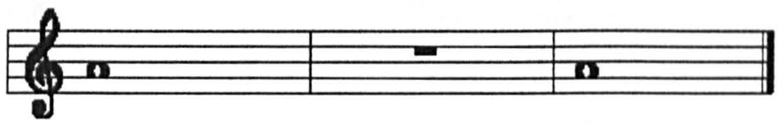
23- A: MM=61 B: MM=80

24- MM=60

IV.4 Perceptual Discrimination Experiment 5: Chord analysis

Transcriptions are given in order of presentation. Excerpts 1-3 were given as practice trials.

1



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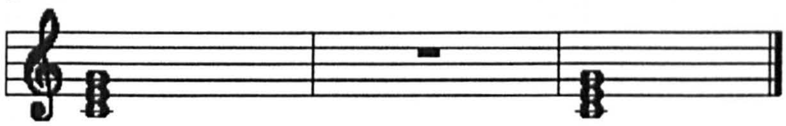
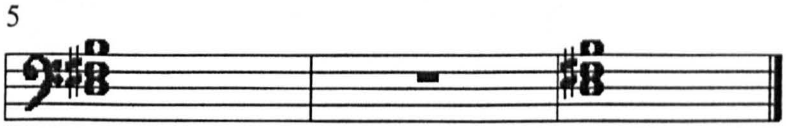


3

4

5



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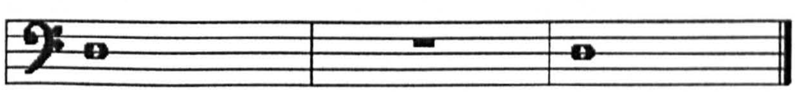
7



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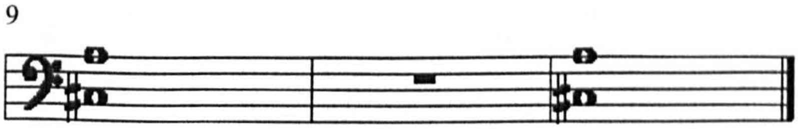

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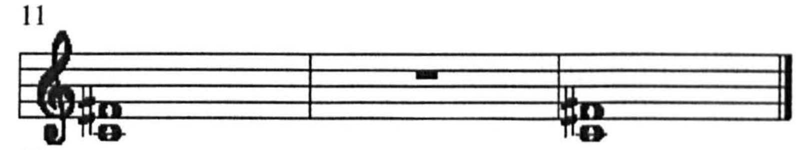

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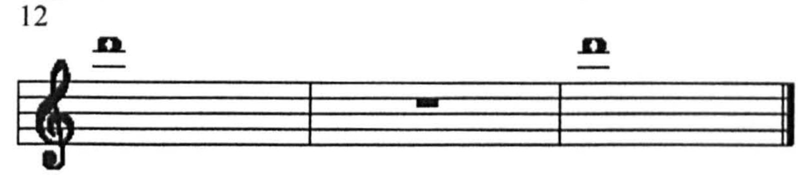

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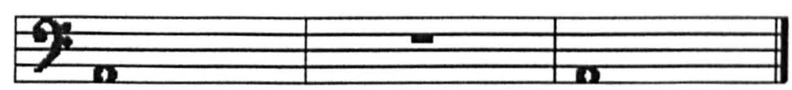

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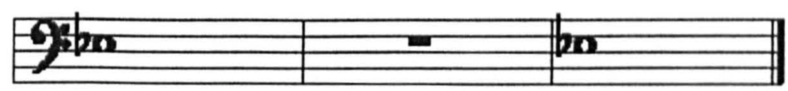

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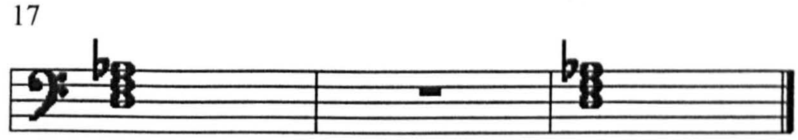

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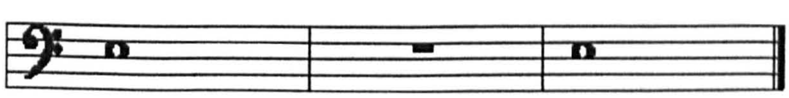

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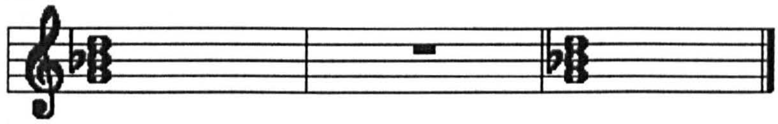

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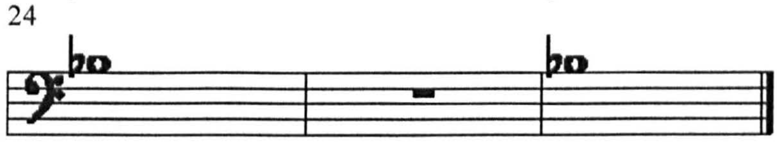

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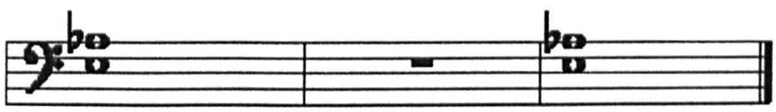

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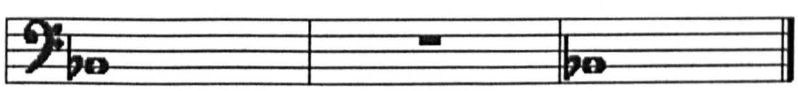

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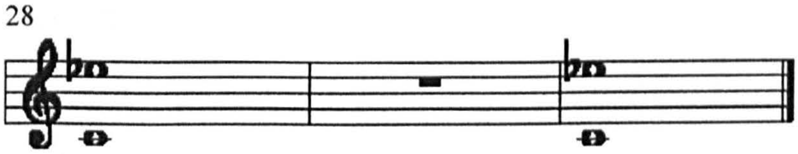
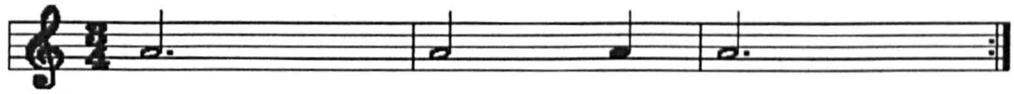


IV.5 Perceptual Discrimination Experiment 6: Rhythm Discrimination 1

Examples are given in order of presentation. Examples forming 'different' subset are marked A & B. Numbers 1& 2 were given as practice trials.

1



2A

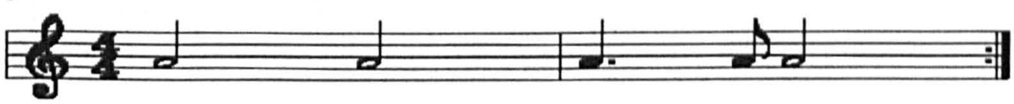
2B

3

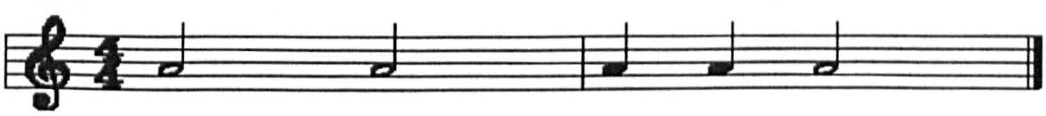
4A

4B

5



6A



6B

7

8A

8B

9A

9B

10

11A

11B

12

13

14A

15A

15B

16

17A

17B

18A

18B

19A

19B

20

21A

21B

22

23

24A

24B

IV.6 Perceptual Discrimination Experiment 7: Rhythm Discrimination 2

Numbers 1 & 2 were given as practice trials. Each example shows a target and comparison melody. Comparison melodies divide into 4 groups -identical melody, rhythm only varied, melody only varied, and both melody and rhythm varied.

1

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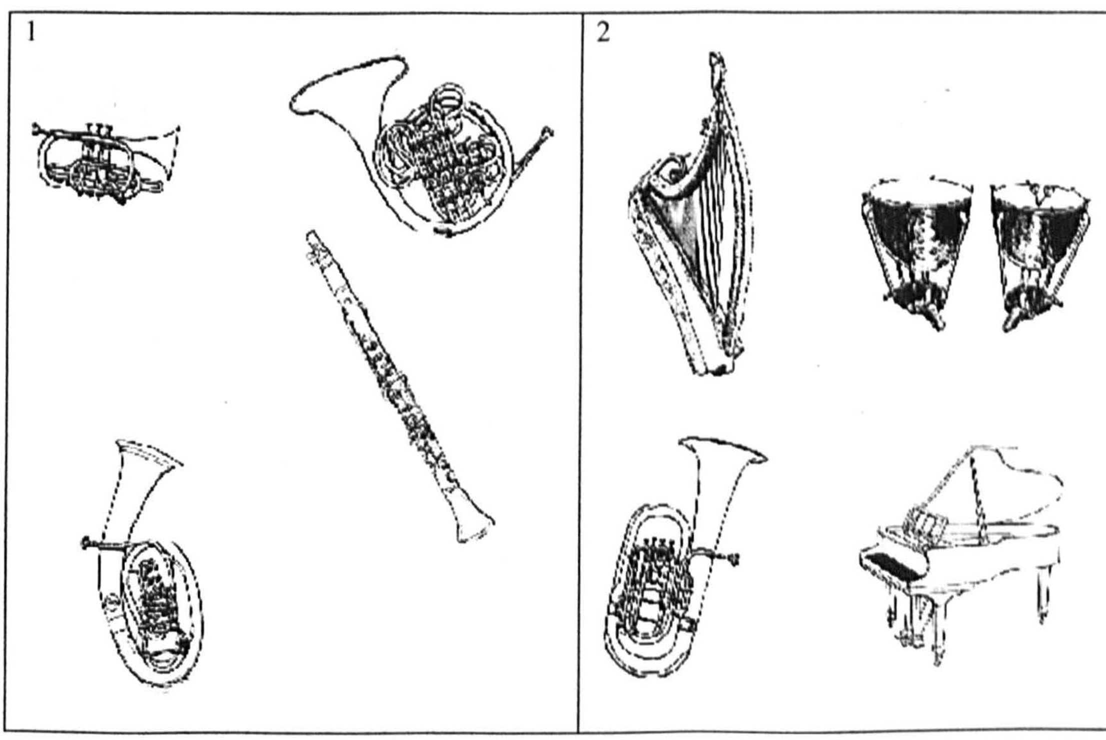
28

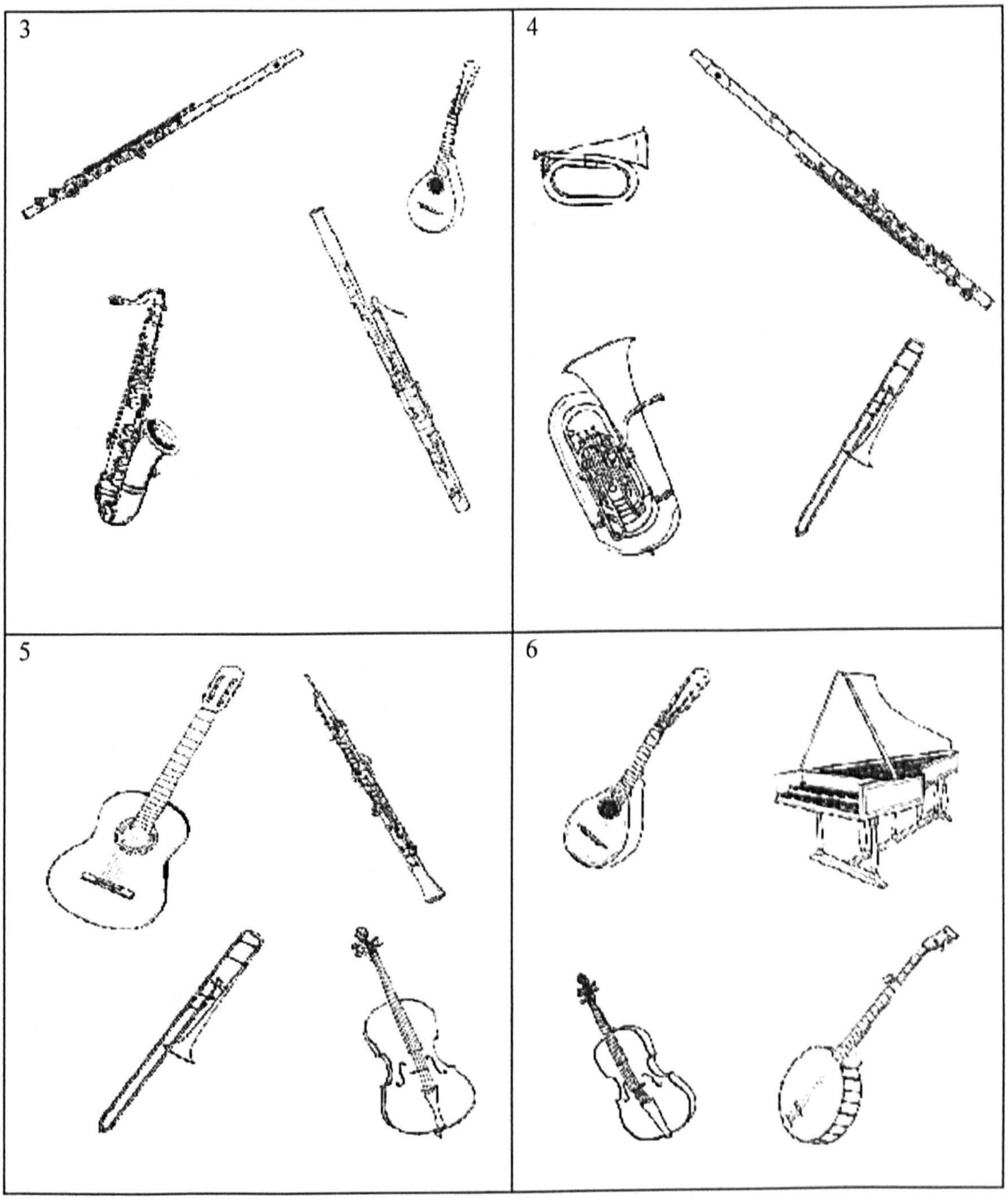
IV.7 Perceptual discrimination Experiment 8: Instrument Discrimination

No practice trials were given on this task.. Pictures for response choices were taken from The New Harvard dictionary of Music. Response choices are listed below table 1, and given in order of presentation (corresponding to excerpts listed on page 8).

