When Should Careers Guidance Happen? Associations between Theory of Mind, Vocational Interests and Career Aspirations

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Abstract

Background and aims: Adolescence is a period of identity development and decision-making for the future. However, the relationship between the socio-cognitive development occurring during adolescence and how vocational interests (VIs) develop is absent in UK career guidance policy. There is evidence that Theory of Mind (ToM), the ability to attribute mental states to others, continues to develop during adolescence, and may affect VI development and stability. The aim of the research was to make a positive contribution to careers education by gathering evidence on the role of ToM alongside other variables (such as birth order and SES) in the development of VIs in adolescence. Three interrelated studies structure the research. Studies 1 and 2 explored associations between ToM, birth order and VIs, cross-sectionally (Study 1) and longitudinally (Study 2). Study 3 examined the stability of career aspirations and VIs.

Methods: Participants were *N*=164 (62 male, 102 female) adolescents. Of these, *n*=91 were Year 10 pupils (mid-adolescents) and *n*=73 were final-year university students (late-adolescents). ToM was measured using a computer-based cartoon vignette paradigm; VIs were measured on a short, 4-item scale; IQ was measured using the WASI-II (FSIQ-2 Short Subscale). Quantitative analysis was conducted using SPSS.

Results: We found evidence to support ToM development during adolescence. We also found significant positive associations between IQ, SES and career aspirations, and evidence to suggest a relationship exists between ToM and VI development, especially in late-adolescence.

Conclusions: ToM is a useful construct to consider in relation to VIs and career aspirations, although further longitudinal research is needed. Our findings suggest the development of cognitive abilities during adolescence may be beneficial to understanding when careers guidance would be most usefully implemented, as well as emphasise the importance of providing individualised personal guidance.

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Declarations

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

1 Background and Rationale

1.1 The current careers crisis

The UK is experiencing a ‘skills crisis’. A recent report from the Chartered Institute of Personnel and Development (CIPD) warns that after two decades of a failed skills policy and lack of investment, the UK is now ‘sleepwalking’ into a low-value, low-skills economy (Brinkley & Crowley, 2017). The current economic climate means schools are being forced to make cuts to their budgets, and despite extensive new career policy guidelines, the practical reality is that careers advice is an area that is commonly sacrificed by headteachers when allocating limited funding within schools (Kewin & Donhowe, 2019). The Sixth Form Colleges Association (SFCA) found that 73% of headteachers surveyed said the amount of allocated funding for the year is simply not enough to provide their students with the personal support, such as careers advice, required for progression to higher education or employment (Kewin & Donhowe, 2019).

The Institute for Fiscal Studies (IFS) recently published an annual report on education spending in England, showing that total school spending per pupil decreased by 8% between 2009-10 and 2017-18 (Belfield et al., 2018). They conclude that this was driven by large cuts to school sixth form funding (21% per student since 2010-11) (Belfield et al., 2018). These cuts target student support services, with the SFCA finding in their most recent survey of headteachers that the number of schools and colleges to have reduced careers guidance for sixth forms has increased from 28% to 41% in the past year (Kewin & Donhowe, 2019). Arguably sixth formers are the students in the most pressing need of careers guidance as they are required to make decisions about next steps that can have far-reaching consequences. Figure 1.1 illustrates the vast number of recent articles that have been written about the severe cuts to careers services in the UK.

FIGURE 1.1. SELECTION OF RECENT NEWSPAPER AND ONLINE ARTICLE HEADLINES REGARDING CAREERS SERVICE FUNDING CUTS IN THE UK

In order to tackle this skills crisis, amongst other recommendations, the CIPD report outlined that it is vital that schools provide high-quality careers information, advice and guidance (Brinkley & Crowley, 2017). The development of the Careers and Enterprise Company (CEC), an employer-led organisation created to prepare young people for and motivate them about their futures, was an important development. However, the CIPD writes that the work of the CEC urgently needs to be supported in schools, and it is essential that careers advice and guidance is prioritised (Brinkley & Crowley, 2017). In a recent article (Whittaker, 2019), Damian Hinds, former UK Education Secretary, was quoted as saying:

"Good careers education is such a valuable asset that helps children to explore future possibilities and go on to lead happy rewarding lives."

New careers strategies published by the Government, and the recent allocation of £2.5 million to form ‘careers hubs’ to work with 1300 schools and colleges, shows that in some ways the skills shortage and careers crisis is being tackled seriously (Whittaker, 2019). However, this quote above begs the question: what is ‘good’ careers education?

1.2 The Government’s approach to ‘good’ careers education

Recently, the Government published a long-term careers strategy, structured around eight ‘Gatsby Benchmarks’, which aims to ensure that all secondary school children receive a structured programme of advice and guidance delivered by those with the right skills and experience (Department for Education, 2018a). The Gatsby Benchmarks outline a substantial list of requirements that each school should be addressing (see Figure 1.2 for a more detailed overview of the Gatsby Benchmarks). The Government has stated they expect every school to be working towards achieving the Benchmarks, and that every school should meet all eight of them by the end of 2020 (Department for Education, 2018a). They argue that the eight Benchmarks represent a “demanding but achievable standard” (Department for Education, 2018a. p.14), although an initial study found that 79.4% of schools achieve one or more Benchmarks, and only 51% of schools were achieving at least two (The Careers & Enterprise Company, 2017). These reported statistics can be misleading, unrepresentative of the actual patchiness of careers provision nationwide: more accurately, “1 in 5 schools are achieving none of the Benchmarks, and only 6.2% are achieving more than half” (The Careers & Enterprise Company, 2017. p.5). Based on this analysis, the Government has suggested that key to achieving the Benchmarks is through implementing careers leadership, clear strategy and resourcing (Department for Education, 2018a).

1. A stable careers programme	Every school and college should have an embedded programme of career education and guidance that is known and understood by students, parents, teachers, governors and employers.	• Every school should have a stable, structured careers programme that has the explicit backing of the senior management team, and has an identified and appropriately trained person responsible for it. • The careers programme should be published on the school's website in a way that enables pupils, parents, teachers and employers to access and understand it. • The programme should be regularly evaluated with feedback from pupils, parents, teachers and employers as part of the evaluation process.
2.Learning from career and labour market information	Every student, and their parents, should have access to good quality information about future study options and labour market opportunities. They will need the support of an informed adviser to make best use of available information.	• By the age of 14, all pupils should have accessed and used information about career paths and the labour market to inform their own decisions on study options. • Parents should be encouraged to access and use information about labour markets and future study options to inform their support to their children.
3.Addressing the needs of each student	Students have different career guidance needs at different stages. Opportunities for advice and support need to be tailored to the needs of each student. A school's careers programme should embed equality and diversity considerations throughout.	• A school's careers programme should actively seek to challenge stereotypical thinking and raise aspirations. • Schools should keep systematic records of the individual advice given to each pupil, and subsequent agreed decisions. • All pupils should have access to these records to support their career development. • Schools should collect and maintain accurate data for each pupil on their education, training or employment destinations for at least three years after they leave the school.
4.Linking curriculum learning to careers	All teachers should link curriculum learning with careers. STEM subject teachers should highlight the relevance of STEM subjects for a wide range of future career paths.	• By the age of 14, every pupil should have had the opportunity to learn how the different STEM subjects help people to gain entry to, and be more effective workers within, a wide range of careers.
5.Encounters with employers and employees	Every student should have multiple opportunities to learn from employers about work, employment and the skills that are valued in the workplace. This can be through a range of enrichment activities including visiting speakers, mentoring and enterprise schemes.	• Every year, from the age of 11, pupils should participate in at least one meaningful encounter* with an employer. *A 'meaningful encounter' is one in which the student has an opportunity to learn about what work is like or what it takes to be successful in the workplace.
6.Experiences of workplaces	Every student should have first-hand experiences of the workplace through work visits, work shadowing and/or work experience to help their exploration of career opportunities, and expand their networks.	• By the age of 16, every pupil should have had at least one experience of a workplace, additional to any part-time jobs they may have. • By the age of 18, every pupil should have had one further such experience, additional to any part-time jobs they may have.
7.Encounters with further and higher education	All students should understand the full range of learning opportunities that are available to them. This includes both academic and vocational routes and learning in schools, colleges, universities and in the workplace.	• By the age of 16, every pupil should have had a meaningful encounter* with providers of the full range of learning opportunities, including Sixth Forms, colleges, universities and apprenticeship providers. This should include the opportunity to meet both staff and pupils. • By the age of 18, all pupils who are considering applying for university should have had at least two visits to universities to meet staff and pupils. *A 'meaningful encounter' is one in which the student has an opportunity to explore what it is like to learn in that environment.
8.Personal guidance	Every student should have opportunities for guidance interviews with a career adviser, who could be internal (a member of school staff) or external, provided they are trained to an appropriate level. These should be available whenever significant study or career choices are being made.	• Every pupil should have at least one such interview by the age of 16, and the opportunity for a further interview by the age of 18.

FIGURE 1.2 THE GATSBY BENCHMARKS (GATSBY CHARITABLE FOUNDATION (2014). GOOD CAREER GUIDANCE. LONDON: GATSBY CHARITABLE FOUNDATION). COPYRIGHT © THE GATSBY CHARITABLE FOUNDATION

Taken from: Department for Education, (2018a). Careers guidance and access for education and training providers.

The Gatsby Benchmarks were developed through national and international research, although whether the evidence base referenced is sufficient for a national policy is not convincing. The Benchmarks are based on the Gatsby Foundation's 'Good Career Guidance' report, developed through findings from interviews with school leaders and pupils in six countries where career guidance is considered to be good, as well as in five English independent schools that have been anecdotally reported as providing good career guidance (Gatsby Charitable Foundation, 2014). While literature on career guidance in England was studied and integrated into the report, there appeared to be no psychological literature regarding cognitive development, career-decision making and even vocational interest stability or development during adolescence included.

In the statutory guidance, the Government have argued that there is strong research evidence to support some of the Benchmarks, although this seems to be mostly policy-based evidence, with vocational psychology research appearing to be absent from the evidence base (Department for Education, 2018a). For example, to support Benchmark 5 (which focuses on the importance of increasing encounters with employers and employees), they reference a study conducted by the Education and Employers Taskforce (Mann et al., 2017) that found a positive relationship between employer engagement and future prospects and income (Department for Education, 2018a). However, the report also emphasises that students' career guidance needs vary at different stages and has imposed strict age-specific deadlines for some of the Benchmarks, which do not appear to be based on empirical evidence. For example, Benchmark 7 states that since choices about whether to continue studying in further education or training in an apprenticeship are often made before the age of 16, all pupils should have had a meaningful encounter with Sixth Forms, universities and apprenticeship providers by this age (Department for Education, 2018a). However, as a paper published by the CEC reported, there is very limited evidence regarding whether particular careers interventions are more effective at particular ages (Williams et al., 2018), and instead it appears that the age-specific recommendations of the Gatsby Benchmarks are situated around the key school years in which decisions about the next stage are made. In fact, a recent report by the education and youth thinktank LKMco found that employability skills gained through work experience varies by age, with students aged 16 and over more likely to develop valuable employability skills than younger pupils (Millard et al., 2019). This therefore counters the Government's current policy

(Benchmark 5) that requires all students to have undertaken work experience before the age of 16.

While there is some evidence to support the Gatsby Benchmarks, this appears to largely be a combination of anecdotal and policy-based research. Adolescence is a period characterized by social and emotional changes, with a vast amount of research demonstrating that adolescents undergo substantial structural and functional cognitive development during this stage (see Crone & Dahl, 2012 for a review). It is therefore surprising that a national policy does not fully embrace the wealth of information available on adolescent development in relation to careers guidance.

1.3 Our approach to 'good' careers education

Planning a future and formulating specific career aspirations is a highly complex task, found to be influenced by various individual differences in traits and structural factors. There are numerous reasons why adolescents vary in their approach to career planning, including individual differences such as personality and motivation (e.g. Corr & Mutinelli, 2017), as well as numerous reasons for the actual career aspirations young people develop. Ability has been put forward as a contributing factor to career aspirations, with students who report achieving well in school being more likely to aim for more prestigious occupations (Patton & Creed, 2007a). Structural factors such as SES have additionally been seen to influence career aspirations: with one study finding that regardless of ability, adolescents from families of higher SES aspire to more prestigious occupations (Cochran et al., 2011).

The Governmental career policy does demonstrate some awareness that understanding 'what works' in careers education is reliant on understanding how these individual differences, and structural factors, influence the development of career aspirations. Prior to the Government publishing their careers strategy, the Sub-Committee on Education, Skills and the Economy came together to better co-ordinate education and skills policy, focusing their first inquiry on careers advice and guidance. This inquiry involved various sessions and events, including seminars to listen to the concerns of young people, and one that arose frequently was that careers advice was not tailored to students at an individual basis, and instead unhelpful, generic careers advice was provided to all students (Business, Innovation and Skills and Education Committees, 2016).

Taking into account the importance of tailoring careers advice to each student, Benchmark 3 outlines that students career guidance needs will vary at different stages, and advice and support should be tailored to each student individually (Department of Education, 2018). While this acknowledgement of differences between students is a step in the right direction, the clear focus of this benchmark is in relation to gender and SES-background: focusing on challenging stereotypes and raising aspirations in relation to these factors. While this fulfils the benchmark's intention to address the *needs* of each pupil, there is no discussion of the *interests* of each pupil in relation to this benchmark.

Vocational interests are crucial to understanding how career aspirations form, yet there is limited mention of them in governmental policy (Department of Education, 2018). Vocational interests are central to career aspiration development, as they "serve as a motivational force that drives individuals to focus attention, exert effort, and persist on related activities" (Nye & Rounds, 2019. p.1). Some references to interests are made in the policy: the Gatsby Benchmarks Toolkit (Careers & Enterprise Company, 2018) mentions that, particularly in relation to Benchmarks 5 and 6, encounters with employers and employees/experiences of workplaces are important for exploring and developing student interests further. Additionally, Benchmark 8 focuses on personal guidance, in which the key focus is to listen to students' ideas and aims, which can be tied to discussion of vocational interests, although this is not explicitly stated in either the main Gatsby report (Gatsby Charitable Foundation, 2014) nor the Gatsby Benchmark Toolkit (Careers & Enterprise Company, 2018). Ultimately, any evidence or discussion understanding how and why vocational interests develop and differ amongst students is not explicitly outlined in the guidance.

As stated previously, adolescence is a period characterized by extensive structural and functional brain development (Crone & Dahl, 2012), yet the relationship between the socio-cognitive development occurring during adolescence and how vocational interests develop is not referenced in the UK career guidance policy. Factors such as gender and SES have been taken into account, but there are other areas where individual differences may be influencing vocational interests in adolescence that require further exploration.

Two factors yet to be empirically assessed in relation to vocational interests in adolescence are Theory of Mind and birth order position. Theory of Mind (ToM) development, growth in the ability to accurately and appropriately ascribe mental states to other individuals (Peterson et al., 2005), has been seen to continue throughout adolescence until early adulthood (e.g. Choudhury et al., 2006; Sebastian et al., 2012). Positive associations between ToM ability and prosocial behaviour have been found (Imuta et al., 2016), as well as positive associations between the related construct of empathising and vocational interest in working with people (Svedholm-Häkkinen & Lindeman, 2016). Individual differences in ToM development during adolescence may therefore influence people-based career aspirations. Additionally, birth-order position has been seen to contribute to differences in college major choice, with first-born children seen to be more likely to apply to engineering, law and medical programmes, and later-born children more likely to pursue degrees in art and journalism (Barclay et al., 2017). Evidence of a relationship between ToM development and birth-order position exists in pre-schoolers and young children (e.g. Ruffman et al., 1998; Cassidy et al., 2005), but has not been explored in adolescence. Measuring the strength of association between ToM development and vocational interests, as well as assessing whether birth order could mediate this development, could potentially contribute to the development of a more personalised careers guidance tool.

Additionally, empirical evidence is needed to assess when careers guidance can be implemented most effectively. Gatsby Benchmark 8, which focuses on providing effective personal guidance, emphasises that guidance interviews should be timed to meet the individual needs of students (Careers & Enterprise Company, 2018). But what does this mean? How will schools know students are ready to talk seriously and constructively about their career plans? We put forward the argument that effective career decision-making is reliant on developing a perception of what certain roles entail and how one might feel in that job, suggesting ToM may play an important role in doing this successfully. There is evidence to suggest ToM is related to other cognitive abilities, such as self-concept (Białecka-Pikul et al., 2020) and prospection, the ability to project oneself into the future (Buckner & Carroll, 2007; Spreng et al., 2009). The development of self-concept is critical in forming and crystallising career aspirations (e.g. Gottfredson, 2002a; Super 1990), and with evidence to suggest ToM and future-thinking are related, ToM development in adolescence may well impact career decision-making. Therefore, associations between ToM and both vocational interest and career aspiration stability will be measured, in order to assess the important issue of the timing in providing careers guidance.

1.4 Summary of research aims

Skills Minister Anne Milton recently said individuals "will continue to be held back if they don't have the right advice, at the right time to make informed decisions about their future" (Burke, 2017). What we do matters, but also when we do it. It is therefore vital that research should be conducted to consider ways to implement the most effective careers advice: both in terms of individualisation of careers guidance, as well as exploring the timing of implementing careers advice. If students are not cognitively ready to make important career decisions, it could be a waste of much-needed resources to spread careers guidance thinly across all secondary school years.

There is a need for further understanding of how students' vocational interests develop, how to create more personalised careers tools for students, and to assess the best time to implement careers guidance. With huge funding and time pressures in schools, it is critical to ground policy in empirical evidence. This PhD research explores various factors, including Theory of Mind (ToM) development, birth order, and SES that may, separately and in combination, enhance current understanding of how young people's vocational interests develop. Additionally, exploring the role of cognitive abilities that have been seen to continue developing throughout adolescence, such as Theory of Mind, in relation to how vocational interests develop, could help further understanding of when careers guidance would be most helpfully implemented in schools.

The aim of the research is to make a positive contribution to careers education by gathering evidence on the role of ToM, birth order and SES in the development of vocational interests in adolescence. The relationships between these variables, and their impact on how career aspirations develop and change, are explored via three studies, specific research questions for which are presented in Chapters 4, 5 and 6.

2 Literature Review

2.1 Overview

The following literature review explores existing evidence for the relationships between Theory of Mind, birth order and vocational interests. Firstly, the literature regarding Theory of Mind development in adolescence will be assessed, followed by a discussion on the relationship between Theory of Mind and vocational interests. A general section on birth order studies will follow, before separate reviews of the relationship between birth order and both Theory of Mind and vocational interests.

2.2 Theory of Mind in adolescence

General introduction

Theory of Mind (ToM) is the ability to ascribe mental states, particularly beliefs, intentions and desires, to other individuals and oneself (Peterson et al., 2005; Premack & Woodruff, 1978). ToM ability is commonly assessed in young children, with the expected age of success in false belief tasks, and development of the ability to understand representational change of an object, generally being agreed to be at four years old (Gopnik & Astington, 1988; Wellman et al., 2001). Although typically associated with these milestone developments in pre-schoolers, recent studies have provided evidence to suggest that ToM continues to develop throughout adolescence and early adulthood. When reviewing the evidence regarding ToM development in adolescence, we will adhere to the framework developed by Shamay-Tsoory et al. (2010), which suggests ToM is a multidimensional concept, comprising two processes: cognitive and affective ToM. Within this framework, cognitive ToM is defined as the ability to infer the *beliefs* of other people, whereas affective ToM is the ability to infer the *emotions* of other people (Shamay-Tsoory et al., 2010; Shamay-Tsoory et al., 2007; Shamay-Tsoory et al., 2006).

Cognitive ToM

Evidence of cognitive ToM development

Cognitive ToM is the ability to differentiate between one's own beliefs and the beliefs of others, typically assessed through the use of false belief tasks (Kalbe et al., 2009; Shamay-Tsoory et al., 2007; Shamay-Tsoory et al., 2010). There are levels within cognitive ToM: first-order cognitive ToM, second-order cognitive ToM and advanced cognitive ToM. Wimmer and Perner (1983) established the false belief task, mastery of which signals development of first-order cognitive ToM. Based on Wimmer and Perner's (1983) false belief task, Baron-Cohen et al. (1985) created the Sally-Ann test to assess first-order cognitive ToM development in autistic children. The Sally-Ann task is now perceived as the standard first-order false belief task (Bloom & German, 2000). The premise of the task is simple: there are two dolls, Sally and Anne, who are both present in the first scene (Baron-Cohen et al., 1985). Sally places a marble in a basket and leaves the room, Anne then moves the marble into a box, Sally re-enters, and the child being tested is required to answer where Sally thinks the marble is located (Baron-Cohen et al., 1985). The child will be granted false belief understanding if they point to the basket, and can also confirm where the marble is now, and where the original location was too (Baron-Cohen et al., 1985).

Flavell et al. (1968) differentiated this first-order cognitive ToM, or 'Level 1 perspective taking' from second-order 'Level 2 perspective taking', by outlining that second-order cognitive ToM ability requires another layer of understanding with an added character: being able to identify and understand the beliefs of another person's beliefs about *another* person. Table 2.1 below outlines the description of first and second-order perspective taking, as well as descriptions of additional higher-order ToM skills. In typically developing children, the first-order false belief task is passed by 4 years old (Wellman et al., 2001). In the more complex second-order false belief tasks, Perner and Wimmer (1985) suggested the ability to understand second-order epistemic states is established in many 6-year-olds, and most 7-year-olds. Furthermore, in their study on verbal deception in children aged between 6 and 11, Talwar et al. (2007) found scores on second-order belief tasks positively correlated with their ability to lie, which also positively correlated with age. Such evidence suggests that cognitive ToM ability follows an upward trajectory as we age, a suggestion further supported by a study conducted by Liddle and Nettle (2006) on advanced cognitive ToM. It was found that 10- and 11-year olds performed at a level slightly higher than chance on third-order belief tasks, thus showing further ToM development in this later age-group (Liddle & Nettle, 2006). When tested in an adult population, however, although performing at a level higher than chance in first to fourth-order false belief tasks, there is a noticeable and substantial increase in ToM errors compared to memory errors in the fifth-order false belief task (Kinderman et al., 1998). In the study by Liddle and Nettle (2006), it was seen that performance of 10 and 11 year olds in fourth-order belief tasks was only at chance, so by comparing that to the study of Kinderman et al. (1998), where it is the *fifth*-order false belief tasks with the significant errors, it could be inferred that there is advanced cognitive ToM progression between childhood and adulthood.

TABLE 2.1 TOM FALSE BELIEF LEVELS AND DESCRIPTIONS (COMPOSED BASED ON INFORMATION FROM KINDERMAN ET AL., 1996)

ToM level	Description
First-order ToM	Identify and understand the belief of another person
Second-order ToM	Identify and understand the beliefs of another person's beliefs
Third-order ToM	Identify and understand the beliefs of another person's beliefs about another person's belief
Fourth-order ToM	Identify and understand the beliefs of another person's beliefs about another person's beliefs about another person's belief
Fifth-order ToM	Identify and understand the beliefs of another person's beliefs about another person's beliefs about another person's beliefs about another person's belief

An interesting observation is the significant correlation between ToM errors and memory errors in assessments of advanced cognitive ToM using these false belief tests (Kinderman et al., 1998). Although episodic memory was found to be unassociated with ToM ability (Rosenbaum et al., 2007), there are numerous studies to support the *working* memory hypothesis, namely that working memory capacity is responsible for ToM performance (Davis & Pratt, 1995; Kinderman et al., 1998; Mutter et al., 2006). Baddeley (2010) defines working memory as the "system or systems that are assumed to be necessary in order to keep things in mind while performing complex tasks" (p.R136), such as learning, reason, and language comprehension. The frontal lobe, through its support of the dorsolateral prefrontal cortex, has been found to play a vital role in working memory (Conklin et al., 2007; Curtis & D'Esposito, 2003). We know that the frontal lobe develops through adolescence and into adulthood, and there is evidence that as healthy individuals progress through the adolescent years, performance in most working memory tasks improves (Conklin et al., 2007).

In addition to multiple-order false belief tasks, other methods of assessing advanced cognitive ToM have been formulated: Happé (1994) developed a set of vignettes, each with two associated test questions, testing understanding of the mental states of others but utilising a more 'everyday', naturalistic approach, rather than a series of false belief tasks. The social stories task assessed advanced cognitive ToM through 12 different story-types, including ones involving a white lie, sarcasm, and double-bluffing (Happé, 1994). Although Happé (1994) designed the 'Strange Stories' assessment to test advanced cognitive ToM ability in individuals with autism, O'Hare et al. (2009) implemented the same technique to assess typically developing children aged between 5 and 12-years-old. It was found that age was positively correlated with advanced cognitive ToM ability, and there is a strong likelihood that this correlation would continue into adolescence, as the 12-year-olds in this study were not performing at ceiling on the tasks (O'Hare et al., 2009).

Evidence of advanced cognitive ToM development in adolescence

Although there has been considerable progression in understanding brain development in adolescence (see Blakemore & Choudhury, 2006, for a review), literature demonstrating evidence of advanced cognitive ToM development through empirical studies in adolescents is limited. Choudhury et al. (2006) assessed 112 participants aged between 8 and 36 years old in a computerised perspective taking study, where the difference in reaction time to answer in the first-person perspective and third person perspective was recorded. The results showed there was a significant relationship: as age increased, the difference in the reaction time reduced (Choudhury et al., 2006). Essentially, adults show a better ability in perspective taking than pre-adolescents, thus suggesting a developmental period in cognitive ToM during adolescence (Choudhury et al., 2006).

Dumontheil et al. (2010) suggested cognitive ToM improves specifically during the period of late adolescence. This conclusion was based on the results of their computerised task, where participants were required to move objects as instructed by, and from the perspective of, a 'director', a task in which participants in the Adolescent II category (aged 14.0 - 17.7) made more mistakes than those in the Adult category (aged 19.1-27.5). Whilst there was a continued accuracy in both non-director and director trials until mid-adolescence, suggesting success depended on development of certain executive functions, such as working memory and inhibitory control (supported in other studies, e.g. Mutter et al., 2006), improvements in accuracy only continued in the director (perspective-taking) condition (Dumontheil et al., 2010). The reasoning for the noticeable difference in continued development during late-adolescence, however, was suggested to *not* be due to an increased efficiency in perspective-taking processes themselves, but instead due to developing a natural tendency to acknowledge another actor's perspective (Dumontheil et al., 2010).

Valle et al. (2015) focused on recursive thinking in young adolescents, adolescents and young adults, using both an Imposing Memory Task (IMT) and a third-order false belief task. They found an age effect; young adults performed better than either adolescent category in both the third-order false belief task and the IMT (Valle et al., 2015). When controlled for general cognitive functions, however, the age effect disappeared in the IMT, yet there was still a significant correlation between age and performance in the third-order false belief task (Valle et al., 2015). This supports the hypothesis suggested by Dumontheil et al. (2010): it is the increasing propensity to consider other individuals' perspectives rather than cognitive skills, such as working memory, that are responsible for the improved accuracy (in adulthood compared to adolescence) in applying recursive thinking to predicting behaviour (Valle et al., 2015). As Valle et al. (2015) outline, the cognitive skills have already reached a high level, thus the further development of ToM abilities are hypothesised to be due to "the individual's richer social experience and more sophisticated ability to verify inferences on the basis of behaviour" (p.119). This is a hypothesis supported further by Choudhury et al.'s (2006) study referenced earlier. Although their focus was on how the reorganisation of the synapses in the frontal and parietal cortices that occurs during adolescence is responsible for improved cognitive ability, they suggest the improved ability in perspective-taking seen in adults is additionally supported by encountering a wider range of social interactions (Choudhury et al., 2006).

Affective ToM

Evidence of affective ToM development

Affective ToM is the ability to infer the emotions of other people, as opposed to beliefs of others, as in cognitive ToM (Shamay-Tsoory et al., 2007; Shamay-Tsoory et al., 2010). Evidence of the mechanisms underlying cognitive ToM partially differing from those responsible for affective ToM confirm the separation of these two processes: e.g. ventromedial front lobe damage was mostly responsible for affective ToM impairment, whereas extensive damage in the prefrontal cortex was mostly responsible for cognitive ToM impairment (Shamay-Tsoory & Aharon-Peretz, 2007). More specifically, the use of functional magnetic resonance imaging alongside ToM scenario tasks found emotional-related effects observed only in the ventral portion of medial prefrontal cortex, whereas belief-related activation was seen in the dorsomedial prefrontal cortex too (Corradi-Dell'Acqua et al., 2014).

Despite the evidence for the differing underlying mechanisms of affective ToM and cognitive ToM, these only partially differ; there is both anatomical evidence of shared neural mechanisms (e.g. Bodden et al., 2013; Corradi-Dell'Acqua et al., 2014) and evidence from psychological and behavioural analysis connecting affective ToM with cognitive ToM. For example, Jingxin et al. (2006) reaffirmed other cognitive ToM studies by finding the age of 6 was the critical period for success in second-order false belief tasks, but additionally found that second-order *emotion* was developed at this age too. Bennett and Matthews (2000) found similar correlations in their study of children aged between 4 and 7 years old: second-order belief understanding significantly correlated with the ability to self-attribute social emotions (assign feelings such as guilt or embarrassment to oneself). A story-based second-order belief task was used to assess cognitive ToM ability, and ability to self-attribute social emotion was assessed by coding the responses of participants to vignettes, in which participants were asked to imagine themselves in particular scenarios (Bennett & Matthews, 2000). These vignettes involved imagining one has committed either social-conventional rule violations (such as going to the supermarket in pyjamas) or moral rule violations (such as stealing someone else's toy). Of the thirty children participating, only fifteen passed the second-order belief task, and then only seven self-attributed any form of social emotion in the vignettes task. Bennett and Matthews (2000) concluded that this therefore suggests success in second-order false belief tasks alone does not determine the development of social emotion self-attribution, and instead this varies between individuals.