Table 1: Response Choices

Response Choices in Order of Presentation	Choice From: (in order: top left, top right, bottom left, bottom right.)
1- Clarinet	Cornet, French Horn, Clarinet, Double B-flat Baritone.
2- Piano	Harp, timpani, Piano, Euphonium.
3- Bassoon	Flute, Bandurria (guitar), Alto Saxophone, Bassoon.
4- Flute	Bugle, Flute, Euphonium, Trombone.
5- Guitar	Guitar, Oboe, Trombone, Cello.
6- Harpsichord	Guitar, Oboe, Trombone, Cello.
7- Drums	Double B-flat Baritone, Gong, Drums, Guitar.
8- Viola	Pan Pipes, Viola, piccolo, Trumpet.
9- Harp	Clarinet, Harp, Xylophone, Guitar.
10- Violin	Bugle, Violin, Cello, Banjo.
11- French Horn	French horn, Violin, Guitar, Bugle.
12- Trumpet	Cor Anglais, Trumpet, Recorder, Bassoon.
13- Oboe	Oboe, Euphonium, Cornet, Piccolo.
14- Recorder	Double B-flat Baritone, Bass Clarinet, Recorder, French Horn.

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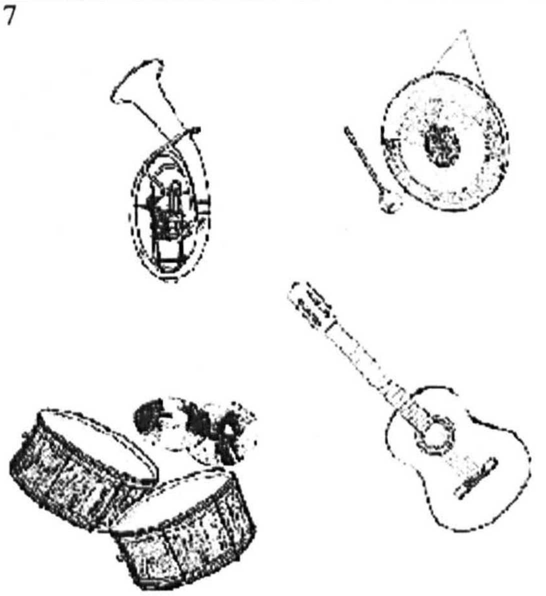

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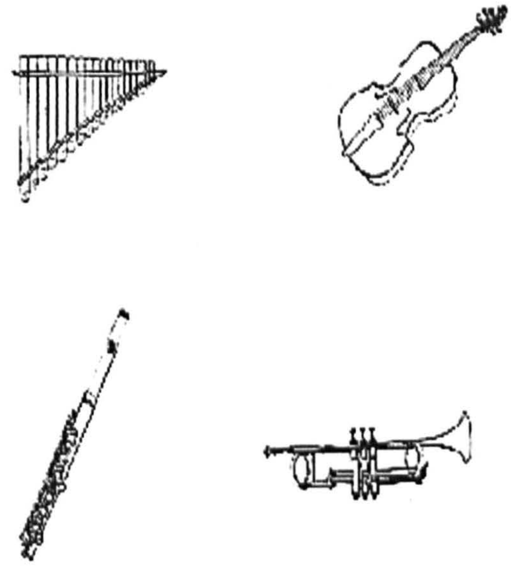

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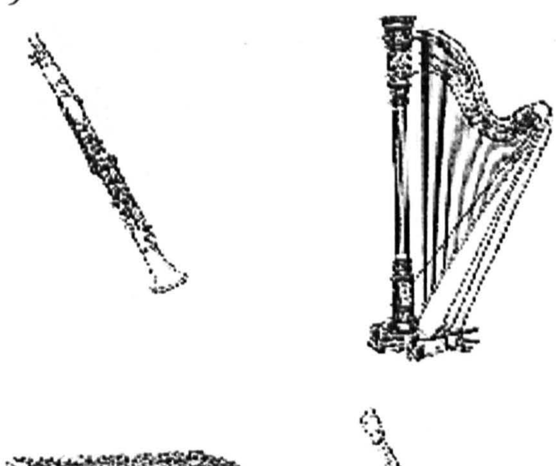

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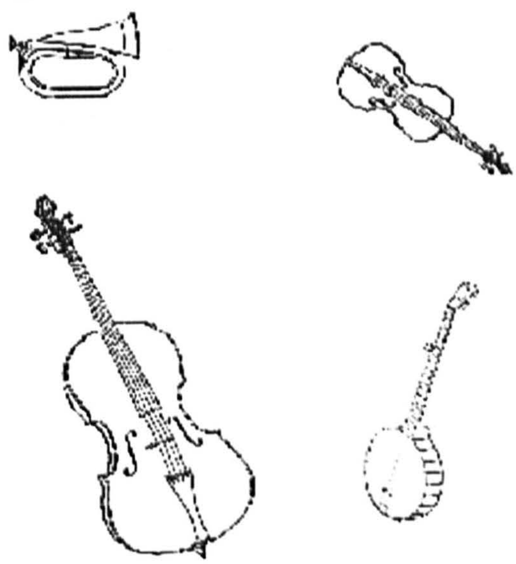

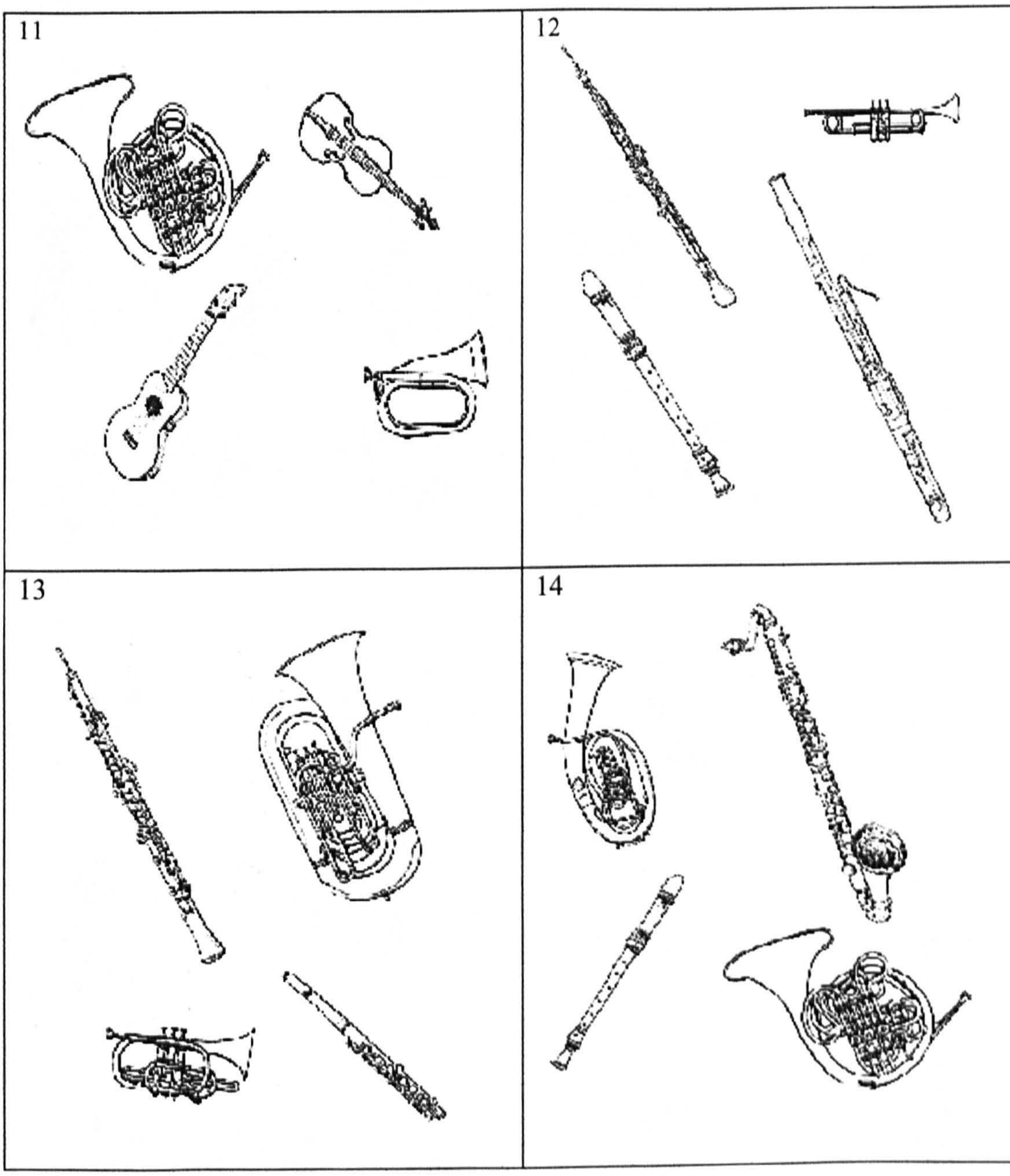
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IV.8 Perceptual Discrimination Experiment 9: Type Classification.

Response Choices in order of presentation. Pictures were taken from The Usborne Story of Music.

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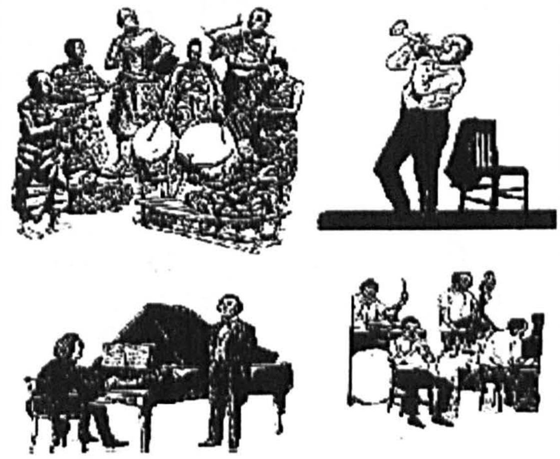

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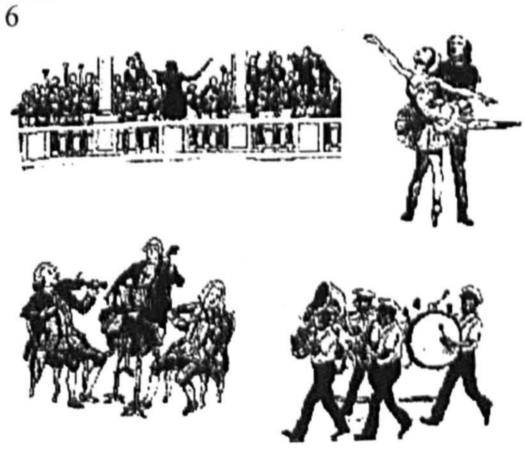

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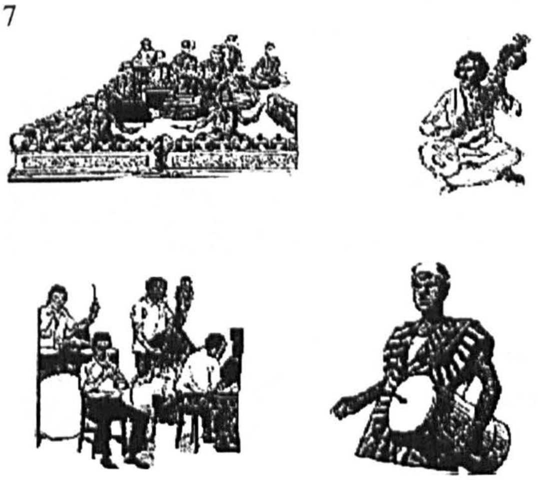

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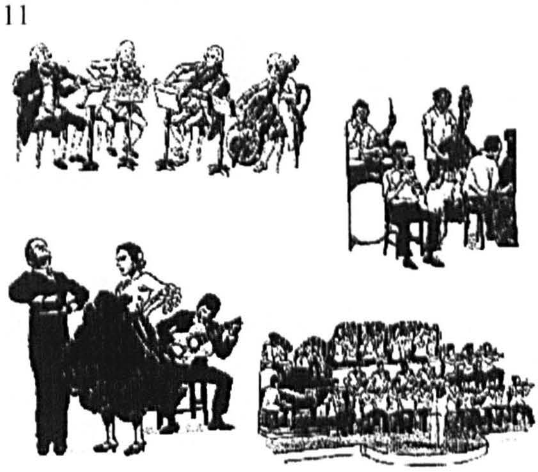

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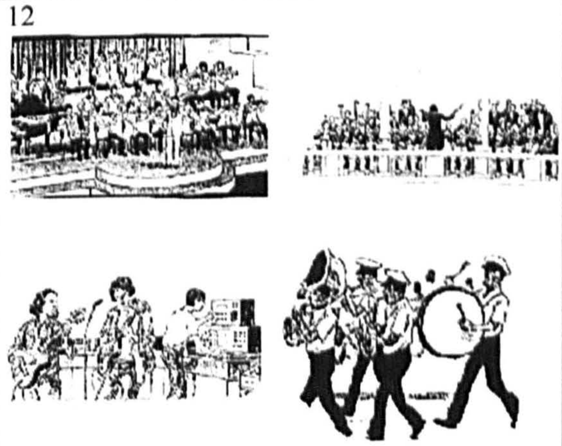