Conversely, numerous studies have assessed the relationship between passing false belief tasks and the ability of emotion attribution in young children and discovered that there is a lag between the two (e.g. Hadwin & Perner, 1991). Harris et al. (1989) were the first to notice ability to make belief-based emotion attributions developing between the ages of 3 to 6. Utilising tasks similar to the Sally-Ann false belief task (Baron-Cohen et al., 1985), children saw animal characters being presented with containers, and were then asked to predict the emotional response of these characters (Harris et al., 1989). In the first experiment, the child knows that the desirable object has been removed from its container, but the animal character does not (Harris et al., 1989). The child is asked to state the emotional response of the animal character when presented with the container, before opening it. It was found that the majority of children aged 4 were unsuccessful in understanding the correct emotional reaction, whereas the majority of 6-year-olds understood that from seeing the container alone, and lacking the knowledge of what is actually inside, the animal character would have a happy response. de Rosnay et al. (2004) adapted another of Harris et al.'s (1989) experiments, terming it the Dog-Rabbit Test: whilst Roger the rabbit is on a walk, Gromit the dog secretly swaps the rabbit's favourite food (Smarties) with a different food (peanuts). The ability to make belief-based emotion attributions was assessed by asking the child how Roger will feel when he first sees his box of food (before knowing that the Smarties have been replaced with peanuts) (de Rosnay et al., 2004). The results of this test, with imagined emotional outcomes, alongside the results of watching two videos with *observable* emotional outcomes, provided further evidence of the lag between false belief understanding and emotion attribution (de Rosnay et al., 2004). It was further suggested that maternal input, particularly linguistically, alongside providing rich social exchanges and opportunities to interact with beliefs, thoughts and opinions of others, would help to overcome this lag (de Rosnay et al., 2004). This is important to address when considering the role of siblings and the effect of birth order place on affective ToM development, a relationship we will explore in more detail in Section 2.5.

Further evidence has pointed towards the existence of advanced affective ToM, such as that seen in faux pas tasks (Banerjee, 2000; Baron-Cohen et al., 1999). The faux pas task assesses higher mental-state reasoning in a naturalistic way, reflecting everyday social circumstances (Banerjee et al., 2011). Typically, participants are required to point out and explain the faux pas in a scenario, for example, a boy bakes an apple pie for a cousin who, without knowing that the protagonist baked the pie, says he hates apple pie (Banerjee et al., 2011). Most progress in being able to detect and explain the faux pas in such tasks is expected between 6 and 8 years old (Banerjee, 2000), though Baron-Cohen et al. (1999) found most progress occurred between 7 and 9 years old in girls, and later on, between 9 and 11 years old, in boys. Even considering this whole bracket of 6 to 11 years, it can be inferred that success in faux pas tasks, and thus evidence of advanced affective ToM development, follows development of second-order cognitive ToM (Baron-Cohen et al., 1999). Knowing cognitive ToM advances further than second-order, and also having evidence of age positively correlating with success on advanced affective ToM tests, suggests further affective ToM development past the age of 11, and into adolescence.

Evidence of advanced affective ToM development in adolescence

Keulers et al. (2010) conducted two mentalizing tasks, one focusing on emotions (thus assessing affective ToM) and another on actions (assessing cognitive ToM), and discovered success on both tasks positively corresponded with age throughout adolescence until 19 years of age. As age increased, reaction times decreased in assessing emotional circumstances from both first and third person perspectives, thus highlighting evidence of affective ToM development in adolescence (Keulers et al., 2010). Furthermore, girls outperformed boys on both emotional and cognitive tasks, and there was also evidence that puberty affected reaction times in boys - specifically, as pubertal phases increased, mentalizing speeds in both emotional and cognitive tasks also increased (Keulers et al., 2010). This linear influence of puberty counters other studies that have previously suggested there is a 'dip' in social cognition associated with mid-pubertal adolescents compared to pre- or post-pubertal adolescents (e.g. Diamond et al., 1983; McGivern et al., 2002). McGivern et al. (2002), for example, similarly utilised reaction times to measure emotion perception, and found response times slowed at the age of 11 and 12, the age puberty typically starts, in comparison to the previous year. However, this conclusion was based on age determining pubertal onset rather than quantitive measures of pubertal phases, as employed by Keulers and colleagues (2010).

Vetter, Leipold, et al., (2013) considered this effect of puberty in their study concerning social cognitive development during adolescence, implementing a 'Reading the Mind in the Eyes test' (RMET or Eyes test) to assess emotion recognition and whether pubertal phase is influential. The Eyes test was established by Baron-Cohen et al. (2001), involves recognising complex emotions visually, and is important in assessing aspects of advanced affective ToM (Vetter, Leipold, et al., 2013). No significant effect of pubertal onset or stage on either emotion recognition (in the Eyes test) or ToM (in a story comprehension task) was found. However, a significant age effect on both aspects of social cognition was found, with adolescents performing at a lower standard and with lower accuracy than adults, with data suggesting there is social cognition development occurring between the ages of 15 and 18 (Vetter, Leipold, et al., 2013).

In their study using cartoon vignettes to assess both cognitive and affective ToM, Sebastian and colleagues (2012) found that male adolescents (aged between 11 and 16 years) and male adults (aged between 24 and 40 years) performed at similar levels in the cognitive ToM task, yet adolescents made significantly more errors than adults in the affective ToM task. This is important evidence in assessing affective ToM development in adolescence, though having data for late adolescents (aged 17-24) would have proved valuable in plotting continuous cognitive development. It is suggested affective ToM is an especially challenging development that continues growing during adolescence, and that it could be the necessary integration of cognitive ToM with empathy to form affective ToM, as proposed by Shamay-Tsoory and colleagues (2010), that results in this later development (Sebastian et al., 2012). Sebastian and colleagues (2012) also noted that during the affective ToM tasks, adolescents activated the ventromedial prefrontal cortex (vmPFC) more than adults (as seen by Corradi-Dell'Acqua et al., 2014). Vetter et al. (2014) further investigated this in their all-female sample, and found the vmPFC was significantly more strongly activated in adolescents than adults when affective ToM was being tested. As the studies have compared both males (Sebastian et al., 2012) and females (Vetter et al., 2014) independently, it is unlikely that this is a sex-specific development, and instead provides important evidence that affective ToM continues to develop during adolescence.

Areas for development

Whilst ToM development during adolescence remains a relatively unexplored area, there has been a marked increase in the number of empirical studies carried out on the topic in recent years. However, there have been very few longitudinal studies assessing ToM development in adolescence. Additionally, understanding associations between the speed or level of ToM development in adolescence and contextual or situational factors however, remains relatively unexplored. The current study uses both a longitudinal and cross-sectional design to further test whether ToM, particularly affective ToM, develops in adolescence, but will also explore whether factors such as birth order are associated with this development, and whether outcomes such as vocational interests are affected by ToM development.

2.3 The relationship between ToM and vocational interests

Introduction

In this study, the potential importance of ToM in vocational interest and career aspiration development is hypothesised for two reasons. ToM ability has been associated with cooperative, pro-social behaviour and popularity amongst peers in childhood (Imuta et al., 2016; Slaughter et al., 2015) and self-reported pro-social behaviour across adolescence (Tamnes et al., 2018). As there is longitudinal evidence to suggest individuals tend to have interests in areas where they do well and perceive they have strengths (Denissen et al., 2007), it is hypothesised that those individuals with higher levels of ToM are more likely to possess, or further develop, people-based vocational interests. The first part of the literature review will focus on this association, particularly in relation to the Empathising-Systemising theory (Baron-Cohen et al., 2003).

Additionally, choosing a career involves developing a perception of what a person does in a certain job, and how that might feel: in terms of enjoyment, stimulation, and reward. To do this well, one has to have the ability to 'walk in another person's shoes', setting up the possibility that ToM may be a relevant consideration in career aspiration and vocational interest development. Research has suggested a core neural network exists underlying a number of cognitive processes, with high correspondence found between the domains associated with ToM and the ability to project oneself into the future (Spreng et al., 2009). Those individuals with better ToM performance may well also demonstrate better abilities of projecting themselves into future career roles, which could therefore have an overall influence on career aspiration stability. Therefore, the second part of this literature review concerns the relationship between ToM, alongside other related cognitive abilities including prospection and self-concept, in relation to vocational interest and career aspiration development. Literature regarding vocational interest stability is explored in more detail in Chapter 6, where we explore the role of ToM amongst other factors in relation to career aspiration and vocational interest stability.

ToM and People-based vocational interests

ToM and prosocial behaviour

The relationship between ToM and prosocial behaviour is important to explore when considering the relationship between ToM and vocational interests, particularly in relation to People-based, or social, vocational interests. Prosocial behaviour is voluntary behaviour with the key intention to benefit other people; actions such as cooperating, helping and comforting

(Dunfield & Kulmeier, 2013). Similarly, in Holland's (1997) RIASEC model of vocational interests, 'Social' individuals have preferences for activities involving social interactions, including helping and teaching people. Therefore, associations found between ToM and prosocial behaviour can possibly be applied to the relationship between ToM and People-based vocational interests.

Empirical research testing the relationship between ToM and prosocial behaviour has been mixed, although a recent meta-analysis of 76 studies (N=6432 children aged between 2 and 12) has presented the most convincing argument to date that a relationship between ToM and prosocial tendencies exists (Imuta et al., 2016). Their meta-analysis assessed this relationship across studies that assessed 'healthy' children (no psychiatric or neurological condition, or severe sensory impairment), and involved both a behavioural measure of ToM assessed concurrently with another measure of prosocial behaviour (behavioural tasks, observations and questionnaires were included, but studies measuring self-reported prosocial behaviour were not). The overall, major finding of their meta-analysis was the significant, though weak, positive correlation between ToM and prosociality (r=.19) (Imuta et al., 2016). Sub-analysis noted that this effect size was greater for affective perspective taking (r=.24) than cognitive perspective taking (r=.16). As highlighted previously, adolescence appears to be an important stage for affective perspective taking development (e.g. Sebastian et al., 2012), and with this stronger relationship between prosocial behaviour and affective ToM, it could mean those individuals who perform better on affective ToM tasks are even more likely to demonstrate prosocial behaviour, and possibly be more inclined towards People-based occupations where they can use these skills.

Large-scale research on the relationship between ToM and prosocial behaviour in adolescents aged 12 and over is more limited, but of the existing studies, there does appear to be an association between perspective-taking ability and prosocial tendencies. Güroğloet al. (2014), for example, found older adolescents (aged 15 and 18) were more likely to demonstrate non-costly prosocial behaviour towards peers than younger children (aged 9 and 12), which was an age-related difference mediated by levels of self-reported perspective-taking ability. Additionally, Tamnes et al (2018) assessed the relationship between perspective-taking ability and prosocial behaviour in a large cross-sectional sample (n=293) of participants (aged 7 to 26), using the Director/No-Director ToM task described in the previous section (Dumontheil et al., 2010) and the Strengths and Difficulties Questionnaire (SDQ) prosocial behaviour scale, for a measure of self-reported prosocial behaviour. In line with Imuta et al's (2016) meta-analysis, a small negative association between errors made on the ToM task and prosocial behaviour was found ($F=4.42$, $p=.037$, $\eta_p^2=.024$). While Tamnes et al (2018) were exploring the association of perspective-taking on self-reported prosociality, and in Imuta et al's (2016) meta-analysis, self-reported measures were deliberately excluded, both pieces of research suggest a weak relationship between the two variables exist. Additionally, in relation to our study, self-reported prosociality is in fact likely to be even more closely related to vocational interest in People in comparison to measured prosociality, by the very nature of vocational interests as variables. Although overlapping with personality, vocational interests have frequently been described as reflecting the 'motivations' of people (Darley & Hagenah, 1955; Hogan & Sherman, 2019) so evidence to suggest a connection between how people view their own level of prosocial behaviour and perspective-taking is of value when considering the potential connection with vocational interest in People.

Importantly, the connection between People-based vocational interests and this relationship between ToM and prosocial behaviour is hypothetical: while logically the concept is sound, there is no evidence directly testing the association to suggest this is the case. Additionally, the most convincing argument of the relationship between ToM and prosocial behaviour alone is only moderate even across meta-analyses of over 70 studies, and also only included studies involving children under 12 (Imuta et al., 2016). That being said, there is evidence of this relationship continuing throughout adolescence (Tamnes et al., 2016), and, of more relevance, there is evidence of a relationship between the ToM-related ability of empathising with vocational interest in People-related fields, as explored in the next section.

The empathising-systemising theory and vocational interests

Literature testing the empathising-systemising theory provides most support for our hypothesis that there is a relationship between ToM and vocational interests. Empathising is the ability to predict, understand and appropriately react to the mental states and behaviour of others, whilst systemising is the drive and ability to understand, analyse and construct *systems* and their underlying rules (Baron-Cohen, 2002). Studies have considered the empathising-systemising theory in relation to undergraduate degree choice (e.g. Kidron et al., 2018) and vocational interests (Svedholm-Häkkinen & Lindeman, 2016), broadly finding strong empathising ability is positively associated to working with people and in the humanities, and working in the physical sciences and with things is positively associated with strong systemising ability.

While clearly related constructs, empathising and ToM are not interchangeable. According to Baron-Cohen et al. (2003), the term ‘empathising’ in fact encompasses ToM, ‘sympathy’ and ‘empathy’. However, Rogers et al. (2007) have argued that there needs to be a clear distinction between ToM and empathy. They state empathy is multi-dimensional in nature, with both cognitive and affective aspects, with ToM appearing to be equivalent to cognitive empathy, but not necessarily related to affective empathy (Rogers et al., 2007). By definition, the necessity for an affective state in order to empathise fully with others automatically differentiates empathy from ToM: "'empathising' connotes the capacity to share other people's feelings…when one understands someone else's thoughts, one does not feel the thought of the other in one's own body" (Singer, 2009. p.254). Evidence from neuroimaging studies suggest there are overlapping, but distinct, neural networks: ToM and empathy both rely on activation of the medial prefrontal cortex, temporoparietal junction, and temporal poles, though engagement of the amygdala is additionally required for empathy (Völlm et al., 2005). Our research design is considering the role of cognitive and affective ToM as distinct constructs. As it has been argued successful affective ToM processing "requires the integration of cognitive ToM and empathy" (Sebastian et al., 2012. p.53), the relevance of studies assessing empathising and vocational interests are undeniable.

In the general population, those in STEM careers typically score higher in systemising tests, and lower in empathising tests, with the opposite pattern again being observed in students of the humanities (e.g. Billington et al., 2007). In their study of N=1761 students, Wheelwright et al (2006) found a significant effect of degree subject on both systemizing and empathizing scores. Degree subjects were grouped and compared (physical science vs biological science vs social science vs humanities): physical scientists scored significantly lower than the other degree subjects on the empathizing quotient (Wheelwright et al., 2006). Physical scientists also scored significantly higher than the other degree subjects on the systemizing quotient, with humanities students scoring lowest of all degree subjects. While these results are in line with predictions, analysis of broadly grouped degree subjects does not allow for the variability within some subjects. Wheelwright et al. (2006) acknowledge that certain social sciences and humanities subjects (such as law, linguistics and economics) will involve more systemising than others, arguing however that “these ways of dividing degree subjects may still capture some important differences between the highly lawful physical sciences and less lawful domains” (p.53). But what about in the case of subjects such as medicine? According to their categorisation, Wheelwright et al. (2006) class medicine under the biological science group, alongside biochemistry and molecular biology. While systemising is certainly an important part of medicine, ability and interest in empathising is also vital. By assessing systemising and empathising scores in relation to broad degree subject grouping, the lack of significance found for the other subjects that are not physical sciences is not especially surprising.