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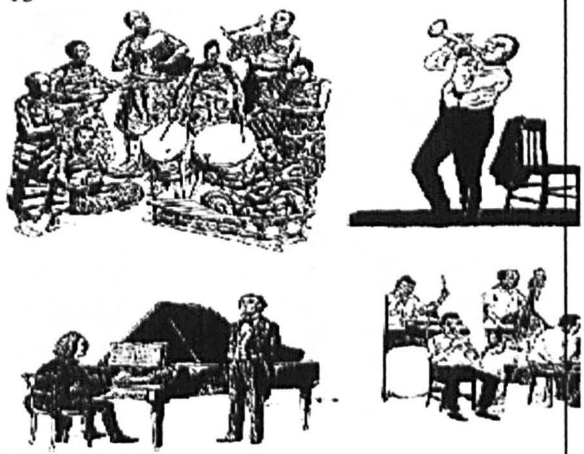

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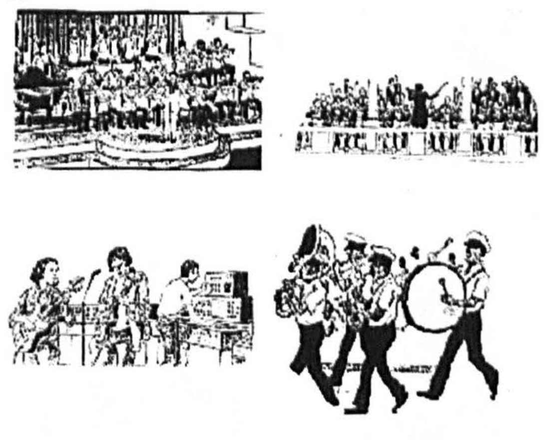

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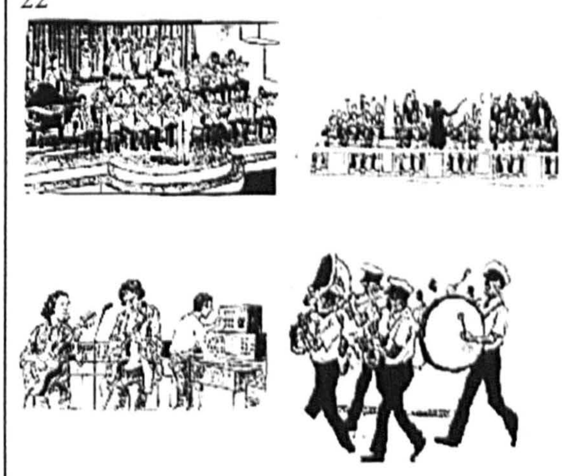

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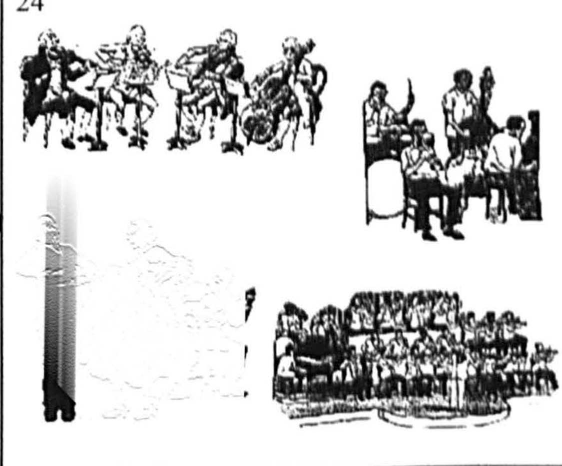

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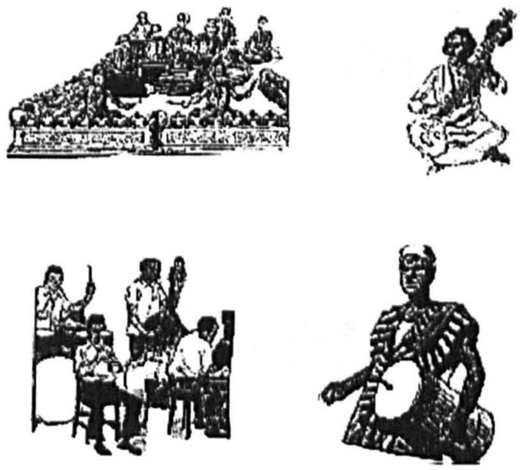


26

IV.9 Symbolic Tests Experiment 1: Score reading - Error Detection.

A- Original Score Mozart Clarinet Concerto bars 1-166.

CLARINET CONCERTO

W. A. MOZART, K.V. 622
(1756 - 1791)
Revised by
FREDERICK THURSTON

CLARINET


30
40
50
Solo
60
70


p dolce
poco a poco crescendo


130
p
1
mf
cresc.
f
140
f
p
f
p
f
ff
150
3
Tutti
160
p

A5.9 B-Edited version of score. Edited sections are marked□.