Baron-Cohen et al. (2003) had suggested a ‘trade-off’ between systemising and empathising, resulting in three groupings: those with high systemising and low empathising abilities and interests, those with low systemising and high empathising abilities and interests, and a ‘balanced brain type’, with neither higher nor lower systemising or empathising abilities. Baron-Cohen et al. (2003) suggested individuals with very low empathising or systemising ability may use the other domain to compensate. This can result in ‘hyper-systemisers’, commonly seen in individuals on the autism spectrum who can overcompensate for low empathising ability with extremely high levels of systemising (Baron-Cohen, 2006). Baron-Cohen (2002) claimed empathising and systemising are determined by one biological factor and, based on early findings that individuals combined scores do not differ, it was argued that “empathizing and systemizing compete neurally in the brain” (Goldenfeld et al., 2005. p.344). Results from empirical studies dispute this claim: Morsanyi et al. (2012) found scores on the systemising quotient and empathizing quotient were unrelated, and in fact a weak positive correlation was found between the scales (once gender was controlled for). If empathising and systemising were competing in the brain, we would expect to see a negative correlation between the scores (Svedholm-Häkkinen & Lindeman, 2016). Even in studies where a negative correlation was found between scores on the Empathy Quotient (EQ) and Systemising Quotient (SQ), these were weak, (*r*=-.15) (Wakabayashi et al., 2006). Svedholm-Häkkinen and Lindeman (2016) outlined how "the possibility that there is no trade-off opens up the question of variation within the 'balanced brain type'" (p.366). Instead of those with high empathising abilities and interests automatically being assumed to therefore demonstrate low systemising abilities and interests, the 'balanced brain type' group could include people with high levels of both empathising and systemising, as well as people with low levels on both dimensions (Svedholm-Häkkinen & Lindeman, 2016). Viewing empathising and systemising as independent constructs enables an even clearer exploration of the relationship between ToM and vocational interests.

Svedholm-Häkkinen and Lindeman (2016) applied the empathising-systemising theory to the general population, testing its relation to occupation, hobbies and vocational interests, but their approach was broader. They suggested that there is likely variation within the 'balanced brain type' group, as well as acknowledging that there is not necessarily a clear-cut divide between only humanities being favoured by high empathisers, and only physical science being the preference for high systemisers. Taking this into account, they measured both empathising and systemising quotients alongside a survey regarding field of current occupation or study (27% of the participants were working, and 64% were students), and a questionnaire concerning vocational interests in a large sample of Finnish volunteers (N=3084, mean age = 28 years, range 15-69). The vocational interests scale asked participants to rate the importance of Data, Ideas, People and Things in their work (though only the People and Things information was used), and they also included a self-report scale of social intelligence (Silvera et al.'s (2001)

Tromsø Social Intelligence Scale). Some of their findings matched their predictions: individuals with strong empathising ability and low systemising ability were associated with occupations in education and psychology, and people-based vocational interests (Svedholm-Häkkinen & Lindeman, 2016). Their data also found those individuals with low empathising ability and high systemising ability and interest were more likely to be undertaking scientific occupations: IT, technology, and the ‘exact’ sciences, such as physics, chemistry, mathematics (Svedholm-Häkkinen & Lindeman, 2016).

While including more specific areas of work and study, such as education and psychology, research on the associations between empathising, systemising, vocational interests and occupational choice would benefit from the broad subject areas being broken down further. Svedholm-Häkkinen and Lindeman (2016) acknowledged these limitations and suggested looking at occupation alone does not clearly determine the level of empathising or systemising involved. Psychology, for example, is a very broad field – while associated with strong empathising ability, there are some psychology research jobs that are likely more focused on data than people (Svedholm-Häkkinen and Lindeman, 2016).

Assessing empathising and systemising as independent factors allowed Svedholm-Häkkinen and Lindeman (2016) to identify that the field of humanities was equally popular in both low empathising and high empathising individuals, with the main predictor being low talent and interest in systemising. Therefore, it is not the straightforward case of systemising vs empathising, as this study showed variation in individuals within the ‘balanced brain type’ group – those with High-High status had high levels of social intelligence as well as high ability in physics, whereas those in the Low-Low group had low levels of social intelligence and weak ability in physics (Svedholm-Häkkinen & Lindeman, 2016). Although we have posited that the most likely relationship we may find will be between those individuals with high levels of empathising, and therefore a more developed ToM, and interest in humanities and people-based vocational interests, we should be aware that it could be the *lack* of interest and ability in systemising that leads to these vocational interests, rather than high empathising ability or strong performance in ToM tasks.

The empathising-systemising literature provides interesting insight as to possible associations between ToM and vocational interests, specifically that high empathising is associated with people-based vocational interests. In association with evidence of a moderate relationship between ToM and prosocial behaviour, there is clearly a gap in the literature regarding the influence both cognitive and affective ToM play in the development of vocational interests, especially in the realm of people-based vocational interests. Not only is our research the first to explore the direct relationship between ToM and vocational interests, the association is being explored longitudinally during mid and late-adolescence, at time-points when important career-related decisions are being made.

Studies considering ToM and vocational related variables

ToM may play a role in variables related to vocational interest development. When considering various careers, being able to 'put yourself in someone else's shoes', a core component of ToM, will likely be beneficial. This ability may result in better understanding of what certain roles entail, leading to more efficient career decision-making, and higher career aspiration stability during adolescence. Concepts that have been linked to advanced ToM development in adolescence include episodic foresight and self-concept. Evidence of a core brain network responsible for both ToM and episodic foresight lays the foundation of our hypothesis that ToM may be related to career development, due to similarities in the ability to take on different perspectives with the ability to project oneself into the future (Buckner & Carroll, 2007; Spreng et al., 2009). Self-concept is a construct central to numerous career development theories (e.g. Gottfredson, 2002a; Super, 1990), and although evidence of a relationship between self-concept and ToM exists (Białecka-Pikul et al., 2020), ToM development in adolescence has not been considered in relationship to career decision-making, or career development at all. The following subsection discusses evidence for the relationship between these variables and ToM in relation to vocational interest and career development.

One variable possibly associated with vocational interests and career development is episodic foresight (EpF), described as the capacity to envisage potential future scenarios and make use of this ability when making current decisions (Suddendorf & Moore, 2011). It was proposed that the capacity to project oneself into an imagined future scenario would still demand the ability to take on a different perspective, despite it technically being the mental state of the same individual, and these cognitive abilities would therefore be supported by a core brain network (Buckner & Carroll, 2007; Hanson et al., 2014). Buckner and Carroll (2007) even speculated that these abilities, ToM, episodic memory, thinking about the future, and navigation, should not be seen as distinct entities, but instead are “best understood as part of a larger class of function that enables flexible forms of self-projection” (Buckner & Carroll, 2007. p.55). In their quantitative meta-analysis of neuroimaging studies, Spreng et al (2009) highlighted the presence of a core neural network underlying several cognitive processes, specifically noting a high correspondence between the domains associated with ToM and prospection. Spreng and Grady’s (2010) fMRI study examining the brain activity of N=16 adults directly tested this association, finding a common pattern of activation in the default mode network (DMN) during tasks involving ToM, prospection, and autobiographical memory.

Hanson et al. (2014) assessed episodic foresight (EpF), executive function (EF) and ToM in pre-schoolers, and conversely, did not find a significant correlation between EpF and ToM nor EpF and EF. They considered various explanations for this result, outlining that the heterogeneity of the tasks used to assess EpF may have affected their findings. Specifically, individual EpF tasks were not significantly intercorrelated themselves so there was no EpF composite to correlate with the ToM and EF composites. Instead each EpF task was separately analysed with ToM and EF scores, thus reducing the statistical power of the data and the likelihood of finding significant correlations. Furthermore, they speculated that perhaps ToM and EpF only correlate in older children. Hanson et al (2014) cited the research conducted by Fair and colleagues (2008) that showed the core neural network, which is suggested to support self-projection amongst other cognitive functions, undergoes important development in which the default regions become completely integrated. Even at 7-9 years of age, the regions are only somewhat connected, suggesting there would be limited correlation in pre-schoolers (Fair et al., 2008). Lind et al. (2014) also conducted research assessing episodic future thinking, episodic memory and ToM amongst other cognitive functions in both typically developing children and intellectually high functioning children with autism spectrum disorder (aged between 6 and 12), and found impairments in episodic future thinking and episodic memory in children with ASD, but no similar impairments in ToM ability. While this result evokes further doubt as to whether there is a relationship between the two variables, it should be noted that the group differences could have been concealed as both the ASD group and the group of typically developing children found the ToM task difficult: the mean accuracy score in the typically developing group was only 21% (Lind et al., 2014).

While it appears there is uncertainty about a definite relationship between ToM and episodic future thinking, or prospection, the studies that cast doubt on the relationship are limited by either their methodologies (e.g. Lind et al's (2014) difficult ToM task), or their samples being composed of children. There is evidence to suggest that the relationship exists in older children and adults (from Spreng et al's (2009) meta-analysis and Spreng and Grady's (2010) fMRI study directly testing the regions of the brain activated). Our longitudinal study provides us with the opportunity to consider the role of ToM over time, and also enables the ability to consider stability and change of career aspirations and vocational interests. In relation to our analysis, it is possible that if a relationship does exist between ToM ability and episodic foresight, there may possibly be a positive association between ToM and career aspiration decisiveness or stability.

Self-concept and vocational interests

Super's self-concept theory of career development

A variable that is central throughout the career development literature is self-concept, and is one that has been seen to be associated with ToM (e.g. Bosacki, 2000). Super (1990) wrote that the development of an individual's self-concept, created as a result of a combination of factors including neural growth and personal experiences, is vital to career development. One of the stages Super (1990) proposed in his life stage developmental framework is exploration, occurring during adolescence (between 15 and 24 years old), during which a 'crystallisation' process occurs (Leung, 2008). The crystallisation process involves an individual reflecting upon their preferred interests and best skills, and aspiring to follow a career path that best suits these interests and understanding. Super (1990) outlined that his career choice and development theory should be seen to not only rely on the development, and ultimately the implementation, of self-concept during adolescence, but also on the environment of the individual. Before we even consider the empirical studies regarding the relationship between self-concept and ToM, there are already similarities: having a rich social experience during late adolescence is hypothesised to be responsible for higher levels of ToM development at this stage (Choudhury et al., 2006; Valle et al., 2015). Regarding Super's self-concept theory, Leung (2008) outlines that an already stable self-concept at late adolescence similarly continues to develop to higher levels as one confronts new life and work experiences.

Gottfredson's theory of circumscription, compromise and self-creation

Similarly to Super (1990), self-concept plays a major part in Gottfredson's circumscription and compromise theory (1981, 1996, 2002a). Her theory relies heavily on self-concept, the view one has of oneself both publicly and privately, and how this relates to occupational choice. Gottfredson (2002a) states that in addition to the views one has of oneself, individuals hold occupational stereotypes, distinguished most frequently by field of work, the masculine or feminine nature of work, and the associated prestige level. The combination of assessing an individual's perceived self-image alongside different occupational stereotypes is essentially how occupational aspirations are formed, with the process being less about *selection* and instead on the elimination of unsuitable vocational options (Gottfredson, 2002a). The process of developing one's self-concept and self-image occurs in four stages, with progression between stages reflecting both general cognitive development and increasing understanding of a variety of occupations. As Gottfredson (2002a) writes "Each new step in psychological integration is also a step in creating a public self" (p.95-96). The awareness one develops concerning the public perception of oneself could plausibly be associated with ToM: understanding the beliefs, opinions and mental states of other people about one's own image and occupational choice suggests an element of ToM understanding. The first three of Gottfredson's stages are dedicated to the *circumscription* process, eliminating unsuitable occupational options, with the fourth stage focusing on the *compromise* element: selecting the most appropriate, accessible, and likely occupational choice out of the remaining options. This fourth stage is said to occur in individuals aged fourteen and above, at a similar point to Super's (1990) exploration stage, when their ability to understand and apprehend complex information has developed to a sufficiently high level. In her extended theory, Gottfredson (2002a) built on behavioural genetic research to note that the important processes of circumscription and compromise in career choice are shaped by both genetics and cultural upbringing, which career counsellors can use to help adolescents and young adults develop stronger levels of self-insight and make appropriate career choices. Gottfredson's (2002a) theory of circumscription and compromise is explored in more detail in the literature review of Chapter 6, where the theory is tested.

The relationship between self-concept and ToM

Self-concept is evidently an important construct in relation to career development literature, however, the existence of a relationship between self-concept and ToM has been disputed. Bosacki (2000) found a robust, significant positive correlation between ToM and self-understanding in a small sample of 128 pre-adolescents, a moderately strong relationship that remained even when controlling for vocabulary ability: partial r=.60 for boys and partial r=.45 for girls. Bosacki (2000) suggests there are two possible explanations for the relationship: one being that individuals have 'theory-making' capacities that enable thinking, feeling and behaviour, and that there is a common cognitive framework underlying the theories created for both self and other, and the second suggesting 'other' and 'self' are in fact the same, with both self-perception and the understanding of others being developed through social experience and interactions. In a review on the relationship between ToM and the self, Happé (2003) agreed with the speculation that there is a common underlying cognitive basis, suggesting that the ability to self-reflect may have even evolved from the cognitive and neural processes developed to ascribe mental states to others. In a more recent, small-scale study, Bosacki (2014) considered the relationship between ToM and self-understanding in children aged 8-12 years old, but only found a positive relation at the first measurement, with the repeated tests two years later showing no significant correlation. Ahn and Miller's (2012) cross cultural comparison of Korean and American pre-schoolers provided data that deviates even further from the expected positive relationship between ToM and self-concept: better performance on the false belief task correlated with lower scores of self-concept. Bosacki et al. (2015) similarly considered the relationship cross-culturally, comparing Canadian and Polish adolescents. They found that when confronted with a challenging social situation task, most Canadian participants attempted to understand the situation by referring to their own previous experiences, a finding not seen in the Polish sample. Their data did show a positive relation between ToM and self-concept, but only amongst the Canadian participants, with no such association seen in the Polish sample. It is interesting to note, however that their Canadian sample had a mean age of 10 years 4 months, and the Polish sample ranged between 16-17 years old. Bosacki and her colleagues (2015) speculated that the difference in results could suggest self-concept development and ToM development diversify along two different trajectories during adolescence.

A combination of recent experimental and fMRI studies have suggested further evidence to support the idea that, although independent, ToM and self-concept are related, although results regarding the possible direction of the causal relationship are mixed. As cited previously, Choudhury et al., (2006) found that when children, adolescents and adults performed the same perspective-taking tasks, the reaction time differences of using first-person perspective-taking and third-person perspective taking decreases with age, suggesting ToM ability improves during adolescence. Sebastian et al. (2008) hypothesised that it could be the strengthening coherence of the self-concept with age that is responsible for this increasingly better performance on ToM tasks: “adolescents might increasingly use the self as the basis for judging others” (p.442). In a longitudinal study of N=201 adolescents (N=105 early-adolescents aged 13-14; N=96 late-adolescents (aged 16), psychological self and advanced ToM were found to be positively, strongly related r_s = .57 in early adolescence, and r_s = .56 in mid-adolescence (Białecka-Pikul et al., 2020), further supporting evidence that ToM and self-concept are related. However, this study found ToM ability predicted growth of the psychological self (standardized coefficient =.73) in the early adolescent group, suggesting that “competence in advanced theory of mind facilitates the development of psychological self-understanding” (Białecka-Pikul et al., 2020. p.95). While acknowledging that this result only stands in relation to the ToM task they used, and that future research would benefit from longitudinal research with multiple data-points, this finding is novel in suggesting that it is advanced ToM that is responsible for facilitating development of self-understanding during adolescence (Białecka-Pikul et al., 2020). If ToM development during adolescence is responsible for the growth of the psychological self, it therefore further justifies exploring the relationship between ToM development and stability in career aspirations and vocational interests during adolescence. In relation to career development theory, those with earlier advanced ToM may benefit from earlier growth of the psychological self, which in turn may result in earlier experience of crystallisation (Super, 1990) or full circumscription (Gottfredson, 2002a).

The relationship between self-concept and vocational choice

Significant positive relationships have been found between self-concept and particular career choice in students internationally, such as in Nigeria (Otta & Williams, 2012; Salawu & Bagudo, 2008) and in an international school in Malaysia (Nasir & Lin, 2012). Otta and

Williams (2012) found that those individuals with high levels of self-concept made vocational choices in clerical, scientific and IT fields. Those with low self-concept chose artistic, musical, outdoor and mechanical fields. These results can be considered in relation to Gottfredson's (2002a) theory of circumscription and compromise: during the third stage of circumscription, young adolescents (aged 9-13) begin to incorporate their social class and ability into their self-concept, and when rejecting options that seem too difficult in relation to their perceived abilities, a 'tolerable-effort boundary' is set, which is unlikely to be changed (Gottfredson, 2002a). It could be interpreted that those individuals from Otta and Williams' (2012) sample with low self-concept choosing outdoor and mechanical fields have set their tolerable-effort boundary at a lower level, hence choosing occupations with lower levels of associated prestige and lower necessary ability.

These findings further support the need to consider the role of ToM on vocational interests and career aspiration choices, possibly via the development of self-concept. Numerous factors are involved in career aspiration choice, including self-perceived and measured ability, self-confidence for the future, socio-economic status and gender (literature reviewing these are found in Chapter 6). However, here we have presented evidence to suggest relationships exist between ToM and self-concept, and self-concept and vocational interests, but no direct assessment of the influence ToM development in adolescence may have on vocational interest and career aspiration stability. Our longitudinal research of mid- and late-adolescents aims to fill this gap.

Summary

ToM has been hypothesised to be associated with vocational interests for two possible reasons: the increased likelihood of better ToM ability being associated with an increased interest in working with people, and the role ToM plays in relation to vocational interest and career development related variables. While correlations between empathising abilities and vocational interests in people have been found (Svedholm-Häkkinen & Lindeman, 2016), these are in the general population, and not focused at the point in adolescence associated with career aspiration development. Considering this relationship during mid- and late-adolescence specifically is currently an unexplored area. Evidence of a relationship between these factors could possibly be a useful tool for career guidance, and will be explored both cross-sectionally and longitudinally in Chapters 4 and 5. Additionally, there is evidence of relationships between ToM and both prospection and self-concept, which may correspond with decision-making and career development. Possible associations between ToM and career aspiration and vocational interest stability, assessing the 'timing' aspect of careers guidance in relation to ToM will be explored in Chapter 6.

2.4 Birth order: an overview

Birth order, or ordinal position in the family, is a variable deemed 'ready-made' for use in social science research; it is both easily measured, and intuition suggests that it *should* be relevant in relation to behaviour and personality (Adams, 1972). Whether an individual is the eldest, intermediate-born or youngest sibling, and the lifelong impact this position has on intelligence and personality, has been studied extensively, controversially and inconclusively for over 100 years (Damian & Roberts, 2015a; Rohrer et al., 2015). Disputes regarding birth-order effects on both intelligence and personality traits are mostly grounded in differing methodological approaches, as seen in the different outcomes from using between-family data (comparing personality traits and intelligence across unrelated individuals of different birth-order rankings) compared to within-family data (comparing personality traits and intelligence between first- and later-born related siblings) (Damian & Roberts, 2015a).

According to Rohrer et al. (2015), the evidence from empirical research into the relationship between birth order and intelligence appears convincing, specifically that there is a slight decline in success in psychometric intelligence tests between first-born and later-born children. Bjerkedal et al. (2008), for example analysed intelligence test scores in relation to birth order both within and between families, and found strong evidence supporting intellectual performance decreasing with sibship size. Barclay (2015) similarly found evidence of birth order being negatively associated with cognitive ability amongst Swedish male military conscripts. However, Kanazawa's (2012) analysis of the UK National Child Development Study showed that when the number of siblings in a family is statistically controlled, there is no association between birth order and general intelligence. Instead, his analysis supports the admixture hypothesis, which states the statistical correlation between birth-order and intelligence is due to family size: firstly, because less intelligent parents are more likely to have more children, and secondly because there is an overrepresentation of smaller families in samples of first-born and second-born children (Kanazawa, 2012). He deems the suggested birth-order effect on intelligence a "methodological artefact of using between-family (cross-sectional) data to infer within-family dynamics" (Kanazawa, 2012. p.1157). However, Rohrer and colleagues (2015) utilised large datasets from the US, Great Britain and Germany, as well as both between-family and within-family data and still found evidence of first-borns scoring slightly higher on both measured and self-reported intellect - a statistically significant but small (~10% of a SD) effect. Controlling for age in within-family data, and sibship size in between-family data, as well as collecting independent self-reports from each sibling (as opposed to data from only one sibling per family as seen in most other within-family research), it has been suggested that Rohrer and colleagues (2015) conducted "the most methodologically sound birth order study to date" (Damian & Roberts, 2015a. p.14120).

Sulloway (1996) strongly advocated for a significant relationship between birth-order and personality, outlining differences in personality between first-borns and last-borns in his book *Born to Rebel,* utilising the Big Five personality traits (extraversion, agreeableness, openness, conscientiousness and neuroticism) as his framework. He claimed that first-borns are less open, less agreeable, and more conscientious, whereas last-borns are rebellious, more adventurous, and show higher levels of openness (Sulloway, 1996). Various studies have supported Sulloway's claims, one example being Michalski and Shackelford's (2002) analysis of self-report data from 438 young adults that noted the same negative relationship between agreeableness and first-born status. However, Sulloway's (1996) claims were heavily criticised, for example by Townsend (2000) who found multiple inconsistencies and contradictions in the data, unsupported by empirical research: the same analysis by Michalski and Shackelford (2002) found a positive relationship between first-born status and openness, thus contradicting Sulloway's (1996) claim that first-borns are less open than later-born siblings. Additionally, the recent, methodologically thorough, large-scale analysis conducted by Rohrer et al. (2015) analysed data of the following personality traits: agreeableness, emotional stability, extraversion, imagination and conscientiousness, and found no birth-order effects for any trait.

Sulloway (1996) used various sources to support his findings. Both infant mortality and the large age-gap that can occur between first- and second-born children can result in siblings that are 'functionally' only children despite their 'biological' place in the birth order (Sulloway, 2007). Sulloway (1996) used this distinction between 'functional' and 'biological' birth order as a fundamental basis for his evolutionary explanation for birth order effects, though once dissected, it appeared the investigations of the individual scientists used as examples to support his results varied in depth depending on how well they supported his conclusions, evidence of possible investigative bias (Freese et al., 1999). This concern was also expressed by Harris (2002), who added that researchers who mold their data to support their findings are more likely to avoid scrutiny if their conclusions confirm lay-beliefs. Damian and Roberts (2015a) supported this, writing that despite the emerging and strong scientific evidence suggesting there are no birth-order effects on personality traits (e.g. Rohrer et al. 2015), anecdotal evidence will always fuel lay beliefs that it must be birth-order, and could not be simply age differences, that are responsible for the varying personality traits displayed by siblings. In addition to the confirmation bias commonly associated with birth order studies, Harris (2002) outlined that those findings that disagree with birth order being responsible for any significant effect can be ‘explained away’, primarily due to the explanations being grounded in personality traits that are difficult to define. Using evidence of ToM development therefore provides an approach to understanding effects of birth order that tests a specific stage of psychological development, rather than personality traits that can be interchangeable, and difficult to define.

2.5 The relationship between birth order and ToM

Introduction

It is largely accepted that children’s ToM skills are transformed by their close relationships (Hughes & Leekam, 2004). In the earliest years of life, social interactions, and thus close relationships, are typically limited to those within the family. Much of the literature focuses on ToM development in pre-schoolers and the majority suggests evidence for a relationship between success on ToM tasks and the sibling status of children (e.g. Cassidy et al., 2005). This section will describe and critique findings from a number of these studies: those that suggest having both older and younger siblings provide an advantage in ToM development (e.g. Perner et al. 1994; Jenkins & Astington, 1996; Peterson 2000), those that suggest ToM development is related to birth order (e.g. Ruffman et al., 1998; Cassidy et al., 2005), and those that have found no significant link between sibling status and ToM development (e.g. Calero et al., 2013; Shahaeian 2015). Randell and Peterson (2009) have suggested potential branches of reasoning for understanding *how* having siblings could result in higher scores in ToM tasks, namely, sibling conflict and pretend play. These potential mechanisms will be briefly discussed, before considering the rather limited extant literature on ToM development and birth order in older children and adolescents.

Evidence of relationship between ToM and presence of siblings

Dunn et al. (1991) conducted some of the earliest work on the relationship between familial relationships and social understanding in children, including assessing the ability to use false belief understanding to explain actions in certain tasks. Their longitudinal study tested only second-born children at 33-months of age, and again at 40-months, and involved carrying out observations of each family and recording the interactions between each participant and their siblings and mother, as well as conducting false belief and affective perspective-taking tasks. Greater success in false belief tasks was found among children with more frequent experiences of seeing their mother exhibit controlling behaviour on an older sibling. Additionally, where children were more highly engaged in conversations about feelings with their siblings and mothers at 33-months, they performed at a higher standard in false-belief and perspective-taking tasks seven months later than those children who did not. Although this study drew out some of the possible reasons as to why having older siblings promotes ToM development, there are key limitations. Dunn and colleagues (1991) acknowledged that the correlation between children's success in perspective-taking tasks and their engagement in conversations is not necessarily direct, and also that their sample size was limited (N=50). Additionally, it was concluded that "the appropriate framework in which we should study developmental influences is that of the family, rather than solely that of a parent-child dyad" (Dunn et al., 1991. p.1364-5). However, the parent-child dyad *is* the family unit for both only children and first-borns: this study only involved second-born children. When exploring the role of the family in development, it is important to compare across varying birth order positions and consider how and why only children and first-borns may vary compared to later-borns.

Perner et al. (1994) built on this study focusing specifically on the impact of siblings on ToM development, and found their work complemented that of Dunn and colleagues (1991): three- and four-year old children brought up in larger families performed significantly better in false belief tasks than those in smaller families (Perner et al., 1994). In their second experiment within the same study, they assessed two-sibling families only, in order to assess the potential importance of birth order, but found older siblings provided no significant benefit (to their sibling) over younger siblings in promoting faster ToM development (Perner et al., 1994).

The suggestion that *more* siblings in a family, rather than older siblings, proves more beneficial in successful performance in ToM tasks at an earlier stage was further supported by Jenkins and Astington (1996). In their study, the ToM development of 68 three- to five- year olds was tested using four false-belief tasks, and a moderate positive correlation (r=.46) was found between family size and false belief understanding (Jenkins & Astington, 1996). A hierarchical multiple regression found that when both age and language ability were partialled out, it was only the *number* of siblings, and not birth order position, that was a significant predictor of false belief understanding (Jenkins & Astington, 1996). An important consideration in relation to these results is sample size: whilst there was a relatively even spread of number of siblings across the sample (22 were only children, 32 had one sibling, 13 had two siblings, 1 had three siblings), this does not correspond to birth-order groups. Only children are classed as first-born, so the group sizes were more uneven for birth-order position analysis (38 children were first-born, 24 were second-born, 5 were third-born, 1 was fourth-born). Larger sample sizes are required to fully analyse the impact birth-order position has on ToM development.

Whilst these early studies suggest it is the number of siblings, rather than the age of the siblings, that predicts ToM development, Peterson's (2000) examination of a larger sample (N=265 pre-schoolers) found no significant link between family size and success in false belief tasks. The study did, however, partially support the idea that the age of the sibling is not important; if the 'target' child being assessed has a sibling aged between 12 months and 12 years, their ToM development will advance significantly in comparison to that of only-children, regardless of their place in the birth order (Peterson, 2000). However, it was seen that those children with siblings that fall outside these perimeters (infants under 12 months or adolescent siblings aged 12-years and above) will benefit from no sibling advantage, and develop ToM understanding at a rate equivalent to that of only-children (Peterson, 2000). The importance of having a sibling past infancy but not yet a teenager, as well as the finding that the best performance on these false belief tasks was seen in middle-born children, suggests how it is being exposed to frequent and varied conversation with other *children* of multiple ages at home that promotes earlier ToM development (Peterson, 2000). For those pre-schoolers whose closest-aged siblings are teenagers or older, there are fewer opportunities for "distinctively sibling-based play than those whose siblings are younger" (p.449). A later study by McAlister and Peterson (2006) extended these findings, and noted that having a child-aged sibling positively correlated with a wider range of abilities: other aspects of ToM development (specifically understanding of pretence) in addition to false belief understanding, and executive functioning capacities (e.g. forward planning; the ability to resist distractions). Similarly to Peterson's (2000) conclusion, McAlister and Peterson (2006) suggest it is the rich social experience gained from interacting with a child-aged sibling that promotes both earlier ToM understanding and enhanced executive functioning capacities. Jenkins and Astington (1996) similarly emphasised the importance of observing and engaging in interactions but stated that the effect of attending preschool does not necessarily have the equivalent effect on false belief understanding as having siblings does. Their study found a positive correlation between family size and false belief understanding, but the majority of the children in their study attended nursery, so they concluded “it is unlikely…to be just simply exposure to other children that has the important effect” (Jenkins & Astington, p.77). This finding and conclusion are promising in relation to our research considering this relationship in adolescence, as we considered the possibility that there may be a ‘levelling out’ across individuals once they attend school.