CLARINET CONCERTO

W. A. MOZART, K.V. 622
(1756 - 1791)

CLARINET

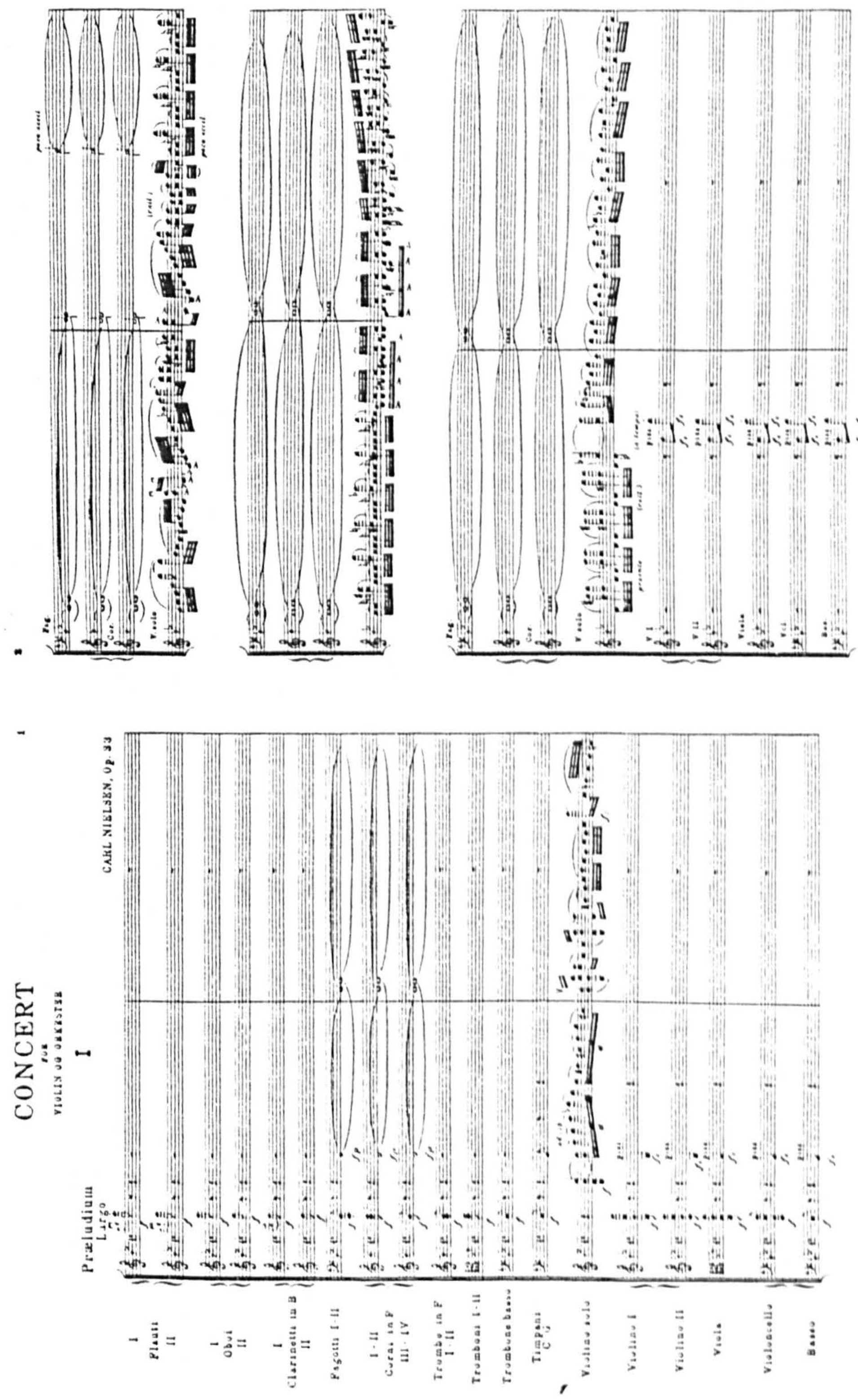
Revised by
FREDERICK THURSTON

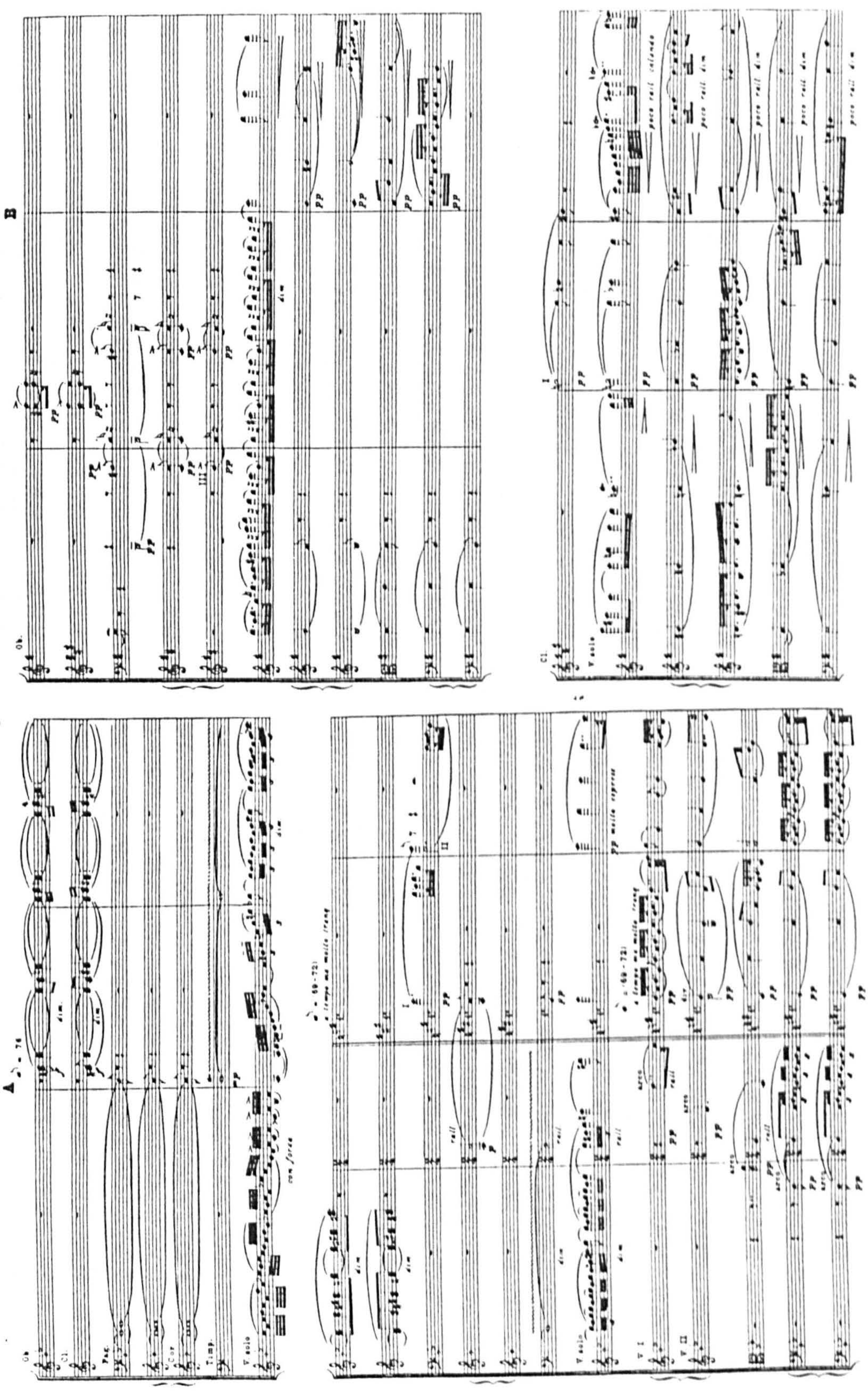

30
tr
40
50
Solo
60
70
2

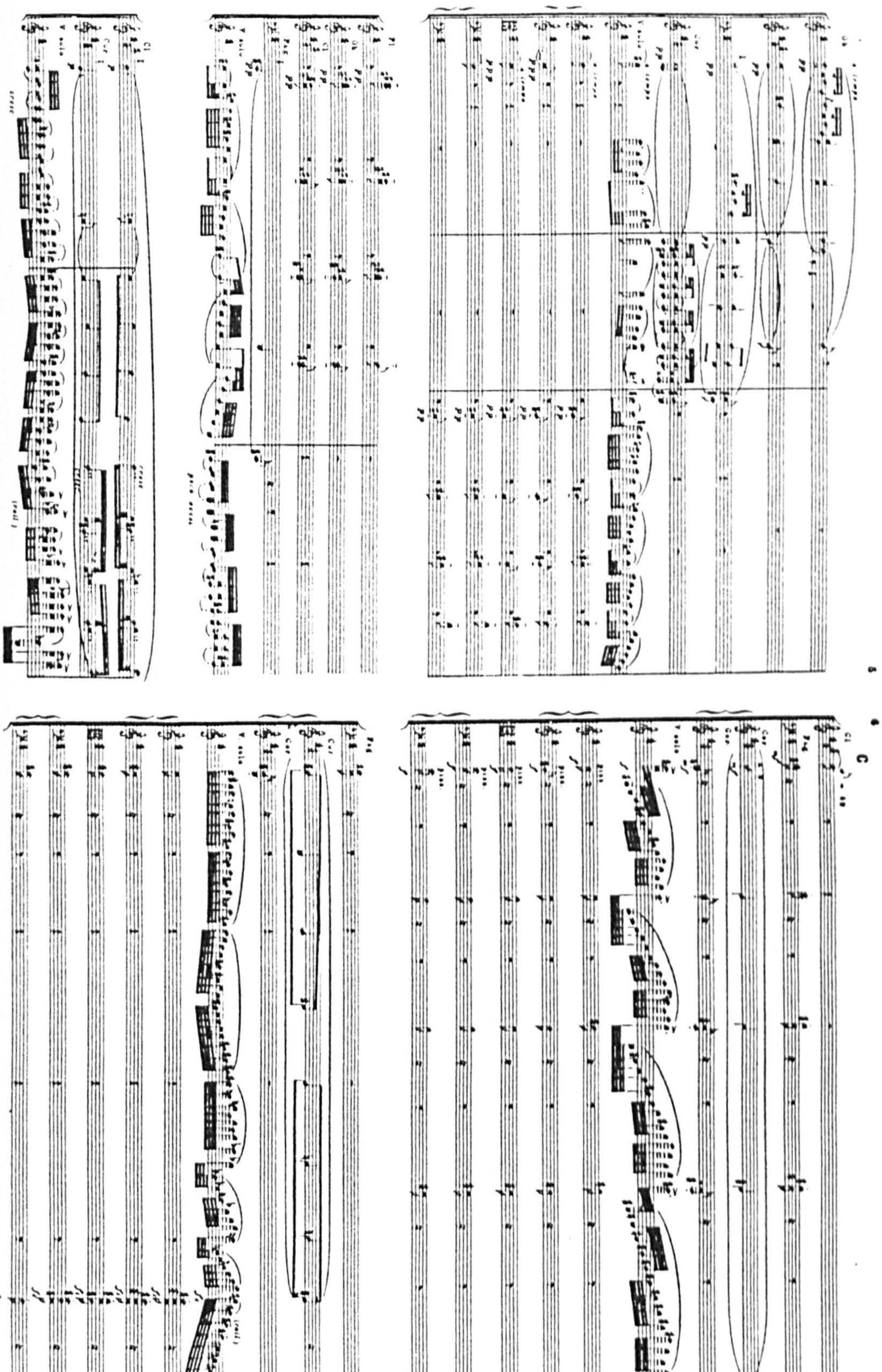

80
p dolce
f
p
mf
90
f
pp
mf
100
p
poco a poco crescendo
110
f
p
120
p
mf
mf
f
fff

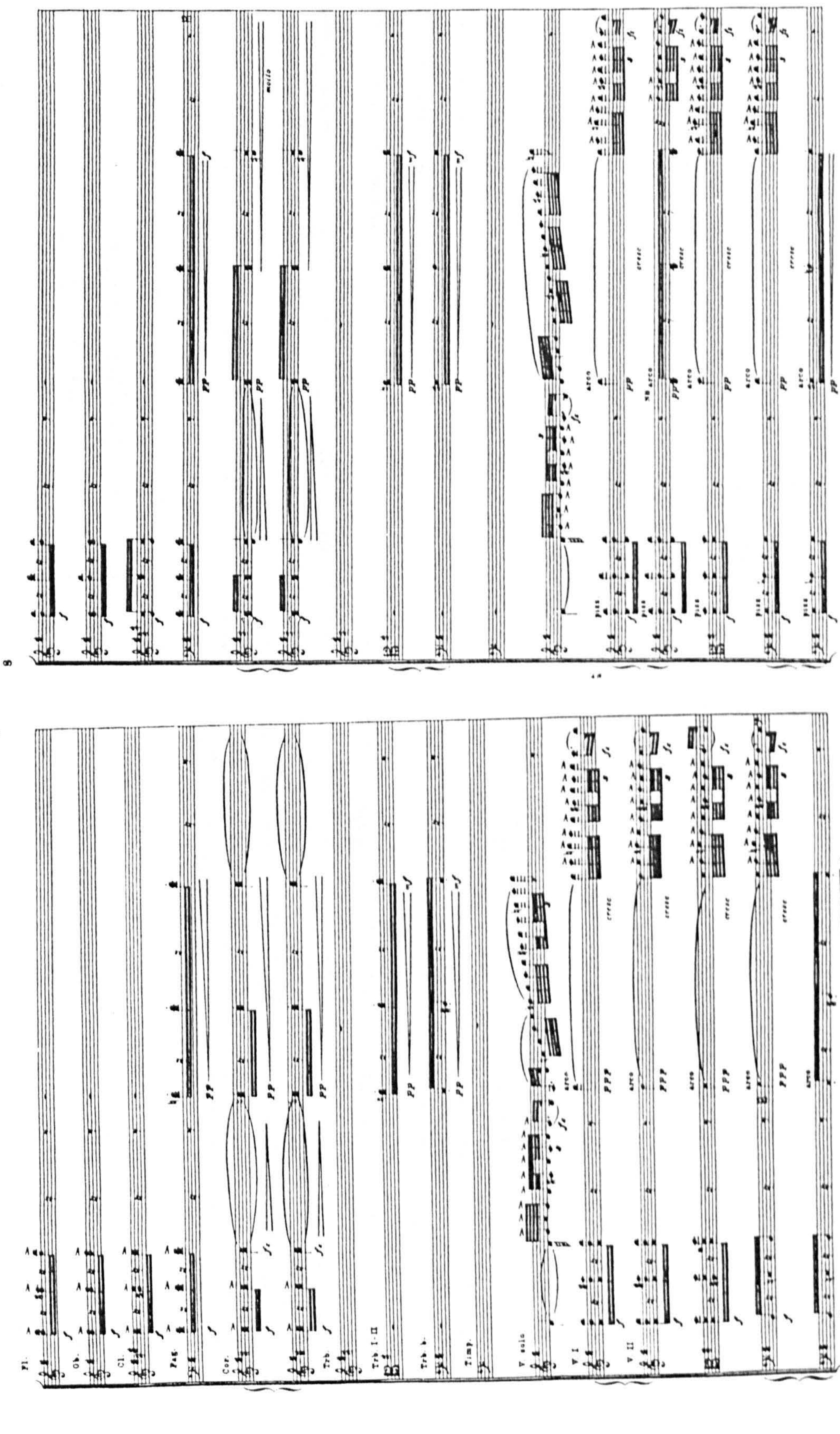

130
140
150
160
cresc.
Tutti

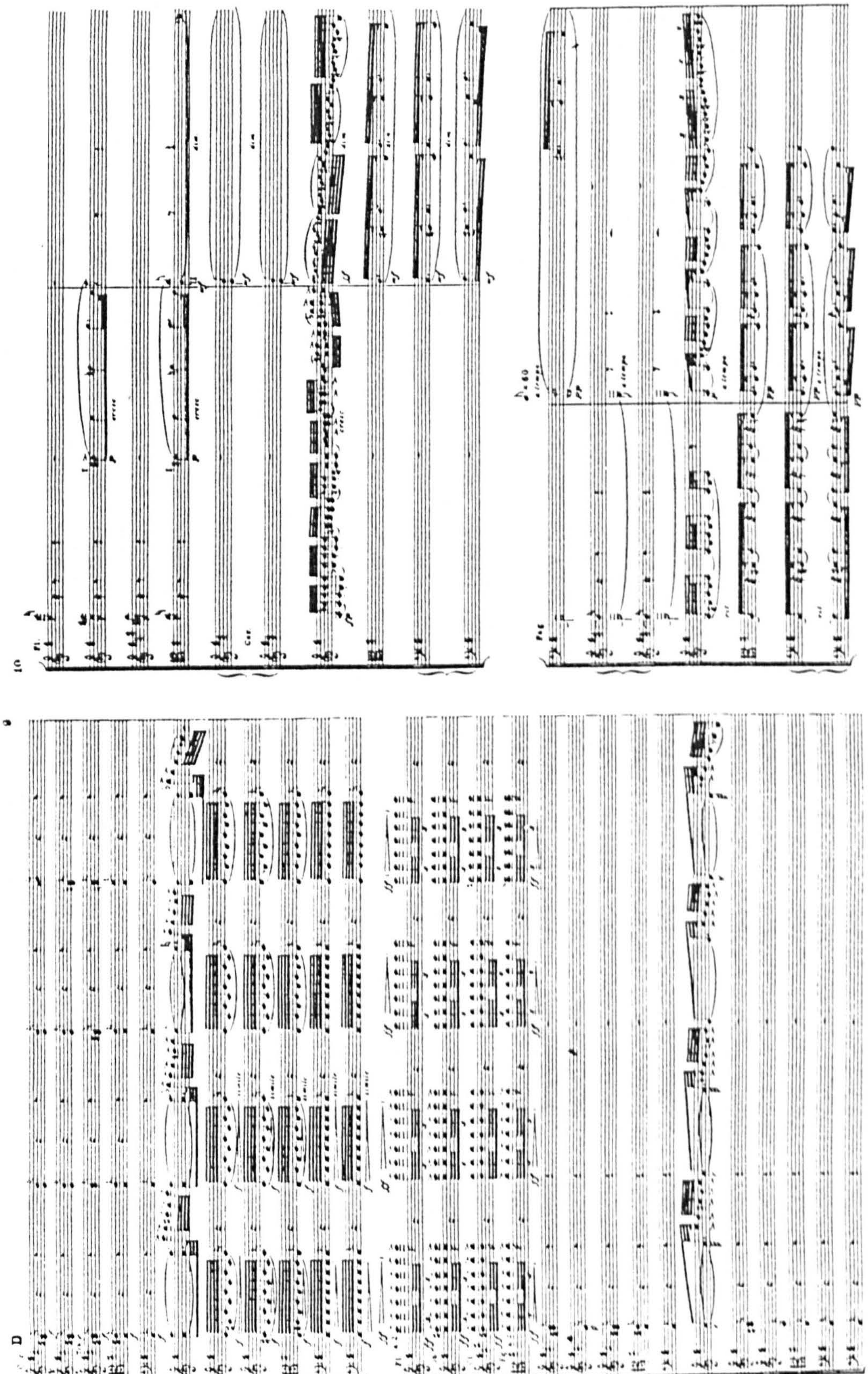
IV.10 Symbolic Tests Experiment 2. Identification of Excerpts in Notational Form
Transcription of Nielson Violin Concerto 1st movement, provided to accompany recorded excerpts of bars: **1; 13-14; 31-32; 24-25; 47-48; 38, 4-5; 18-21; 29-30; 10-11; 26-27; 7; 16-17; 34**.

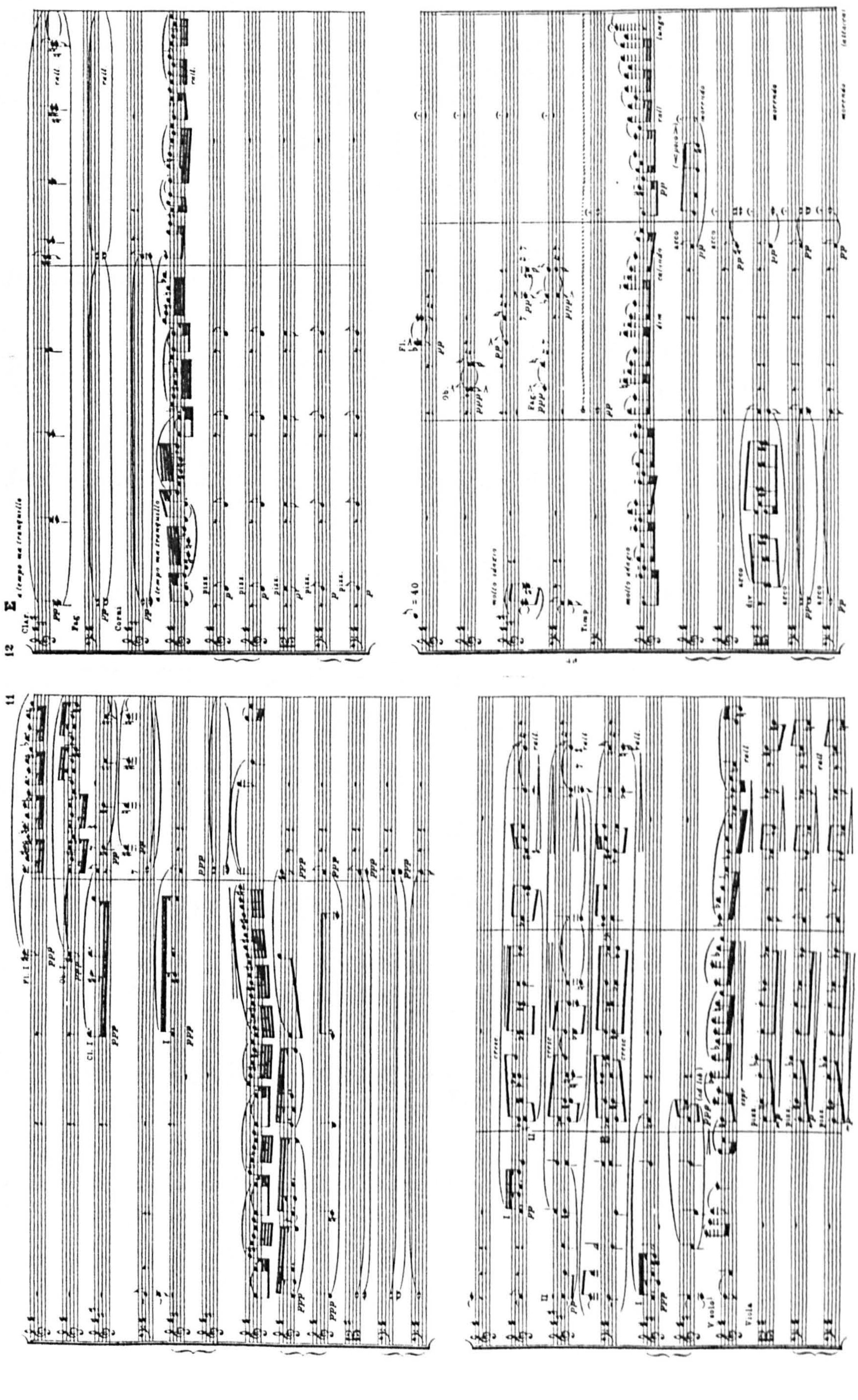







7
8
Fl.
Ob.
Cl.
Fag.
Cor.
Trb.
Trb. I-II
Timp.
V solo
V I
V II
arco
pizz
cresc




12
11
a tempo ma tranquillo
Clar
Fag
Corni
molto adagio
Timp
Viola
pizz
arco
rall
morendo
calando
lunga

IV.11 Symbolic Tests Experiment 3: Discrimination of Dynamics.