Evidence of relationship between ToM and birth-order position

By contrast, Ruffman and colleagues (1998) found false belief understanding in a large, multicultural sample (444 children from both England and Japan) only positively correlated with the number of older siblings a child has, with younger siblings demonstrating no helpful effect. In considering the evidence from earlier studies, the authors suggested that the small sample size was responsible for the failure to find a significant association between birth order and ToM in Jenkins and Astington’s (1996) study. Contrastingly, in a study considering how ToM development is affected by birth order in children with autism spectrum disorders (ASD), O’Brien et al. (2011) found that there was a significant *negative* correlation between performance on ToM tasks and having older siblings. Although an anomaly amongst the studies of typically developing children, this study supports the idea that the involvement of siblings in creating a rich social experience may shape ToM development. In this case, however, the older siblings may not be allowing ToM to advance at its full potential in their younger autistic siblings due to overcompensating for them in social interactions (O'Brien et al., 2011).

Further supporting the potential importance of birth order in ToM development, Cassidy and colleagues (2005) studied twin and non-twin pre-schoolers (with a mean age of 47.8 months). They found that twins with additional non-twin siblings outperformed twins with no other siblings on false belief tasks (who performed at essentially the same level as only-children), and that children with no twin relations but other siblings outperformed both only-children and twins with no other siblings (Cassidy et al., 2005). This finding suggests that it is not simply the presence of another child that enhances false belief understanding, but instead supports Peterson's (2000) suggestion that being exposed to a variety of opinions and conversations, and thus a range of differently aged siblings, is most advantageous for ToM development (Cassidy et al., 2005). It is considered that parental attitude may be responsible for more limited ToM development in twins: the perceived differences parents see in their children likely shape conversation, and when these children are of the same age, it is hypothesised that parents feel less of a need to explain the viewpoints of one twin to another, in comparison to differently aged siblings (Cassidy et al., 2005). Family conversations may represent an important mechanism for developing ToM in children. It is important to note that this study was conducted with n=72 children, so when broken into different birth-order groups there were n=16 only children, n=25 non-twin children with siblings, and n=31 twins (Cassidy et al., 2005). Both the overall and subgroup sample sizes are therefore small and require testing in a much larger group.

Explanations for role of siblings in ToM development

Various possible explanations have been put forward as to why the presence of siblings promotes ToM development in pre-schoolers and young children: increased exposure to family conversations, pretend play, and sibling conflict. Exposure to family conversations has been briefly discussed previously, so this section will focus on pretend play and sibling conflict on ToM development.

Pretend play is a form of play in which children use their imagination to take on roles and create scenarios, such as pretending to be school teachers, doctors or princesses (Lillard, 1993), and is an activity that has been seen to benefit ToM development. Dunn and Cutting (1999) assessed 64 pairs of 4-year-olds and found positive correlations between cooperative pretend play and performance on false belief tasks. Looking specifically at the role siblings play, Hughes et al. (2006) assessed the performance on ToM tasks of n=111 2-year-old children, and also recorded them playing at home with their siblings, coding the sessions for reciprocal play, pretence and inner state talk. The kinds of inner state talk coded for in this study were desires, perceptions, emotions and cognitions, with significant correlations being seen between inner state talk and the frequency of pretence and reciprocal play with sibling. There were also positive correlations found between inner state talk and performance on ToM tasks, although once verbal ability was controlled, this correlation was no longer significant (Hughes et al., 2006). Pretend play provides rich opportunities for collaborative interactions, with the presence of siblings at home meaning there is even more opportunity to engage in this kind of play, likely enabling earlier acquisition of ToM in children (White & Hughes, 2018).

It has been argued that exposure to sibling conflict promotes ToM development. Foote and Holmes-Lonergan (2003) tested n=22 children (aged between 3 years and 5 years 8 months) on eight false-belief tasks, and they also participated in a play session with their sibling, during which their interactions were recorded and any conflict scored for both mental state talk and type of argument. Mental state terms referred to thoughts, knowledge or memories of the target child, their sibling, or another person (e.g. ‘know’, ‘understand’, ‘believe’). Arguments were scored as one of three categories: other-oriented argument (when the conversation takes into account the other person, possibly including compromise or agreement), self-oriented arguments (when the conversation involves only defending one’s position), or no use of argument (no justification or excuse is provided). It was found that success in false belief tasks was positively correlated with the proportion of other-oriented arguments (Foote & Holmes-Lonergan, 2003). Randell and Peterson (2009) found a significant association between ToM and affective aspects of sibling conflict, namely that children with higher false belief task scores conducted their disputes with siblings more amicably, ultimately displaying fewer angry or tearful responses during and post-conflict. It was suggested that children with better perspective-taking abilities may be able to recognise that conducting a dispute calmly as opposed to angrily would minimize long-lasting negative feelings amongst siblings (Randell & Peterson, 2009). Reversing the direction of causality, however, would suggest that it is the experience gained from conducting numerous sibling disputes that promotes an enhanced ToM understanding (Randell & Peterson, 2009). This argument of reverse causality could also be applied to Foote and Holmes-Lonergan’s (2003) study, and is something the authors themselves considered: “it could be that those individuals who performed well on the false-belief measures were more likely to use other-oriented arguments in conflict because of their more advanced sociocognitive abilities” (p.55). They argued longitudinal research would be beneficial to assess and clarify the direction of the correlation.

Evidence in school-aged children

There is a large gap in the literature regarding the relationship between ToM development and the sibling effect in children older than six-years old. Calero and colleagues (2013) examined ToM development alongside other factors, including birth order and number of siblings, in children aged between six- and eight-years old. Despite an interesting observation that girls perform significantly better than boys in the tasks at this age, there was no significant correlation between ToM development and birth order, nor number of siblings generally (Calero et al., 2013). Although the authors did not provide any explanation for why numerous studies have observed the sibling effect on ToM development in pre-schoolers, yet no such effect exists in these older children, it is possible that starting full-time education could be usefully considered as a relevant factor. It could be speculated that those pre-schoolers with child-aged siblings have full-time access to taking part in sibling disputes and pretend play, whereas only-children's social interactions are limited to the much less frequent time spent with their peers. When these children reach school age, however, it could be considered that social experiences tend to 'level out' across all children; there is a 'standard' level of social interaction all children are exposed to, and the sibling effect could potentially be too small to notice as the number of other important peer relationships develops throughout school.

Two relatively recent studies have suggested that the enhanced ToM development observed in adults compared to adolescents, described in the previous section, was likely to be due to the richer social experiences gained between adolescence and adulthood (Choudhury et al., 2006; Valle et al., 2015). Thus, although forming strong peer relationships and having access to school-related social interactions may result in a higher general standard of social experience for all school-aged individuals, with or without siblings, it could also be argued that having siblings during adolescence might promote an even richer social experience than that gained from school interactions alone.

Additionally, there is increasing evidence that siblings are important and powerful influences on other important outcomes, such as educational attainment, beyond preschool years and into early to mid-adolescence (White & Hughes, 2018). For example, Melby et al. (2008) conducted a large, longitudinal study of 451 families over 13 years, and found supportive sibling interpersonal relationships during adolescence were positively associated with educational attainment in early adulthood (participants averaged 26 years old). Sibling relationships being observed to remain important influences for other outcomes beyond preschool and early childhood age suggest the sibling relationship provides benefits that may not be gained from peer relationships alone.

Crucially, there is evidence of both ToM development during adolescence, and evidence of siblings having a significant effect on ToM development, yet almost no studies have considered the relationship between both factors at this important developmental stage. A potential exception to this is a study by Artar (2007) that explored egocentrism in 16 to 18 year olds in the context of familial relationships. However, the entire study was based on a sample of only 11 individuals, and analysis consisted of ToM task results being assessed against descriptions of relationships from interviews (Artar, 2007). Considering specifically the place in birth order against ToM development in adolescence has not been addressed and represents an important gap in the literature which the current study has been designed to fill.

2.6 Birth order and vocational interests

Introduction

Although there have been recent evaluations of the direct effect of birth order on vocational interests and occupational choice in the economic literature (Grinberg, 2015; Black et al., 2017), the psychological literature concerning this relationship is more limited. The data collection and analysis required to gain convincing evidence in all birth-order studies is challenging: large sample sizes are required, as is accounting for family size and socioeconomic status, conditions that numerous studies have not fulfilled, particularly when focusing on the relationship between birth-order and personality (Black et al., 2017; Ernst & Angst, 1983). Adlerian birth-order theory suggests birth-order position is crucial in the development of an individual's personality, which then impacts on their vocational behaviour (Adler, cited in Ansbacher & Ansbacher, 1958; Watkins, 1984), and Holland's (1985; 1997), Super's (1990) and Gottfredson's (2002a) well-established career development theories all refer to the importance of family in shaping vocational interests. There is clear acknowledgement across vocational psychology that vocational interests are related with personality traits (Hogan & Sherman, 2019), which supports the reasonable theory that birth order may play a role in the development of vocational interests, possibly in relation to personality. However, recent studies using large representative samples (Damian & Roberts, 2015b; Rohrer et al., 2015) suggest that the associations between birth-order and personality are minimal. As there is only a small amount of academic, current literature focusing on the relationship between birth order and vocational interest (e.g. Leong et al., 2001), this section includes discussion of related relationships: family environment and vocational choice; birth order and personality, and birth order and college major choice.

Why do siblings vary?

Despite sharing 50% genes, and typically being raised in the same socioeconomic background, there is often a great deal of variance in sibling outcomes (Rowe & Plomin, 1981; Plomin & Daniels, 2011). The difficulty with family research is distinguishing the role of genetics and shared environment: similarities seen between full-siblings born and raised in the same family may be due to their shared heredity, or their shared environment (Plomin & Daniels, 2011). Twin and adoption studies have provided the opportunity to consider the level of influence genes and environment have on sibling outcomes, with Plomin and Daniels (2011) arguing "the most important source of environmental variance is nonshared environment" (p.567). A number of non-shared environmental influences responsible for the differences seen between siblings include non-systematic reasons, such as illnesses or trauma, alongside systematic reasons, such as differential treatment from parents and other siblings (Plomin & Daniels, 2011). Another systematic influence, and the one explored in this research is birth order.

In relation to career development theory, Super (1990) placed great value on the development of an individual's self-concept, but also emphasised the importance of an individual's environment. Specifically, Super et al. (1996) highlighted the importance of family values and attitudes in influencing vocational choices. Similarly, Holland's (1985; 1997) theory of vocational personalities hypothesised that vocational personalities develop through childhood, with parent-child interactions playing an important role in this development. When considering birth-order, Super et al. (1996) argue that, assuming a family is grounded in the same values and attitudes when raising all the children in it, all children, regardless of birth order, should have largely the same values and attitudes. The same could be applied to Holland's (1997) theory that also refers to the importance of parent-child interactions. Of course, it is known that as families grow, priorities change and the time a parent has is split between their children, and therefore parent-child interactions can vary within a family. It is also unlikely that siblings will necessarily share the same values, or develop similar personalities, purely due to the familial environment in which they are raised. Siblings differ from one another, for genetic and environmental reasons, regardless of their shared experiences. Gottfredson (2002a) refers to this concept in her theory of circumscription, compromise and self-creation, outlining the passive genotype-environment correlations that can be found in biological families where the birth parents provide both the genes and the rearing environment for their children. Gottfredson (2002a) highlights that all individuals face the developmental task of moving from their birth niche to a life niche, success in which depends on both genetic and non-genetic factors. With age, as genetic and environmental effects interact, the niche becomes increasingly individual. Genes still play a very important role, with some individuals more genetically predisposed to respond to temptation, or others to guidance: “In this way, even siblings in the same household come to inhabit increasingly different – surprisingly different - worlds” (Gottfredson, 2002a. p.128). With one’s career development being shaped by both genetics and environment, Gottfredson’s (2002a) hypothesis suggests birth-order, in relation to the birth niche one is born into, could well be associated with vocational interests (as a non-shared environmental influence).

There are a number of possible explanations put forward outlining more broadly how birth order results in varying sibling outcomes. These theories span disciplines, notably economics, sociology and social psychology, and mostly focus on explaining outcomes in relation to educational attainment and cognitive ability (Riswick & Engelen, 2018), particularly the finding that those individuals with the fewest number of siblings demonstrate the best performance across various measures of cognitive ability and educational attainment (e.g.

Alwin & Thornton, 1984). One explanation put forward is the resource dilution hypothesis, which argues that parental resources (which have an important role in the educational success of their children) are finite, and that as the number of siblings within a family increases, parental resources are increasingly divided (Downey, 2001). Parental resources are not purely financial, but also include personal attention, teaching and opportunities to engage in activities (Blake, 1981). An alternative explanation was outlined by Zanjonc and Markus (1975), who developed the confluence theory, in which a child's intellectual ability is influenced by the overall, averaged intellectual level of the family setting they are born into. A first-born child will be born into a family setting in which only the parents' intelligence is averaged, but a second-born child will be born into a setting where it is not only the parental intelligence taken into account, but also the intelligence level of their older sibling, resulting in a family setting with lower average degree of intellectual stimulation (Zanjonc & Markus, 1975). As the pattern continues, "successive children may be born into an increasingly inferior environment" (Zajonc & Markus, 1975 p.76).

One key issue in birth-order research is the reliance on a between-family design, but more recent research considering the relationship between birth-order rank and educational attainment in a within-family design also found support for this association. Bu (2016) found first-born children also have higher educational aspirations and increased probability of gaining Further Education (FE) qualifications than their later-born siblings. Using data from 1322 sibling clusters (3088 individuals) obtained from the British Household Panel Survey (BHPS), Bu (2016) found first-borns are approximately 9% more likely to aspire to FE, and 12% more likely to gain FE qualifications, than their later-born siblings. The analysis found that this difference in educational attainment when comparing first-borns with later-born siblings was notably higher than for the difference seen between sexes (approximately 5%). Bu (2016) argues that “in this sense, birth order is a much stronger predictor than sex for FE attainment” (Bu, 2016. p.76).

Despite some of the pioneering, and more recent, empirical evidence supporting the general argument that that number of siblings is negatively associated with educational outcomes, there are key methodological problems with a large number of these studies (Guo & VanWey, 1999; Steelman et al., 2002). It has been argued that “the ostensible effect of sibship size on educational progress and other domains is upon closer inspection a function entirely of some other variable” (Steelman et al., 2002. p.253), with socioeconomic status being the most likely possibility. However, studies have shown that the negative relationship remains even when socioeconomic status is controlled for (e.g. Blake, 1989). By extending the cross-sectional studies and instead using change models on longitudinal data, Guo and VanWey (1999) were able to control for a number of variables largely disregarded by previous studies, such as family intellectual climate, family genetic heritage and family value system, over time. When the shared effects were controlled, Guo and VanWey (1999) found the negative relationship between number of siblings and intellectual development did not remain.

When evidence for a relationship between two variables is repeatedly found in empirical studies, it can present a convincing argument that it is likely there is a causal relationship between the two factors. However, as Guo and VanWey (1999) argue, if the variable is developmental and more sensitive to environmental influences at different ages, such as intelligence, longitudinal studies are needed to test these relationships fully. In addition to changes in intellectual development over time, Guo and VanWey (1999) also looked at this in relation to changes in sibship size over time. As our research is focused in mid- and late-adolescence, the likelihood of the participants sibship size or birth order position changing over time is low. However, the same fundamental argument applies to our research: evidence for the role birth order plays in the development of any trait, including vocational interests, is strengthened by being able to consider this effect over time. Longitudinal studies, such as ours, are crucial to understanding how traits and identities not only relate to birth order position, but develop.

There is a wide range of literature on the relationship between sibship size, birth order and both cognitive ability and educational attainment, and only a brief account is provided in this literature review to present some of the theoretical perspectives given as to the reasons why birth order position can contribute to varying sibling outcomes. However, as the focus of this study is on the effect of birth order position on vocational interests, the remaining literature focuses on the theoretical and empirical research regarding birth order position and personality, as well as birth order position and college major choice.

Birth order, personality and vocational choice

As stated previously, it is widely assumed that the relationship between birth-order and vocational choice is largely due to the varying personalities that develop because of birth-order position. The overlapping relationship between personality and vocational interests has largely been confirmed: Holland (1973), a major figure in vocational psychology, stated "If vocational interests are construed as an expression of personality then they represent the expression of personality in work, school subjects, hobbies….In short, what we have called 'vocational interests' are simply another aspect of personality" (p.7). Personality and vocational psychology have been connected both theoretically and empirically. theoretical angle, the socioanalytic theory perspective, links personality and vocational interests on the premise that "people are motivated to get along and get ahead" (Hogan & Sherman, 2019. p.193). From this perspective, the career goals of individuals and the strategies they use to both get along and get ahead reflect their identities, and how successful they are in these activities reflects their reputations (Hogan & Blake, 1996; Hogan & Sherman, 2019). Reputations, what people do, are assessed through personality assessment, whereas identities, the values and interests, the reflections of *why* people do these things, are assessed through vocational assessments (Hogan & Blake, 1996; Hogan & Sherman, 2019).

The relationship between vocational interests and personality traits has also been supported through meta-analytical studies. In their meta-analyses of 24 samples, Larson et al. (2002) found moderate positive correlations between some vocational interest domains and personality factors: among others, the vocational interest domain of Artistic moderately correlated with Openness (r=.48), and the interest in Enterprising moderately correlated with Extraversion (*r*=.41). Barrick et al. (2003) found similar results, with a moderate positive correlation between Extraversion and Enterprising (*r*=.41), and also a moderate positive correlation between Extraversion and the Social type (*r*=.29). Interestingly, the correlation between Agreeableness and the Social type was low (*r*=.15). Moving beyond only assessing Holland's six RIASEC vocational interest types, and the Big Five personality traits, Staggs et al. (2007) conducted a meta-analysis on studies that measured more precise levels of vocational interests and personality traits. Their analysis of N=2023 participants explored the relationship between results from larger, more specific vocational interests measures, such as the Basic Interest Scales and Strong's General Occupational Themes (Strong; Hansen & Campbell, 1985), and more specific personality measures, such as the Multidimensional Personality Questionnaire (Tellegen, 1982, 2000; Tellegen & Waller, 2008 (was in press at time of Larson et al., (2002) writing)). Again, a variety of moderate to strong correlations were found: for example, correlations ranged from *r*=.29 to *r*=.49 between Social Potency and various

Enterprising scales (Staggs et al., 2007). While there is clearly theoretical and empirical evidence to suggest there is a relationship between some personality traits and vocational interests, and overlapping similarities, it is important to clarify they are not interchangeable, identical constructs (Barrick et al., 2003). There is, however, much more research conducted specifically on the relationship between birth order and personality, which will be explored in the following subsections.

2.6.1.1 Adlerian vocational theory

Adlerian vocational theory posits that birth-order position plays a crucial role in a child's character development. Adler (cited in Ansbacher & Ansbacher, 1958) described in detail the different characteristics that develop in children based on their birth order position, and their subsequent experiences. For example, he described the ordeal of being 'dethroned' by the arrival of a second-born results in first-borns that understand and value power and authority and, by extension, rules and laws. According to Adler, when secure in their position, sure of their parents' affections, first-borns develop characteristics that imitate their parents, which might include a desire to protect, organise and teach. The first-born acts as a 'pacemaker', which, according to Adler, results in the development of a very competitive, stimulated and determined nature in typical second-borns. Adler writes that second-born children rarely accept laws and do not tolerate strict rules or leadership from other individuals, although alternative interpretation could suggest second-borns should be more likely to accept strict rules or leadership because they are accustomed to their sibling's 'rules'. There are further discrepancies and contradictions found within Adler's work. For example, the youngest child is described as the most pampered, which can lead to the development of a rather helpless individual that struggles to be independent and relies on others to give their life shape (Dreikurs, 1953). However, Adler argued that the youngest is also often the most stimulated and has most competition, so is often seen to excel and overcome all their older siblings (Ansbacher & Ansbacher, 1958). Although Adler provided these general summaries of the differences between eldest, second-born, youngest and only children, he also stressed that a child's specific number in the birth-order itself is not responsible for differing character development, but that the most influential aspect is "the situation into which he is born and the way in which he interprets it" (cited in Ansbacher & Ansbacher, 1958. p.377). Adler here is describing the importance of the psychological position as opposed to ordinal position in the birth order. For example, if siblings have several years between them, and thus limited direct interactions, each child will be at substantially different stages of cognitive development (Carlson et al., 2006), and both children would develop some characteristics of being an only child (Ansbacher & Ansbacher, 1958).

Adlerian theory appears to support Gottfredson's discussion of the role genetics and environment play in shaping vocational behaviours, with Watkins (1984) writing that a child's ordinal position, and the coinciding personality characteristics that Adler proposes develop, alongside the specific interactional familial events the child is exposed to, influences work style and vocational behaviour. Specifically, parental expectations, demands and even privileges can differ across birth order, which has been suggested to affect the view one has of themselves as a worker, and their interpersonal work style (Watkins, 1984). An example is seen in the first-born child, where parental expectations of responsibility and leadership are most heavily felt, one supported by various studies: Bryant (1987) studied 163 female students aged 16-17-years and did in fact find that first-borns scored higher than last-borns in vocational preferences for teaching and business management.

Adler's theory that personalities are shaped by birth-order has been met with both support and criticism, in the decades of research that have followed his publications. Some of the criticism focuses on specific aspects of Adler's hypothesis, for example Green and Clark (1970) investigated and disputed Adler's claim that there is a more profound effect on the personality of an individual if there are fewer than three years between them and their sibling. In fact, in their analysis they noted that only the sample that included individuals with siblings born *over* three years apart showed any significant relationship between birth order and personality (Green and Clark, 1970). This analysis thus places higher value on ordinal birth order regardless of the age difference between positions. However, Eckstein et al. (2010) found that research that is heavily reliant on strict ordinal position is further challenged in situations where there is a death of a child, or the presence a mentally disabled child, as psychological roles within the family may well be altered in these cases. They also emphasized further complexities that arise within ordinal positioning in blended families, where step-siblings disarrange both the ordinal *and* psychological position. Thus, studying blended families makes "assessing the subjective nature of the individual's birth-order position paramount" (Eckstein et al., 2010. p.410). It is therefore important when recording the birth order of individuals to ensure all siblings, including step-siblings, are accounted for.

Limitations of studies exploring the relationship between birth order and personality go beyond spacing between siblings and assessing the 'psychological' birth order position of individuals. A review conducted by Eckstein et al. (2010) of findings from 200 birth-order studies reflects some of the key limitations and inconsistencies found in the literature when assessing the relationship between birth-order and other characteristics. In their review, first-born children were seen in 23 studies to be the most intellectual and academically successful (e.g. Boomsma et al., 2008), with a further nine studies finding a significant relationship between being a first-born and likelihood of being a leader (e.g. Hudson, 1990; Newman & Taylor, 1994). Five more studies found that first-borns are most likely to become politicians (e.g. Andeweg & Van Den Berg, 2003), with another two showing female first-borns are significantly more likely than middle-born, later-born or only children to gain leadership positions (Eckstein, 1978; Eckstein & Driscoll, 1983). Middle-born children were significantly more likely to be sociable (e.g. Salmon, 2003), and to have most success in team sports (e.g. Sutton-Smith & Rosenberg, 1968). The review also found five studies showing statistically significant relationships in youngest children: they are more likely to be more artistic and less scientific (e.g. White et al., 1997), and are also more likely to choose activities that involve social interplay (e.g. Dimond & Munz, 1967).

The focus of Eckstein et al.'s (2010) review is defined as 'lifestyle characteristics', and when attempting to draw out the studies that have some relationship to vocational interests, the links are tenuous, for example, that middle children are more likely to be sociable or more successful in team sports. Furthermore, even of the studies that are both statistically significant and specifically related to career development and choice, such as first-borns being most likely to become politicians, these are based on analysis of occupational outcome. For example, Andeweg & Van Den Berg's (2003) study assessed 1350 Dutch councillors, and compared their birth order with the birth-order distribution in the general population. Whilst this comparison eliminates any potential bias, a study based on occupational outcome disregards the career pathway, the actual vocational interests, or the personality development that has led to such an outcome. Furthermore, with the notably simple questionnaire Andeweg and Van Den Berg (2003) used, (composed of four questions: do you have an older/younger brother/sister?), there was no reference to specific birth order position. This heavy focus on the outcome, as similarly seen in the cases of using historic figures such as Wagner and Schubert's (1974) analysis of presidents of the USA that found first-borns more likely to be politicians, and the assumed personality traits responsible for that outcome, arguably does not provide evidence for the relationship between birth order and vocational interests.

Whilst Eckstein et al.'s (2010) review provides evidence that statistically significant associations between birth order and certain personality traits exist, the findings should be cautiously interpreted. The review does not explicitly state the effect sizes of the findings of the studies included, instead only presenting studies that showed significant differences by birth-order rank (Eckstein et al., 2010). Additionally, birth-order studies that found non-significant results were excluded from the review. In this regard, the review merely presents which themes have most consistently appeared in birth order studies between 1960 and 2010. These themes are broad, and do not help to clear up the ambiguity and lack of consistency of the literature regarding birth order.

Recent large-scale birth-order studies set out to assess the relationship between birth order and personality traits have largely discredited the association. Damian and Roberts (2015b) tested the relationship between birth order and both personality traits and intelligence in a substantial, representative sample (N=377,000) of high school students in the United States. Controlling for the many potential cofounds that numerous previous birth-order studies neglected, including family structure, sibship size, age, sex and socioeconomic status, their between-family design found a very small association between birth order and personality (r=.02), and a slightly higher correlation between birth order and cognitive ability (r=.04). They considered the correlation with either variable so small that they deemed birth order unimportant as a predictor of either factor (Damian & Roberts, 2015b).

Further large-scale research conducted by Rohrer et al. (2015) used three large national panels

– from the United States, United Kingdom and Germany – to form their database (total N=20,186) in which the relationship between birth order and both personality and intelligence was assessed. Such a large sample provided sufficient statistical power to detect even the smallest effects of birth order on personality and intelligence. Similarly to Damian and Roberts (2015b), Rohrer and colleagues (2015) consistently found no significant birth-order effects on personality (including agreeableness, extraversion, and imagination), despite using both within-family and between-family designs. With such large samples, and thus having such high statistical power, it is difficult to ignore the absence of a significant relationship between personality and birth order. They did, however, find that with each decreasing birth-order position, both self-reported and objectively measured general intelligence significantly declined by a 10^{th} of a SD. Essentially, according to this analysis, there is a small but significant effect of birth order on intelligence: first-borns score highest. Despite the lack of significant effect of birth order on personality traits, the relationship between birth order and intelligence may be influential in the relationship between birth order and vocational interests, which will be explored in the next subsection.

Birth order, intelligence and vocational choice

There are no single studies of birth-order, general intelligence and vocational interest, to our knowledge. Pässler et al. (2015), however, conducted a meta-analysis of the relationship between vocational interests, specifically Holland’s RIASEC themes, and cognitive abilities, including general intelligence. Similarly, Leong et al. (2001) considered the relationship between birth order and vocational interests, again utilising Holland’s RIASEC themes. Combining the results of these studies suggests first-born children are more likely to have high scores on the Investigative vocational interest theme, largely in relation to levels of intelligence.

Pässler and colleagues (2015), in their large meta-analysis (N = 55,297), concluded that Realistic, Investigative and Artistic interests were positively associated with various cognitive abilities, but only negative relationships were found between Enterprising and Social interests and cognitive abilities. More specifically, meaningful positive relations were found between Investigative interests and general intelligence, *g* ($\rho = 0.28$), as well as more specifically verbal ($\rho = 0.21$) and numerical ability ($\rho = 0.25$).

While these correlations found by Pässler et al (2015) are relatively small, another study looking at occupational interests and vocational personality type has found evidence to possibly support the relationship between scoring highly on the Investigative theme and intelligence – via birth order position. Leong et al (2001) conducted two studies of undergraduates in the US: one with a sample of 159 second-year medical students (age range of 21 to 40 years, with a mean age of 25.6 years), and another with 119 undergraduate students (mean age of 20.9 years) majoring in a broad range of academic fields. Compared to the large meta-analyses previously discussed, both samples are rather small and cannot be said to represent the general population. While no significant results were found concerning the relationship between birth-order position and vocational personality type in the sample of undergraduates in various academic fields, significant birth-order position differences within the sample of medical students were found. Only children scored significantly higher on the Investigative theme than either first-borns or later-borns. Considering the Investigative theme alone: both verbal and numerical ability are shown to be have small but significant associations with scores on the Investigative theme (Pässler et al., 2015), and only-children have been found to score significantly higher on this theme than any other birth-order group. It is therefore plausible that birth-order position, specifically being a first-born only child, may promote interest in the Investigative field, and this is possibly influenced by higher levels of intelligence.

Birth order position and occupational choice

Birth order literature is characterised by its inconsistent findings, yet through a combination of speculation, personal experience and research, people tend to agree with birth-rank stereotypes, particularly in relation to personality traits and occupational choice (Ernst & Angst, 1983; Harris, 2002; Herrera et al., 2003). In their study measuring the association between stereotypical views of personality traits and occupations of different birth-order ranks and actual measured personality and occupational differences in birth-order position, Herrera et al. (2003) found correspondence between the factors. Specifically, first-born children were perceived to be highly intelligent, whereas last-borns were perceived to be most creative, a finding supported in the results of the second study: first-borns were expected to become lawyers and physicians, whereas creative roles such as artist and musician were perceived to be more likely to be taken on by last-borns. The levels of occupational prestige seen to actually be attained by the different birth ranks supported these perceptions, with occupational prestige decreasing as birth order position increases (Herrera et al., 2003). This study does not necessarily prove that stereotypes are accurate representations of the reality – in fact, it could be the case that people's stereotypical beliefs about birth order differences may shape parental expectations, which in turn may shape children's behaviour, which strengthens their stereotypical beliefs further (Baskett, 1985; Herrera et al., 2003). However, the finding that occupational prestige decreases as birth order rank increases suggests there may be an actual association worth investigating further.