The edited versions of the scores below were provided to accompany this test. Scores were edited to remove some dynamic markings. 1A & 1B Brahms Sonata: Bars 1-47. 2A & 2B Weber Grand Duo Concertant: Bars 1-69. 3A & 3B Poulenc Sonata: Bars 1-44. Edited Sections are indicated: ☐ **1A Brahms: Original Score.**

1B Brahms: Edited Score

SONATE ES-DUR

Opus 120 No. 2

eingerichtet von / edited by
Jost Michaels

1894

Johannes Brahms

Allegro amabile

2A Weber: Original Score:

2B Weber: Edited Score.

3A Poulenc: Original Score.

3A Poulenc: Edited Score.

2

à la mémoire d'Arthur Honegger

SONATA

for Clarinet in B♭ and Piano

CLARINET in B♭

FRANCIS POULENC
(1962)

I. ALLEGRO TRISTAMENTE

IV.12 Symbolic Tests Experiment 4: Completion of Familiar and Novel Melodies.
Excerpts are given in order of presentation. Familiar and novel extracts are identified. Asterisks mark missing notes requiring completion by the subject the 'Familiar' subset (Excerpts 1, 3, 7, 8, 9, 11, 14, 17, 20, 21, 22) correspond to table 4 (p.10) where they are listed in order of presentation. Examples 1 &2 were given as practice trials.

1-Familiar

2-Novel

3-Familiar

4-Novel

5-Novel

6-Novel

7-Familiar

8-Familiar

9-Familiar

10-Novel

11-Familiar

12-Novel

13-Novel

14-Familiar

15-Novel

16-Novel ** * *

17-Familiar * * **

18-Novel * * * *

19-Novel * * * * *

20-Familiar * * * * *

21-Familiar * * * * *

22-Familiar * ** * *

Appendix V

Testing Recognition of Emotional Expression in Music.

Introduction

The following test was devised to act both as a pilot study for material to be used in neuropsychological testing, and also to derive information regarding the relationship of musical experience to emotional description and levels of consensus for emotional responses. In addition, the experiment was constructed to examine the relationship of musical preferences and familiarity to emotional arousal and labelling, and to examine any difference in the responses of musically trained and untrained listeners.

Materials

A set of 20 excerpts was constructed, using examples taken from professional recordings (Table 1), mean duration 44.7 seconds. The set comprised 18 musical excerpts in western tonal idiom, covering a range of musical periods and genres e.g. contemporary classical, pop music, jazz etc. In addition two environmental sound effects with musical content were added to allow comparison of responses to these sound sources which would be heard in context as environmental sound.

Table 1 List of Recorded Excerpts. Full References are Given in Appendix III.7

Excerpts in Order of Presentation

1. Jools Holland, Lost Chord	11. Debussy, Clair de Lune
2. Philip Glass, Facades	12. Steve Reich, Drumming, Pt. 3
3. Saint-Saens, Finale: Carnival of the Animals	13. Holst, Planets Suite: Mars
4. BBC Sound Effects: Canary singing	14. Beethoven, Eroica Symphony 2nd Mvt.
5. Penderecki, Threnody	15. Julian Butcher, Untitled composition
6. Jamiroquai, Didgerama	16. Dukas, Sorcerer's Apprentice
7. Schubert, Standchen	17. Mozart, Piano Concerto No.21: Andante
8. Dave Brubeck, Take Five	18. Holst, The Planets Suite: Jupiter
9. Mussourgsky, Night on the Bare Mountain	19. Shostakovich 10th Symphony 3rd Mvt.
10. BBC Sound Effects, Barrel organ	20. Prokofiev, Peter And The Wolf.

To provide a point of reference for consensus of listeners' responses, 14 musical excerpts with pre-existing emotional labels were selected. These pieces were chosen in consultation with a number of trained musicians, and in light of existing critical commentary. Agreement that the pieces represented the specified emotions was then reached by two professionally trained musicians (a performer and a composer) and by four non-musicians.[i] For 6 of the extracts, 100% agreement was reached, that they expressed the stated emotions (Table 2) The remaining 8 extracts listed below did not reach 100% agreement however a high degree of consensus (5/6, 83.33%) was still reached (Table 3) therefore the examples were included in the study. In addition to the environmental sound excerpts, the remaining 4 excerpts were to act as controls, chosen from popular and contemporary classical examples *without* pre-existing emotional labels, including a specifically composed excerpt which could not have been previously heard by listeners.

Table 2 Excerpts Reaching 100% Agreement

Emotion	Extracts From:
Happy	Saint Saens: Carnival of the Animals
Sad	Schubert: Standchen, Debussy: Clair de Lune
Fear	Penderecki: Threnody to the victims of Hiroshima
Anger	Holst: Mars from the Planets suite
Grief	Beethoven: Eroica symphony, 2nd Mvt.

Table 3 Additional Excerpts

Emotion	Extracts From:
Happy	Dave Brubeck: Take Five; Holst: Jupiter from the Planets Suite
Sad	Mozart: Piano concerto No 21 Andante
Fear	Mussorgsky: A night on bare mountain, Dukas-Sorcerer's
Anger	Prokofiev: Peter and the wolf
Hope	Shostakovich's: Tenth Symphony
Grief	Grieg: Ase's death from Peer Gynt

Excerpts were pre-recorded onto audio cassette in the order given in Table 1. Two questionnaires were prepared to accompany auditory stimuli, (Fig.1A & Fig.1B). Subjects were given approximately 30 seconds between extracts to supply their answers. It has previously been suggested (Gaver & Mandler, 1987; Krugman, 1943) that existing emotional state, and familiarity with music may influence emotional responses. For this reason, additional questions were added asking subjects to describe their mood before the test and whether they liked each extract in question.

Procedure

2 groups of subjects were used, (1) A group of 10 undergraduate philosophy students. (2) A group of 11 undergraduate music students. The groups subdivided into 14 musicians and 7 non-musicians (subjects with no formal musical qualifications or training, who did not play an instrument, or read music). Within each group, half the subjects were given questionnaire A and the remaining half questionnaire B. 12 respondents used questionnaire A and the remaining 9, questionnaire B. Respondents using questionnaire B provided their own emotional terms to describe the extracts, providing a contrast for the subjects where emotional terms were supplied. Auditory stimuli were presented at a level comfortable for the listeners in an environment free from auditory distraction.

Consistent sound level and tone were maintained across stimuli. Subjects were not permitted to discuss their answers during the test.

Results

Full analyses of results are given (Tables 1-6). All individual responses are documented and levels of consensus are given by percentage of subjects giving the same response. Two schemas were applied to the data, offering differing categorisation of emotional labels into broader groups. Schema 1 classified emotions on two dimensions: arousal/non-arousal, and intensity. Schema 2 divided emotion terms used into broader groups. Full details of schemas 1 and 2 are given (fig.s 2 &3). Results were also classified in terms of positive and negative emotional responses.

Specificity of Agreement

For categorisation in terms of emotional tone: positive, negative and neutral responses, a high level of consensus was reached across both musicians and non-musicians. There was no correlation between subjects preceding emotional state and emotion labelling or reported arousal. Neither was there a correlation between preference (liking or disliking excerpts) and emotion labelling or arousal but a high degree of preference was shown for known examples. Only one 'known' example was disliked (57% of respondents). Musicians showed a higher degree of agreement for emotion labelling on 10/20 excerpts, and musicians showed a higher level of agreement on arousal responses (14/20). There was a clear correlation between labelling and arousal of responses within this categorisation. Only 2/18 musical examples showed no overall consensus for emotional arousal in terms of positive/negative/neutral affect.

It is clear then that there is a high level of consensus for gross distinctions in terms of emotional tone. The idea that specific emotion labelling is dependent on extra-musical features would also seem to be supported here. This is reflected in the relationship between level of agreement on emotion terms and 'known/unknown' excerpts and the difference seen between high levels of agreement for well known 'classical' examples, and the lower levels of agreement seen for contemporary classical and pop examples. The previously 'unlabelled' examples failed to reach a high level of agreement for emotional description or arousal, supporting the idea that familiarity *may* influence emotional description and arousal. The higher levels of agreement for musical subjects may well be explained by their knowledge of musical conventions and techniques for emotional expression.

To conclude, emotional tone both for description and aroused emotion is easily detected by musical and non-musical subjects. At this level of discrimination there is no real difference in performance between the two groups. More specific emotional descriptions would seem to be related to convention, extra-musical associations and knowledge of musical techniques. This suggestion is well represented within other studies on emotion recognition for music. Familiarity also played a role as regards preference, and may in turn influence the emotional polarity assigned to the music although this was not demonstrated in the results obtained. With the latter claim difficulties arise due to the enjoyment of negative emotion in music. Whilst subjects may report a negative emotion aroused, they may nonetheless show preference for the piece.

Fig.1A

QUESTIONNAIRE A

YOU WILL HEAR A SERIES OF MUSICAL EXTRACTS EACH FOLLOWED BY A THIRTY SECOND PAUSE. IDENTIFY BY CIRCLING **ONE** TERM FROM THE LIST AN EMOTION WHICH BEST **DESCRIBES** EACH EXTRACT, **AND** SPECIFY WHETHER YOU **EXPERIENCE** ANY EMOTION MOOD OR FEELING ON HEARING THE EXTRACT BY CIRCLING **ONE** TERM FROM THE LIST GIVEN. INDICATE BY CIRCLING THE APPROPRIATE ANSWER **1**-IF YOU **THINK** YOU HAVE HEARD EACH PIECE BEFORE AND **2**-WHETHER YOU LIKE EACH EXTRACT.

BEFORE BEGINNING HOW WOULD YOU DESCRIBE YOUR PREDOMINANT MOOD, EMOTION OR FEELINGS DURING THE LAST FEW HOURS ?

[____]

EXTRACT 1

GIVE AN EMOTIONAL TERM TO DESCRIBE THE PIECE (CIRCLE)

HAPPINESS HOPE FEAR SADNESS ANGER

GRIEF NEUTRAL - (NO EMOTION) DON'T KNOW

DOES IT MAKE YOU FEEL ANY EMOTION? (CIRCLE)

HAPPINESS HOPE FEAR SADNESS ANGER

GRIEF NEUTRAL - (NO EMOTION) DON'T KNOW

DO YOU THINK YOU HAVE HEARD THIS PIECE BEFORE? (CIRCLE)

YES \ NO \ DON'T KNOW

DO YOU LIKE THIS PIECE? (CIRCLE)

YES \ NO \ DON'T KNOW

Fig.1B

QUESTIONNAIRE B

YOU WILL HEAR A SERIES OF MUSICAL EXTRACTS EACH FOLLOWED BY A THIRTY SECOND PAUSE. IDENTIFY AN EMOTIONAL TERM WHICH BEST **DESCRIBES** EACH PIECE **AND** STATE WHETHER YOU **EXPERIENCE** ANY EMOTION MOOD OR FEELING ON HEARING THE EXTRACT. YOU MAY SPECIFY IF YOU FEEL AN EXTRACT BRINGS NO EMOTIONAL TERM TO MIND AND YOU MAY USE THE SAME TERM MORE THAN ONCE. INDICATE BY CIRCLING THE APPROPRIATE ANSWER 1- IF YOU **THINK** YOU HAVE HEARD EACH PIECE BEFORE AND 2-WHETHER YOU LIKE EACH PIECE

BEFORE BEGINNING, HOW WOULD YOU DESCRIBE YOUR PREDOMINANT MOOD, EMOTION OR FEELINGS DURING THE LAST FEW HOURS ?

[____]

EXTRACT 1

GIVE AN EMOTIONAL TERM TO DESCRIBE THE PIECE:

[____]

DOES IT MAKE YOU FEEL ANY
EMOTION?[________________________________]

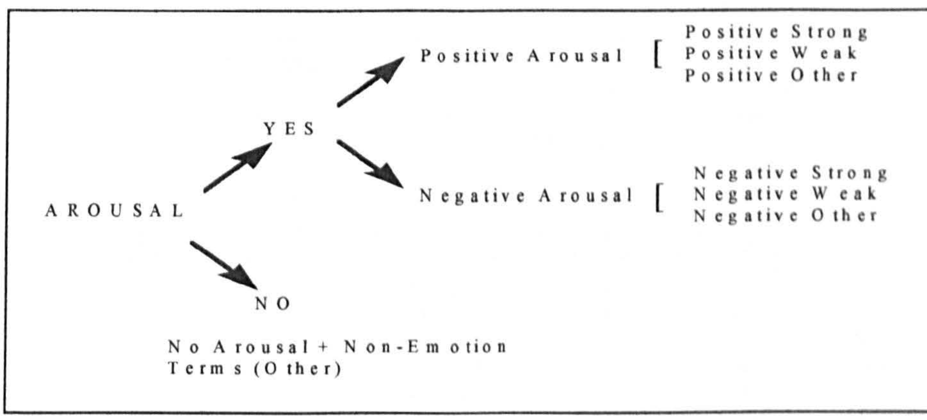
DO YOU THINK YOU HAVE HEARD THIS PIECE BEFORE? (CIRCLE)
YES \ NO \ DON'T KNOW

DO YOU LIKE THIS PIECE? (CIRCLE)
YES \ NO \ DON'T KNOW

Fig.2 Schema 1

Schema 1 classified emotions in terms of physiological arousal. As demonstrated in fig.2 all terms given as responses in the questionnaires were listed and divided into the above categories as in table.1. There were however, difficulties with this method of classification. In addition to many respondents using non-emotional terms to describe the piece and their own felt responses, many emotions may vary as regards their level of arousal. E.g. it makes perfect sense for someone to be mildly agitated, with no physiological symptoms, but also for them to be highly agitated, accompanied by perhaps a rise in temperature, trembling and other physiological effects. For this reason, I have attempted to classify emotions in terms of their typical application to emotional states, and in consultation with other arousal classifications (see Parkinson Ideas & Realities of Emotion.)

Method for Classification in Terms of Arousal



Positive Arousal

Positive Strong		Positive Weak		Positive Other
Alert	Happiness	Calm	Awake	Playful
Awe	Hope	Carefree	Bright	Strong
Cheerful	Jolly	Contentment	Extrovert	Up
Confident	Lively	Pleasant	Fun	Upbeat
Energetic	Love	Relaxed	Jocular	Humour
Energised	Passionate	Serene	Jokey	Rousing
Excitement	Positivity	Reassuring	Light	
Gay	Motivated		Light Hearted	

Negative Arousal & Non-Emotional Terms

Negative Strong		Negative Weak		Negative Other		Other
Aggressive	Scared	Annoyance	Tentative	Dark	Anticipation	Martial
Anger	Sinister	Anxious	Uncomfortable	Heavy	Blasé	Nostalgia
Bitterness	Tense	Apprehensive	Unsettled	Mysterious	Bombastic	Pensive
Dislike	Threatening	Bored	Uptight	Nightmare	Bravery	Powerful
Distress		Confused	Yearning	Oppressive	Busy	Rhythmic
Edgy		Disconcerted	Worry	Pressured	Childish	Righteous
Fear		Gloomy	Wistful	Remote	Comical	Rugged
Foreboding		Impatient		Doomed	Cool	Rushed
Fraught		Irritating			Detached	Security
Fury		Lonely			Dramatic	Simplistic
Grief		Melancholic			Epic	Sleepy
Malicious		Nervous			Expectation	Soulful
Painful		Restless			Indifference	Thoughtful
Regretful		Shyness			Intensity	Tired
Sadness		Spooky			Jointy	Warlike

Schema 2

Schema 2 attempted to divide responses into distinct categories of emotion, without combining similar emotion types such as Annoyance/Anxiety. Using as a guide those emotion terms which were given most frequently as responses, this led to division into 14 categories, which exhibit distinct characteristics: anger, annoyance, anxiety, calm, excitement, fear, grief, hope, happiness, love, regret, sadness, yearning, other.

ANGER	ANNOYANCE	ANXIETY	CALM	EXCITEMENT	FEAR	GRIEF	HOPE
Warlike	Irritating	Fraught	Cool	Rousing	Foreboding		
Aggressive	Impatient	Edgy	Remote	Anticipation	Scared		
Furious	Bored	Tense	Relaxed	Alert	Ominous		
		Tentative	Serene	Awake	Threatening		
		Confused	Simplistic	Energised	Sinister		
		Disconcerted	Thoughtful	Energetic	Spooky		
		Restless	Pensive	Expectant	Nightmare		
		Uncomfortable	Indifference	Lively	Oppressive		
		Unsettled	Blase	Motivated			
		Worry	Detached				
		Nervous					
		Pressured					

HAPPINESS	LOVE	REGRET	SADNESS	YEARNING	OTHER	
Cheerful	Passionate	Bitterness	Distress	Nostalgia	Awe	Neutral
Jolly			Gloomy	Wistful	Bombastic	Powerful
Gay			Lonely		Bravery	Tired
Playful			Melancholic		Busy	Rugged
Pleasant			Painful		Bright	Shyness
Positivity					Childish	Humour
Contentment					Comical	
Carefree					Dark	
Confident					Dislike	
Fun					Dramatic	
Jocular					Epic	
Jokey					Extrovert	
Up					Heavy	
Upbeat					Jointy	
Light Hearted					Malicious	
Light					Martial	
Reassured					Mysterious	

Table 1: Summary of Emotional Description of Excerpts

Extract No:	1	2	3	4	5	6	7	8	9	10
Known\Unknown	Unknown	Unknown	Known	Unknown	Unknown	Unknown	Known	Known	Known	Known
%	76.19%	90.48%	80.95%	90.48%	85.71%	85.71%	85.71%	90.48%	80.95%	95.24%
Musicians	Unknown	Unknown	Known	Unknown	Unknown	Unknown	Known	Known	Known	Known
%	78.57%	92.86%	85.71%	92.86%	78.57%	85.71%	92.86%	92.86%	85.71%	92.86%
Non-Musicians	Unknown	Unknown	Known	Unknown	Unknown	Unknown	Known	Known	Known	Known
%	71.43%	85.71%	71.43%	85.71%	100.00%	85.71%	57.14%	85.71%	71.43%	100.00%
Liked\Disliked	Liked	Liked	Liked	Disliked	Disliked	Liked	Liked	Liked	Liked	Disliked
%	85.71%	47.62%	100.00%	42.86%	76.19%	42.86%	95.24%	95.24%	85.71%	57.14%
Musicians	Liked	Liked	Liked	Disliked	Disliked	Disliked	Liked	Liked	Liked	Disliked
%	78.57%	57.14%	100.00%	57.14%	78.57%	42.86%	92.86%	100.00%	78.57%	50.00%
Non-Musicians	Liked	\\\\\\\\\\\\	Liked	Liked	Disliked	Liked	Liked	Liked	Liked	Disliked
%	100.00%	\\\\\\\\\\\\	100.00%	57.14%	71.43%	57.14%	100.00%	100.00%	100.00%	71.43%
Same Emotion Term (No.)	10 Happiness	8 Fear	14 Happiness	12 Neutral	8 Fear	6 Neutral	6 Sadness	7 Happiness	11 Fear	\\\\\\\\\\\\
%	47.62%	38.10%	66.66%	57.14%	38.10%	28.57%	28.57%	33.33%	52.38%	\\\\\\\\\\\\
Musicians	57.14%	42.86%	71.43%	57.14%	50.00%	21.43%	21.43%	42.86%	57.14%	21.43%
Non-Musicians	42.86%	28.57%	57.14%	57.14%	28.57%	42.86%	28.57%	28.57%	42.86%	28.57%
Positive\Negative (No.)	17 Pos.	15 Neg.	21 Pos.	14 Neutral	20 Neg.	10 Neg.	16 Neg.	14 Pos.	18 Neg.	9 Pos.
%	80.95%	71.43%	100.00%	66.66%	95.24%	47.62%	76.19%	66.66%	85.71%	42.86%
Musicians	85.71%	78.57%	100.00%	71.43%	92.86%	57.14%	78.57%	71.43%	92.86%	42.86%
Non-Musicians	71.43%	57.14%	100.00%	57.14%	100.00%	28.57%	71.43%	40.00%	71.43%	42.86%
Schema 1 Classification (No.)	12 PS	13 NS	17 PS	12 O	18 NS	7 O	10 NS	11 PS	15 NS	\\\\\\\\\\\\
%	57.14%	61.90%	80.95%	57.14%	85.71%	33.33%	47.62%	52.38%	71.43%	\\\\\\\\\\\\
Musicians	64.29%	71.43%	92.86%	57.14%	85.71%	\\\\\\\\\\\\	50.00%	64.29%	78.57%	\\\\\\\\\\\\
Non-Musicians	42.86%	42.86%	57.14%	57.14%	85.71%	57.14%	42.86%	\\\\\\\\\\\\	57.14%	\\\\\\\\\\\\
Schema 2 Classification (No.)	12 Happiness	9 Fear	18 Happiness	12 Neutral	9 Fear	\\\\\\\\\\\\	10 Sadness	10 Happiness	11 Fear	7 Happiness
%	57.14%	42.86%	85.71%	57.14%	42.86%	\\\\\\\\\\\\	47.62%	47.62%	52.38%	33.33%
Musicians	64.29%	50.00%	85.71%	57.14%	50.00%	\\\\\\\\\\\\	42.86%	42.86%	57.14%	35.71%
Non-Musicians	42.86%	28.57%	85.71%	57.14%	28.57%	\\\\\\\\\\\\	57.14%	57.14%	42.86%	28.57%

See Schema's for relevant classifications. \\\\\\\\\\\\ = no overall consensus.

Table 1 Cont. Summary of Emotional Description of Excerpts

11	12	13	14	15	16	17	18	19	20
Known	Unknown	Known	Known	Unknown	Known	Known	Known	Unknown	Unknown
90.48%	71.43%	80.95%	80.95%	71.43%	61.90%	100.00%	80.95%	52.38%	76.19%
Known	Unknown	Known	Known	Unknown	Known	Known	Known	Unknown	Unknown
100%	64.29%	92.86%	85.71%	71.43%	64.29%	100.00%	92.86%	50.00%	71.43%
Known	Unknown	Known	Known	Unknown	Known	Known	Known	Unknown	Unknown
71.43%	85.71%	57.14%	71.43%	71.43%	57.14%	100.00%	**57.14%**	**57.14%**	85.71%
Liked	\\\\\\\\\\\\	Liked	Liked	Disliked	Liked	Liked	Liked	Liked	\\\\\\\\\\\\
95.24%	\\\\\\\\\\\\	76.19%	76.19%	61.90%	61.90%	90.48%	85.71%	76.19%	\\\\\\\\\\\\
Liked	Liked	Liked	Liked	Disliked	Liked	Liked	Liked	Liked	\\\\\\\\\\\\
100.00%	42.86%	71.43%	71.43%	71.43%	64.29%	92.86%	78.57%	71.43%	\\\\\\\\\\\\
Liked	\\\\\\\\\\\\	Liked	Liked	\\\\\\\\\\\\	Liked	Liked	Liked	Liked	\\\\\\\\\\\\
85.71%	\\\\\\\\\\\\	85.71%	85.71%	\\\\\\\\\\\\	57.14%	100.00%	100.00%	85.71%	\\\\\\\\\\\\
11 Sadness	9 Neutral	6 Fear	14 Grief	\\\\\\\\\\\\	\\\\\\\\\\\\	6 Hope	8 Hope	10 Sadness	8 Anger
52.38%	42.86%	28.57%	66.66%	\\\\\\\\\\\\	\\\\\\\\\\\\	28.57%	38.10%	47.62%	38.10%
50.00%	42.86%	33.33%	71.43%	28.57%	28.57%	35.71%	36.00%	50.00%	50.00%
57.14%	42.86%	42.86%	57.14%	28.57%	\\\\\\\\\\\\	28.57%	42.86%	43.00%	28.57%
14 Neg.	10 Neutral	17 Neg.	19 Neg.	15 Neg.	13 Neg.	17 Pos.	17 Pos.	18 Neg.	16 Neg.
66.66%	47.62%	80.95%	90.48%	71.43%	61.90%	80.95%	80.95%	85.71%	76.19%
57.14%	57.14%	78.57%	100.00%	78.57%	71.43%	92.86%	78.57%	92.86%	78.57%
42.86%	42.86%	85.71%	71.43%	57.14%	42.86%	57.14%	85.71%	71.43%	71.43%
12 NS	12 O	15 NS	19 NS	10 NS	11 NS	13 NS	15 PS	15 NS	14 NS
57.14%	57.14%	71.43%	90.48%	47.62%	52.38%	61.90%	71.43%	71.43%	66.66%
50.00%	57.14%	64.29%	100.00%	64.29%	64.29%	71.43%	71.43%	78.57%	71.43%
71.43%	57.14%	85.71%	71.43%	42.86%	42.86%	57.14%	71.43%	57.14%	57.14%
11 Sadness	9 Neutral	7 Fear	14 Grief	\\\\\\\\\\\\	\\\\\\\\\\\\	8 Happiness	8\8 Happ\Hope	12 Sadness	8 Anger
52.38%	42.86%	33.33%	67%	\\\\\\\\\\\\	\\\\\\\\\\\\	38.10%	38.10%	57.14%	38.10%
50.00%	42.86%	57.14%	71.43%	\\\\\\\\\\\\	\\\\\\\\\\\\	57.14%	\\\\\\\\\\\\	57.14%	50.00%
57.14%	42.86%	28.57%	57.14%	\\\\\\\\\\\\	\\\\\\\\\\\\	42.86%	\\\\\\\\\\\\	57.14%	14.29%

Table 2: Summary of Emotional Arousal by Excerpts

Extract No:	1	2	3	4	5	6	7	8	9	10
Known\Unknown	Unknown	Unknown	Known	Unknown	Unknown	Unknown	Known	Known	Known	Known
%	76.19%	90.48%	80.95%	90.48%	85.71%	85.71%	85.71%	90.48%	80.95%	95.24%
Musicians	Unknown	Unknown	Known	Unknown	Unknown	Unknown	Known	Known	Known	Known
%	78.57%	92.86%	85.71%	92.86%	78.57%	85.71%	92.86%	92.86%	85.71%	92.86%
Non-Musicians	Unknown	Unknown	Known	Unknown	Unknown	Unknown	Known	Known	Known	Known
%	71.43%	85.71%	71.43%	85.71%	100.00%	85.71%	57.14%	85.71%	71.43%	100.00%
Liked\Disliked	Liked	Liked	Liked	Disliked	Disliked	Liked	Liked	Liked	Liked	Disliked
%	85.71%	47.62%	100.00%	42.86%	76.19%	42.86%	95.24%	95.24%	85.71%	57.14%
Musicians	Liked	Liked	Liked	Disliked	Disliked	Disliked	Liked	Liked	Liked	Disliked
%	78.57%	57.14%	100.00%	57.14%	78.57%	42.86%	92.86%	100.00%	78.57%	50.00%
Non-Musicians	Liked	\\\\\\\\\\\\\\	Liked	Liked	Disliked	Liked	Liked	Liked	Liked	Disliked
%	100.00%	\\\\\\\\\\\\\\	100.00%	57.14%	71.43%	57.14%	100.00%	100.00%	100.00%	71.43%
Same Emotion Term (No.)	9 Happiness	8 Neutral	13 Happiness	14 Neutral	5 Fear	5 Neutral	11 Sadness	10 Happiness	8 Fear	Neutral 6
%	42.86%	38.10%	61.90%	66.67%	23.81%	23.81%	52.38%	47.62%	38.10%	28.57%
Musicians	57.14%	42.86%	71.43%	78.57%	41.67%	28.57%	57.14%	64.29%	42.86%	28.57%
Non-Musicians	14.29%	28.57%	42.86%	42.86%	0.00%	14.29%	42.86%	14.29%	28.57%	28.57%
Positive\Negative (No.)	14 Pos.	8 Neg.	20 Pos.	14 Neutral	14Neg	\\\\\\\\\\\\\\	16 Neg.	16 Pos.	10 Neg.	7 Neg.
%	66.66%	38.10%	95.24%	66.66%	66.66%	\\\\\\\\\\\\\\	76.19%	76.19%	47.62%	33.33%
Musicians	64.29%	28.57%	100.00%	78.57%	78.57%	\\\\\\\\\\\\\\	78.57%	78.57%	85.71%	28.57%
Non-Musicians	71.43%	57.14%	85.71%	42.86%	42.86%	\\\\\\\\\\\\\\	71.43%	71.43%	57.14%	42.86%
Schema 1 Classification (No.)	9 PS	9 O	17 PS	13 O	12 NS	\\\\\\\\\\\\\\	12 NS	11 PS	8 NS	\\\\\\\\\\\\\\
%	42.86%	42.86%	80.95%	61.90%	57.14%	\\\\\\\\\\\\\\	57.14%	52.38%	38.10%	\\\\\\\\\\\\\\
Musicians	57.14%	42.86%	92.86%	71.43%	64.29%	\\\\\\\\\\\\\\	64.29%	78.57%	64.29%	\\\\\\\\\\\\\\
Non-Musicians	14.29%	42.86%	57.14%	42.86%	42.86%	\\\\\\\\\\\\\\	42.86%	0.00%	28.57%	\\\\\\\\\\\\\\
Schema 2 Classification (No.)	12 Happiness	8 Neutral	17 Happiness	14 Neutral	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	13 Sadness	13 Happiness	8 Fear	\\\\\\\\\\\\\\
%	57.14%	38.10%	80.95%	66.66%	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	61.90%	61.90%	38.10%	\\\\\\\\\\\\\\
Musicians	57.14%	42.86%	85.71%	78.57%	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	64.29%	64.29%	42.86%	\\\\\\\\\\\\\\
Non-Musicians	57.14%	28.57%	71.43%	42.86%	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	57.14%	57.14%	28.57%	\\\\\\\\\\\\\\

See Schemas for relevant classifications. \\\\\\\\\\\\ = no overall consensus.

Table 2 Cont.: Summary of Emotional Arousal by Excerpts: (Cont.)

11	12	13	14	15	16	17	18	19	20
Known	Unknown	Known	Known	Unknown	Known	Known	Known	Unknown	Unknown
90.48%	71.43%	80.95%	80.95%	71.43%	61.90%	100.00%	80.95%	52.38%	76.19%
Known	Unknown	Known	Known	Unknown	Known	Known	Known	Unknown	Unknown
100%	64.29%	92.86%	85.71%	71.43%	64.29%	100.00%	92.86%	50.00%	71.43%
Known	Unknown	Known	Known	Unknown	Known	Known	Known	Unknown	Unknown
71.43%	85.71%	**57.14%**	71.43%	71.43%	**57.14%**	100.00%	**57.14%**	**57.14%**	85.71%
Liked	\\\\\\\\\\\\\\	Liked	Liked	Disliked	Liked	Liked	Liked	Liked	\\\\\\\\\\\\\\
95.24%	\\\\\\\\\\\\\\	76.19%	76.19%	61.90%	61.90%	90.48%	85.71%	76.19%	\\\\\\\\\\\\\\
Liked	Liked	Liked	Liked	Disliked	Liked	Liked	Liked	Liked	\\\\\\\\\\\\\\
100.00%	42.86%	71.43%	71.43%	71.43%	64.29%	92.86%	78.57%	71.43%	\\\\\\\\\\\\\\
Liked	\\\\\\\\\\\\\\	Liked	Liked	\\\\\\\\\\\\\\	Liked	Liked	Liked	Liked	\\\\\\\\\\\\\\
85.71%	\\\\\\\\\\\\\\	85.71%	85.71%	\\\\\\\\\\\\\\	57.14%	100.00%	100.00%	85.71%	\\\\\\\\\\\\\\
8 Sadness	11 Neutral	6 Fear	9 Sadness	7 Neutral	Fear 6	7 Happiness	7 Neutral	11 Sadness	8 Neutral
38.10%	52.38%	28.57%	42.86%	33.33%	28.57%	33.33%	33.33%	52.38%	38.10%
42.86%	64.29%	41.67%	42.86%	42.86%	41.67%	42.86%	28.57%	64.29%	41.67%
28.57%	28.57%	14.29%	42.86%	14.29%	14.29%	14.29%	42.86%	28.57%	42.86%
14 Neg.	11 Neutral	10 Neg.	16 Neg.	12 Neg.	\\\\\\\\\\\\\\	15 Pos.	11 Pos.	14 Neg.	9 Neutral
66.66%	52.38%	47.62%	76.19%	57.14%	\\\\\\\\\\\\\\	71.43%	52.38%	66.66%	42.86%
71.43%	64.29%	50.00%	85.71%	50.00%	\\\\\\\\\\\\\\	78.57%	64.29%	71.43%	42.86%
57.14%	28.57%	42.86%	57.14%	71.43%	\\\\\\\\\\\\\\	57.14%	28.57%	57.14%	42.86%
10 NS	12 O	7 NS	15 NS	8 NS	8 NS	10 PS	10 PS	11 NS	8 NS
47.62%	57.14%	33.33%	71.43%	38.10%	38.10%	47.62%	47.62%	52.38%	38.10%
57.14%	64.29%	42.86%	78.57%	71.43%	50.00%	57.14%	57.14%	64.29%	50.00%
28.57%	42.86%	14.29%	57.14%	42.86%	14.29%	28.57%	28.57%	28.57%	14.29%
9 Sadness	11 Neutral	\\\\\\\\\\\\\\	10 Sadness	8 Neutral	\\\\\\\\\\\\\\	9 Happiness	8 Happiness	12 Sadness	9 Neutral
42.86%	52.38%	\\\\\\\\\\\\\\	47.62%	38.10%	\\\\\\\\\\\\\\	42.86%	38.10%	57.14%	42.86%
50.00%	64.29%	\\\\\\\\\\\\\\	50.00%	50.00%	\\\\\\\\\\\\\\	50.00%	50.00%	64.29%	42.86%
28.57%	28.57%	\\\\\\\\\\\\\\	42.86%	14.29%	\\\\\\\\\\\\\\	28.57%	14.29%	42.86%	42.86%

Table 3: Question 1 Responses.

Questionnaire No.	Extract No. / Musician/Non Musician	1	2	3	4	5	6	7	8	9	10
Questionnaire A 1	M	Happiness	Fear	Happiness	Neutral	Grief	Fear	Fear	Hope	Fear	Hope
" 2	M	Happiness	Fear	Happiness	Neutral	Fear	Don't Know	Hope	Happiness	Anger	Happiness
" 3	M	Happiness	Fear	Happiness	Neutral	Grief	Don't Know	Sadness	Hope	Fear	Don't Know
" 4	M	Happiness	Grief	Hope	Neutral	Fear	Neutral	Sadness	Happiness	Fear	Fear
" 5	M	Neutral	Don't Know	Happiness	Don't Know	Anger	Don't Know	Hope	Happiness	Fear	Sadness
" 6	M	Hope	Fear	Happiness	Neutral	Anger	Neutral	Sadness	Happiness	Fear	Sadness
" 7	M	Happiness	Neutral	Happiness	Happiness	Fear	Fear	Grief	Sadness	Don't Know	Happiness
" 8	M	Neutral	Fear	Happiness	Happiness	Fear	Fear	Grief	Happiness	Fear	Neutral
" 9	M	Happiness	Hope	Happiness	Neutral	Fear	Neutral	Hope	Hope	Fear	Don't Know
" 10	N/M	Happiness	Hope	Happiness	Neutral	Fear	Neutral	Sadness	Don't Know	Fear	Sadness
" 11	N/M	Happiness	Fear	Happiness	Don't Know	Grief	Neutral	Sadness	Neutral	Anger	Neutral
" 12	N/M	Hope	Fear	Happiness	Hope	Grief	Neutral	Hope	Happiness	Fear	Sadness
Questionnaire B											
" 13	M	Carefree	Foreboding	Happiness	Neutral	Neutral	Irritating	Remote	Neutral	Anxious	Happiness
" 14	M	Relaxed	Anxious	Extrovert	Carefree	Bitterness	Passionate	Melancholic	Soulful	Fury	Shyness
" 15	M	Relaxed	Tense	Jolly	Bright	Anxious	Dark	Melancholy/Relaxed	Relaxed	Anticipation	Fun
" 16	M	Happiness	Fear	Happiness	Neutral	Fear	Ominous	Sadness	Neutral	Fear	Don't Know
" 17	M	Happiness	Expectant	Lively	Calm	Fear	Anger	Wistful	Happiness	Anger	Light-hearted
" 18	N/M	Don't Know	Don't Know	Jokey	Don't Know	Tense	Heavy	Painful	Neutral	Busy	Childish
" 19	N/M	Cool	Detached	Happiness	Neutral	Distress	Relaxed	Melancholic	Contentment	Fear	Happiness
" 20	N/M	Light-hearted	Tense	Upbeat	Neutral	Fraught	Oppressive	Up	Cheerful	Pressured	Cheerful
" 21	N/M	Rousing	Neutral	Bombastic	Neutral	Nightmare	Rugged	Nostalgia	Carefree	Epic	Neutral

Table 3 Cont. : Question 1 Responses

11	12	13	14	15	16	17	18	19	20	Emotional State before test	Schema 1 Class.
Hope	Neutral	Anger	Grief	Fear	Anger	Hope	Hope	Sadness	Anger	Unsettled	Neg.
Hope	Neutral	Anger	Grief	Fear	Anger	Happiness	Don't Know	Sadness	Anger	Cheerful/Happy	Pos.
Sadness	Don't Know	Fear	Grief	Anger	Fear	Hope	Happiness	Sadness	Anger	Relaxed/Bored	Neutral
Hope	Neutral	Grief	Grief	Anger	Anger	Hope	Hope	Grief	Anger	Cheerful/Relaxed	Pos.
Sadness	Don't Know	Fear	Grief	Anger	Fear	Sadness	Happiness	Sadness	Fear	Happy	Pos.
Sadness	Happiness	Fear	Grief	Anger	Hope	Hope	Hope	Grief	Anger	Stressed	Neg.
Sadness	Neutral	Hope	Grief	Fear	Fear	Happiness	Hope	Sadness	Fear	Happy	Pos.
Sadness	Happiness	Hope	Grief	Anger	Fear	Happiness	Happiness	Sadness	Fear	Happy	Pos.
Sadness	Don't Know	Fear	Grief	Don't Know	Anger	Hope	Hope	Grief	Anger	Happy	Pos.
Grief	Hope	Anger	Grief	Fear	Anger	Hope	Hope	Sadness	Fear	Contented	Pos.
Sadness	Neutral	Fear	Grief	Neutral	Fear	Sadness	Hope	Sadness	Fear	Anxious	Neg.
Sadness	Hope	Anger	Grief	Hope	Don't Know	Happiness	Hope	Sadness	Anger	Hopeful	Pos.
Neutral	Busy	Neutral	Sadness	Neutral	Warlike	Pleasant	Neutral	Lonely	Neutral	Frustrated	Neg.
Pensive	Indifference	Malicious	Regretful	Don't Know	Don't Know	Love	Don't Know	Tentative	Blasé	Relaxed/Happy	Pos.
Nostalgia	Jolly	Anticipation	Sadness	Spooky	Excitement	Relaxed	Content	mysterious	Gloomy	Relaxed/Happy	Pos.
Hope	Neutral	Fear	Grief	Tense	Tense	Happiness	Happiness	Sadness	Anger	Anxious/Tired	Neg.
Sadness	Neutral	Unsettled	Sadness	Restless	Excitement	Love	Positivity	Calm	Dramatic	Tense	Neg.
Simplistic	Rhythmic	Tense	Neutral	Jointy	Passionate	Light	Neutral	Heavy	Dark	Relaxed	Pos.
Sadness	Neutral	Anger	Grief	Disconcerted	Bravery	Confident	Happiness	Lonely	Comical	Content	Pos.
Sadness	Up	Awe	Sadness	Confused	Martial	Sadness	Playful	Regret	Threatening	Anxious	Neg.
Nostalgic	Neutral	Foreboding	Epic	Neutral	Bombastic	Don't Know	Gay	Don't Know	Don't Know	On edge	Neg.

Table 4: Question 2 Responses

Questionnaire No.	Extract No. / Musician/Non Musician	1	2	3	4	5	6	7	8	9
Questionnaire A 1	M	Hope	Fear	Happiness	Neutral	Fear	Fear	Sadness	Hope	Fear
" 2	M	Neutral	Neutral	Happiness	Happiness	Neutral	Don't Know	Neutral	Happiness	Neutral
" 3	M	Happiness	Fear	Happiness	Neutral	Grief	Don't Know	Sadness	Happiness	Fear
" 4	M	Happiness	Neutral	Hope	Neutral	Neutral	Don't Know	Sadness	Happiness	Happiness
" 5	M	Neutral	Don't Know	Happiness	Don't Know	Fear	Don't Know	Sadness	Happiness	Fear
" 6	M	Happiness	Neutral	Happiness	Neutral	Anger	Neutral	Sadness	Happiness	Fear
" 7	M	Happiness	Neutral	Happiness	Neutral	Fear	Fear	Sadness	Neutral	Don't know
" 8	M	Neutral	Neutral	Happiness	Neutral	Fear	Neutral	Sadness	Happiness	Don't know
" 9	M	Happiness	Neutral	Happiness	Neutral	Fear	Neutral	Grief	Happiness	Fear
" 10	N/M	Happiness	Don't Know	Happiness	Don't Know	Grief	Don't Know	Sadness	Happiness	Fear
" 11	N/M	Neutral	Neutral	Neutral	Neutral	Don't Know	Neutral	Sadness	Neutral	Neutral
" 12	N/M	Don't Know	Fear	Happiness	Don't Know	Don't Know	Don't Know	Don't Know	Don't Know	Fear
Questionnaire B										
" 13	M	Neutral	Alert	Happiness	Neutral	Neutral	Uncomfortable	Thoughtful	Neutral	Neutral
" 14	M	Happiness	Don't Know	Humour	Contentment	Dislike	Powerful	Wistful	Soulful	Expectation
" 15	M	Happiness	Anxious	Jolly	Neutral	Tense	Mysterious	Melancholic	Happiness	Expectation
" 16	M	Neutral	Anxious	Happiness	Neutral	Anxious	Neutral	Sadness	Happiness	Fear
" 17	M	Happiness	Relaxed	Lively	Neutral	Nervous	Don't Know	Thoughtful	Energised	Positive
" 18	N/M	Relaxed	Uneasy	Jolly	Awake	Sleepy	Heavy	Sadness	Relaxed	Rushed
" 19	N/M	Jocular	Neutral	Happiness	Neutral	Neutral	Relaxed	Melancholic	Content	Worry
" 20	N/M	Light hearted	Sinister	Upbeat	Relaxed	Tense	Don't Know	Yearning	Up	Energetic
" 21	N/M	Light	Anticipatory	Strong	Neutral	Edgy	Anticipatory	Calm	Carefree	Don't know

Table 4 Cont.: Question 2 responses

10	11	12	13	14	15	16	17	18	19	20	Preceding Emotional State
Don't Know	Grief	Fear	Grief	Grief	Fear	Fear	Neutral	Sadness	Sadness	Fear	Unsettled
Neutral	Hope	Neutral	Neutral	Neutral	Neutral	Neutral	Happiness	Neutral	Sadness	Neutral	Happy
Neutral	Sadness	Neutral	Hope	Neutral	Anger	Fear	Hope	Happiness	Sadness	Anger	Relaxed\Bored
Fear	Neutral	Neutral	Fear	Sadness	Neutral	Anger	Neutral	Happiness	Sadness	Happiness	Cheerful\Relaxed
Hope	Sadness	Hope	Fear	Grief	Anger	Fear	Sadness	Happiness	Sadness	Anger	Happy
Sadness	Sadness	Anger	Fear	Grief	Anger	Hope	Hope	Hope	Sadness	Anger	Stressed
Happiness	Sadness	Neutral	Hope	Sadness	Neutral	Fear	Happiness	Happiness	Neutral	Neutral	Happy
Neutral	Sadness	Happiness	Hope	Sadness	Neutral	Fear	Happiness	Happiness	Sadness	Fear	Happy
Don't Know	Sadness	Neutral	Fear	Grief	Neutral	Anger	Happiness	Hope	Sadness	Fear	Happy
Sadness	Sadness	Hope	Hope	Sadness	Fear	Fear	Hope	Hope	Sadness	Fear	Contented
Neutral	Neutral	Neutral	Neutral	Grief	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Anxious\Overworked
Don't Know	Don't Know	Don't Know	Don't Know	Don't Know	Don't know	Don't Know	Don't Know	Don't Know	Sadness	Don't Know	Hopeful
Happiness	Thoughtful	Neutral	Neutral	Sadness	Neutral	Neutral	Pleasant	Neutral	Thoughtful	Neutral	Mixed\Frustrated
Annoyance	Nostalgia	Neutral	Righteous	Sadness	Confusion	Don't Know	Security	Neutral	Reassurance	Neutral	Relaxed\Happy
Happiness	Nostalgia	Bored	Doomed	Gloomy	Expectant	Excited	Happiness	Content	Neutral	Neutral	Relaxed\Happy
Neutral	Hope	Neutral	Fear	Sadness	Tense	Neutral	Happiness	Neutral	Sadness	Don't Know	Anxious\Tired
Impatient	Unhappy	Neutral	Intensity	Grief	Neutral	Happiness	Calm	Cheerful	Worried	Neutral	Tense
Scared	Serene	Rushed	Nervous	Neutral	On edge	Neutral	Content	Jolly	Tired	Neutral	Relaxed
Neutral	Sadness	Neutral	Fear	Sadness	Worried	Neutral	Happiness	Neutral	Lonely	Neutral	Contented
Bored	Nostalgia	Don't Know	Don't Know	Sadness	Uptight	Motivated	Sadness	Don't Know	Don't Know	Don't Know	Anxious
Calm	Nostalgia	Irritated	Apprehensive	Roused	Aggressive	Don't Know	Calm	Neutral	Don't Know	Don't Know	On Edge

Table 5: Question 3

Questionnaire No.	Extract No. Musician/Non Musician	1	2	3	4	5	6	7	8	9	10
Questionnaire A 1	M	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 2	M	No	No	Yes	No	Don't Know	No	Yes	Yes	Yes	Yes
" 3	M	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
" 4	M	Don't Know	No	Yes	No	No	Don't Know	Yes	Yes	Yes	Yes
" 5	M	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
" 6	M	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 7	M	No	No	Yes	No	No	No	Yes	Yes	No	Yes
" 8	M	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 9	M	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 10	N/M	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes
" 11	N/M	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 12	N/M	No	No	No	No	No	No	Yes	No	No	Yes
Questionnaire B											
" 13	M	No	Don't Know	Don't Know	Yes	Don't Know	No	Yes	No	Yes	Don't Know
" 14	M	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 15	M	No	No	No	No	No	No	Yes	Yes	Yes	Yes
" 16	M	No	No	Yes	No	No	No	Yes	Yes	No	Yes
" 17	M	Don't Know	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 18	N/M	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
" 19	N/M	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
" 20	N/M	No	No	Yes	No	No	No	No	Yes	Yes	Yes
" 21	N/M	No	No	No	No	No	No	No	Yes	No	Yes

Consensus No.		16 No	19 No	17 yes	19 No	18 No	18 No	18 yes	19 yes	17 yes	20 yes
Consensus %		76.19%	90.48%	80.95%	90.48%	85.71%	85.71%	85.71%	90.48%	80.95%	95.24%

Musicians		11\14 No	13\14 No	12\14 Yes	13\14 No	11\14 No	12\14 No	13\14 Yes	13\14 Yes	12\14 Yes	13\14 Yes
Non-Musicians		5\7 No	6\7 No	5\7 Yes	6\7 NO	7\7 No	6\7 No	4\7 Yes	6\7 Yes	5\7 Yes	7\7 Yes

Musicians		78.57%	92.86%	85.71%	92.86%	78.57%	85.71%	92.86%	92.86%	85.71%	92.86%
Non-Musicians		71.69%	85.71%	71.69%	85.71%	100.00%	85.71%	57.14%	85.71%	71.69%	100.00%

Table 5 Cont.: Question 3 Responses

11	12	13	14	15	16	17	18	19	20
Yes	No	Yes	Yes	No	No	Yes	Yes	No	No
Yes	Don't Know	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Yes	No	Yes	Yes	No	No	Yes	Yes	Don't Know	No
Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Yes	Yes	Yes	Yes	Don't Know	Yes	Yes	Yes	Yes	No
Yes	No	Yes	Yes	Don't Know	Yes	Yes	Yes	Don't Know	Don't Know
Yes	No	Yes	Yes	Don't Know	No	Yes	Yes	No	No
Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No
Yes	No	Yes	Yes	No	No	Yes	Yes	No	No
Yes	No	Don't Know	Yes	Don't Know	Yes	Yes	Don't Know	Don't Know	No
No	No	No	Yes	No	No	Yes	No	Yes	No
Yes	Don't Know	No	Yes	No	Don't Know	Yes	Don't Know	No	Don't Know
Yes	No	Yes	No	No	No	Yes	Yes	No	No
Yes	No	Yes	No	No	Yes	Yes	Yes	No	No
Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No
Yes	Don't Know	Yes	Yes	Don't Know	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No	No	Yes	No	No	Yes	Yes	Yes	No	No
Yes	No	Yes	Don't Know	No	Yes	Yes	Yes	No	No
Yes	No	Don't Know	Yes	No	No	Yes	No	No	No

19 yes	15 No	17 yes	17 yes	15 No	13 Yes	21 yes	17 yes	11 No	16 No
90.48%	71.43%	80.95%	80.95%	71.43%	61.90%	100.00%	80.95%	52.38%	76.19%

14\14 Yes	9\14 No	13\14 Yes	12\14 Yes	10\14 No	9\14 Yes	14\14 Yes	13\14 Yes	7\14 No	10\14 No
5\7 Yes	6\7 No	4\7 Yes	5\7Yes	5\7 No	4\7 Yes	7\7 Yes	4\7 Yes	4\7 No	6\7 No

100.00%	64.29%	92.86%	85.71%	71.69%	64.29%	100.00%	93%	50.00%	71.69%
71.69%	85.71%	57.14%	71.69%	71.69%	57.14%	100.00%	57.14%	57.14%	85.71%

Table 6: Question 4 Responses

Questionnaire No.	Extract No. / Musician/Non Musician	1	2	3	4	5	6	7	8	9	10
Questionnaire A 1	M	Yes	No	Yes	No	No	No	Yes	Yes	No	No
" 2	M	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
" 3	M	Yes	Yes	Yes	Don't Know	No	No	Yes	Yes	Yes	No
" 4	M	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No
" 5	M	Yes	Don't Know	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
" 6	M	Yes	Don't Know	Yes	No	No	Don't know	Yes	Yes	Yes	Yes
" 7	M	Yes	Don't Know	Yes	No	No	Don't know	Yes	Yes	Don't know	Yes
" 8	M	No	Yes	Yes	Don't Know	No	No	Don't Know	Yes	Yes	No
" 9	M	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No
" 10	N/M	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
" 11	N/M	Yes	Don't Know	Yes	Don't Know	No	No	Yes	Yes	Yes	No
" 12	N/M	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Questionnaire B											
" 13	M	No	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes
" 14	M	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
" 15	M	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Don't Know
" 16	M	Yes	Yes	Yes	No	No	Don't know	Yes	Yes	Yes	Don't Know
" 17	M	Yes	Don't Know	Yes	Yes	No	Yes	Yes	Yes	Yes	No
" 18	N/M	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
" 19	N/M	Yes	Don't Know	Yes	Yes	No	Yes	Yes	Yes	Yes	No
" 20	N/M	Yes	No	Yes	Don't Know	No	Don't know	Yes	Yes	Yes	No
" 21	N/M	Yes	Don't Know	Yes	Yes	Don't Know	Yes	Yes	Yes	Yes	Yes

Consensus		18 Yes	10 Yes	21 Yes	9 No	16 No	9 Yes	20 Yes	20 Yes	18 Yes	12 No
%		86%	48%	100%	43%	76%	43%	95%	95%	86%	57%

Musicians		11\14 Yes	8\14 Yes	14\14 Yes	8\14 No	11\14 No	6\14 No	13\14 Yes	14\14 Yes	11\14 Yes	7\14 No
Non-Musicians		7\7 Yes	\\\\\\\\\\\\\\\\	7\7 Yes	4\7 Yes	5\7 No	4\7 Yes	7\7 Yes	7\7 Yes	7\7 Yes	5\7 No
Musicians %		78.57%	57.14%	100.00%	57%	79%	43%	92.86%	100%	79%	50%
Non-Musicians %		100%	\\\\\\\\\\\\\\\\	100.00%	57%	71%	57%	100%	100%	100%	71%

Table 6 Cont. : Question 4 Responses

11	12	13	14	15	16	17	18	19	20
Yes	No	No	Yes	No	No	No	No	Yes	No
Yes	Yes	yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Yes	No	yes	No	No	Yes	Don't Know	Yes	Don't Know	Yes
Yes	No	yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	Don't Know	Don't Know
Yes	Don't Know	yes	Yes	No	Don't Know	Yes	Yes	Don't Know	Don't Know
Yes	Don't Know	yes	Don't know	No	Don't Know	Yes	Yes	No	Don't Know
Yes	Yes	yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	No
Yes	Yes	yes	Yes	No	Yes	Yes	Yes	No	Don't Know
Yes	No	yes	Yes	No	Yes	Yes	Yes	Yes	Yes
No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Don't Know

Yes	Yes	No	No	Yes	No	Yes	No	Yes	No
Yes	Yes	yes	Yes	Don't know	Don't Know	Yes	Yes	Yes	Don't Know
Yes	No	No	No	No	Yes	Yes	Yes	Yes	No
Yes	Don't Know	yes	Yes	Don't know	Yes	Yes	Don't Know	Yes	No
Yes	No	yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Yes	Yes	yes	Yes	Yes	No	Yes	Yes	Yes	No
Yes	No	yes	Yes	No	No	Yes	Yes	Yes	No
Yes	Don't Know	yes	Don't know	Don't know	Yes	Yes	Yes	Yes	Don't Know
Yes	Don't Know	yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

20 Yes	8\8 Y\N	16 Yes	16 Yes	13 No	13 Yes	19 Yes	18 Yes	16 Yes	\\\\\\\\\\\\\\
95%	38%	76%	76%	62%	62%	90%	86%	76%	\\\\\\\\\\\\\\

14\14 Yes	6\14 Yes	10\14 Yes	10\14 Yes	10\14 No	9\14 Yes	13\14 yes	11\14 yes	10\14 Yes	\\\\\\\\\\\\\\
6\7 Yes	\\\\\\\\\\\\\\	6\7 Yes	6\7 Yes	\\\\\\\\\\\\\\	4\7 Yes	7\7 Yes	7\7 Yes	6\7 Yes	\\\\\\\\\\\\\\
100%	42.86%	71%	71%	71%	64.29%	93%	78.57%	71%	\\\\\\\\\\\\\\
85.71%	\\\\\\\\\\\\\\	86%	86%	\\\\\\\\\\\\\\	57%	100%	100%	86%	\\\\\\\\\\\\\\

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1. Jools Holland, Lost Chord, from CD: The full Compliment, ©1991 IRS Records Ltd. ℗1991 IRS Records Ltd. UK
2. Philip Glass, Facades from minimalists CD
3. Saint-Saens, Carnival of the animals, Finale, Cassette, © 1985, Suprahon Prague.
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[i] Further support for existing emotional classification of these works may be found in critical commentary. The Penguin CD guide, Gramophone, critical reviews, Grove Dictionary of Music and Musicians, Meerum Terwogt M, & Van Grinsen F, 'Musical expression of Moodstates, Psychology of Music 19, 99-109 1991.

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