While there is possible evidence that occupational prestige decreases as birth order rank increases, evidence that this is due to the different vocational interests individuals develop is more limited. Investigations into the relationship between birth order position and actual occupation, and not simply occupational prestige, are necessary. A recent large-scale study conducted on birth-order position affecting college major choice suggests there is evidence to support Herrera et al's (2003) findings (Barclay et al., 2017). Barclay et al (2017) studied cohorts born between 1982 and 1990, sourced from the Swedish administrative register data (effective sample size of 146,107). When comparing siblings from within the same family, first-borns were found to be more likely than later-borns to apply to law, life sciences, long-term engineering programmes, whereas later-born siblings were found to be more likely to make applications for art, business, and journalism (Barclay et al., 2017). When considering entry into medical training programmes (MTPs), taking into account the baseline probability of applying to MTPs being 7.4%, in relative terms there was a 27% difference in likelihood of applying to MTPs between the first-borns and second-borns, and a 78% difference when comparing first-borns with fifth-borns (Barclay et al., 2017). Figure 2.1 (below) shows the relative probability of applying to different courses as birth order rank increases. These birth order effects persist mainly in high-SES families: the main effects that persist from low-SES families is the decreased likelihood of later-born siblings applying to longterm engineering and professional health programmes, and increased likelihood of them applying to business programmes. Importantly, this study used Swedish administrative register data: Swedish education is state-funded, including at tertiary education, so the birth order differences seen can be assessed in relation to individual differences between siblings, and are "not driven by the exhaustion of family financial resources by earlier-born siblings" (Barclay et al., 2017. p.652). In fact, the authors argue the results would likely be more pronounced in countries with tuition fees – particularly in relation to the most expensive degrees such as medical programmes, where later-borns may be at a disadvantage due to financial reasons (Barclay et al., 2017).

The findings of Barclay et al's (2017) study suggest differences in college major choice do exist between siblings, although they found GPA did not fully mediate this relationship. The authors argued that, in line with Bu's (2016) recent within-family research, it could be the influence of educational aspiration, rather than academic achievement, that is responsible for this difference: "If first-borns are more ambitious than later-borns, this could contribute to the explanation for why they tend to apply to college majors with greater expected earnings and college majors that lead to professional careers" (Barclay et al., 2017. p.653).

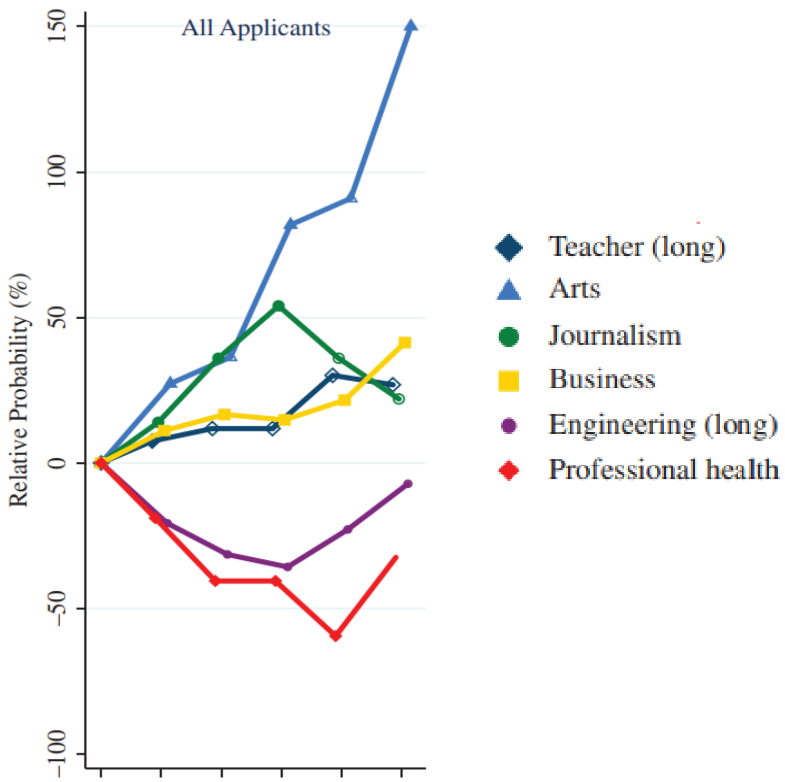


***FIGURE 2.1** RELATIVE PROBABILITY OF COLLEGE MAJOR CHOICE APPLICATION BY BIRTH ORDER POSITION (BARCLAY ET AL., 2017)* COPYRIGHT © *IS HELD BY THE AUTHORS*

Summary

As shown throughout this literature review, the impact of intelligence, educational aspiration, and available resources are often put forward as an explanation for the differences seen between birth order ranks and occupational choice, but the potential role vocational interests specifically play has largely been neglected. While there are clear similarities between vocational interests and personality traits, (although associations between birth order position and personality have largely been discredited through the use of large-scale meta-analyses (e.g. Damian & Roberts, 2015b; Rohrer et al., 2015)), there is a gap in the literature considering the relationship between birth order and vocational interests. The limited existing literature points towards finding associations between only- and first-born children demonstrating interest in Investigative roles, but our study will also explore the role ToM plays. As explained in the previous subsections, there is reason to believe later-born children may possess better ToM ability than first-born children. Additionally, there is further evidence to suggest there is a relationship between empathizing, of which ToM plays a role, and vocational interest in People-based roles. We hypothesized that later-born children may demonstrate stronger interest in People, a relationship possibly mediated by better ToM ability.

While the literature suggests there could be associations between birth order and vocational interests, and ToM and vocational interests, this is a largely unexplored area. Additionally, the effect of birth order on ToM, while assessed in pre-schoolers and young children, is again largely unexplored in adolescence. Finally, there is a need for further exploration of ToM development in adolescence – research in this area is limited but growing, however there is still a particular paucity of longitudinal research. This thesis therefore aims to address these gaps through three interrelated studies. Both Study 1 and Study 2 investigate the development of ToM ability in adolescence, with Study 1 employing a cross-sectional design to compare mid-adolescent (Year 10 students) and late-adolescent (final-year university student) groups, and Study 2 longitudinally assessing ToM development in mid-adolescence, returning to test the Year 10s in Year 11. Study 1 investigates the associations between ToM and birth order in both the mid-adolescent (Year 10) and late-adolescent (final-year university student) sample, with Study 2 investigating the possible longitudinal effects of birth-order on ToM development in mid-adolescence (having returned to retest the Year 10 students one year later in Year 11) . Study 1 additionally cross-sectionally investigates the associations between birth order and vocational interests in the mid-adolescent and late-adolescent group, with Study 2 again investigating the longitudinal effects of birth order position on vocational interest change in the mid-adolescent group. The possible influence of ToM on vocational interests is explored across all three studies: in Study 1, a cross-sectional approach is taken to assess whether any relationships exist between ToM and vocational interests in both the mid-adolescent and late-adolescent group. Study 2 investigates the longitudinal effect of ToM in Year 10 on vocational interest choice in Year 11. Study 3 additionally explores the effect of ToM on the stability of the vocational interests, as well as assesses whether ToM performance predicts change in the vocational interest of People (Study 3 is based in Gottfredson's (2002a) theory of circumscription and compromise, and includes a full literature review outlining additional reasons for exploring ToM in relation to vocational interest stability and change in relation to this theory and other relevant research).

Together, the three studies contribute to addressing the gaps in the literature: assessing ToM development cross-sectionally and longitudinally in adolescence, exploring the influence of birth-order position on ToM in adolescence, assessing whether a relationship exists between birth-order position and vocational interest, and investigating the role of ToM on vocational interest choice, stability and change.

3 Methodology

3.1 Methodological approach

The study used a correlational design and gathered data from two samples: Year 10 students and final year undergraduate and postgraduate students. A longitudinal approach was taken, by returning to test the Year 10 sample a year later when they had progressed to Year 11. The use of Year 10 and Year 11 students was chosen for two reasons: 1) Year 10 and 11s are aged between 14 and 16 years old, an age where it is suggested significant cognitive development occurs (e.g. Sebastian et al., 2012), and the longitudinal approach would enable us to map the presence and speed of this development of the same individuals and; 2) at Year 11, important career choices are made, regarding further education or training choices. Similarly, final year undergraduate and postgraduate students were chosen as most will be applying to graduate schemes or making serious decisions regarding the industry they would like to enter, as well as representing a late-adolescent group in order for us to make cross-sectional comparisons. A maximum age of 24 was imposed on the final-year university student sample, as including mature students could impact both the ToM development and vocational interests data: the final-year university student sample was representative of the period of 'late-adolescence' in this research, which has recently been defined to end at the age of 24 years (Sawyer et al., 2018).

A longitudinal approach was also implemented with the final-year university student sample, though due to the impracticality of getting the same students to return to York for testing, the second wave of data collection for the university student group only included an online follow-up questionnaire, with no in-person testing (no follow-up ToM data was collected for this group). It was intended that both samples would have an even distribution of males and females, in order to note any statistically significant differences between sexes across the tasks. This was achieved in the Year 10 (mid-adolescent) group, but the university group had an uneven distribution, with more female than male participants. Specific participant details are outlined in section 3.2 below.

3.2 Participants

Participants were *N*=164 (62 male and 102 female) adolescents. Of these, *n*=91 (46 male and 45 female) were Year 10 pupils (mid-adolescents) and *n*=73 (17 male and 56 female) were final-year university students (late-adolescents).

Year 10 students were recruited from three non-selective comprehensive secondary schools in England. At the first wave of data collection, mean age was 14.97 years for the total Year 10 sample (SD=.41, range =14.31-16.29), with the mean age for male students being 14.98 years (SD=.43, range =14.31-16.29) and the mean age for female students being 14.96 years (SD=.40, range =14.31-16.07). Parental consent to participate for the Year 10 group was received from 95 parents: two students were ill on the day of testing, one student had to leave school for an appointment and one student did not consent to taking part in the research after reading the information sheet. Children with an Autism Spectrum Disorder (ASD) have been found to have difficulties attributing mental states to others (Baron-Cohen et al.,1985), and even when using age-appropriate tasks, adults with autism also show Theory of Mind difficulties (e.g. Jolliffe & Baron-Cohen, 1999). We therefore checked with schools to ensure that no students had been diagnosed with an Autism Spectrum Disorder and none had. Participation in this study was on a voluntary basis, and none of the Year 10 participants were paid for participation.

Final-year university students were recruited via personal contacts, posts on social media and face-to-face recruitment in a university library. Mean age was 21.93 years for the total university final sample (SD=1.14, range=20.30-24.72). All students were in the final year of their undergraduate or postgraduate degree and spoke English with native level fluency. No students had been diagnosed with an Autism Spectrum Disorder. Participants were offered the opportunity to have their names entered into a draw to win one of six prizes (1x £50 shopping gift card and 5 x £10 shopping gift cards), which all participants took.

3.3 Measures

Affective and Cognitive ToM

ToM measures considered

Assessing ToM development in adolescents has required the development of new tasks that can accurately record perspective-taking abilities using techniques that are age-appropriate and do not have ceiling effects. Although most adolescent ToM studies use the same 'mindreading' premise, they do vary in their methods. While some studies use story-based false-belief tasks (e.g. Valle et al., 2015), others use computer-simulated tasks. Story-based tasks were discounted as options largely due to the lack of time limits on such tasks: computer-simulated tasks had a guaranteed maximum length of time, which was an essential ethical consideration when taking students out of lessons. Additionally, story-based false-belief tasks are more demanding on reading ability, requiring participants to analyse the meaning of sentences in order to infer mental states (Baker, Peterson, et al., 2014).

Dumontheil et al. (2010) developed a computerized task to assess cognitive ToM development in adolescents. In this task participants are asked to 'move' objects in a computer-simulated

4x4 set of shelves and are scored on both reaction time and mean accuracy of response. The task (and research design) incorporates two different conditions, one in which a ‘director’ is present and one without a director. In the ‘Director’ condition, there are different objects distributed on eight of the shelves, with five of the 16 slots blocked from the director’s view. The shelves are displayed for 2 seconds, before instructions are given through an audio headset requiring the participant to use the perspective of the director on the other side of the bookshelf to move objects (Dumontheil et al., 2010). On the basis of Dumontheil et al.’s (2010) findings it was estimated that 20 minutes should be allowed to administer this task to an individual participant, including time for reading the instructions and conducting a practice trial. This task was not chosen for two reasons: the length of time required to administer it was too long for testing in schools, and secondly due to the task only measuring cognitive ToM (and not affective ToM).

Other computer-based tasks have been developed to assess emotional-affective ToM development in adolescents. Choudhury et al. (2006) used a computerized task to measure how reaction times differ between answering questions in the first person and answering them in the third person. Similarly to Dumontheil et al. (2010), their task used visual stimuli, with participants choosing the face with the emotion that most accurately reflects the answer the participant would give, meaning the response time was not affected by verbal ability (Choudhury et al., 2006). In total, there are 120 stimuli in this task, with one stimulus involving: a sentence (e.g, ‘A girl is not allowed to go to her friend’s party’), a question (e.g. ‘How does she feel?’), and then two possible emotional response options (e.g. a sad face and an angry face), which are split into four blocks of 30 stimuli (Choudhury et al., 2006). Each block takes approximately two minutes to complete, thus the whole experiment takes eight minutes, excluding practice stimuli and time for instruction (Choudhury et al., 2006). Keulers et al.

(2010) utilised a similar computer simulation design, termed the Maastricht Mentalizing Task (MMT), which also presents hypothetical situations to participants to assess reaction time differences in responses regarding either first or third person perspectives. In their task, a hypothetical situation appears on the computer screen (e.g. "During a play you forget your lines"), with a question beneath it (e.g. "Do you feel embarrassed?"), to which the participants are instructed to press the spacebar once they have thought about their answer. After the spacebar is pressed, an answer screen appears for participants to indicate their answer, pressing 1 for 'Yes' or 5 for 'No'. With 72 items (36 first and 36 third person perspectives), and a maximum time allowance of 16.5 seconds for each item, the whole task should take approximately 19 minutes and 48 seconds. In this task, the reaction time measured is the time taken between reading the question and pressing the spacebar, thus measuring the 'thinking' time taken to decide on an answer (Keulers et al., 2010), whereas Choudhury and colleagues (2006) measured reaction time as the time taken between seeing the answer screen and selecting the answer by pressing the key. Keulers and colleagues (2010) address this difference in reaction time measures, stating that measuring thinking time rather than reaction speed in selecting an answer is a more accurate reflection of real-life situations of perspective taking. While measuring thinking time would provide data that more accurately reflects real-life interactions than measuring reaction speed, this measure again is both demanding on reading ability, and was similarly too long.

Sebastian et al. (2012) used a computer-based cartoon vignette paradigm to assess both cognitive and affective ToM development in adolescence. This approach had the benefit of reducing demands on reading ability, compared with other measures, and had one of the shortest task times (approximately 9-10 minutes) (Sebastian et al., 2012). The task is outlined in full below.

Chosen method

The study employed a computer-based cartoon vignette paradigm developed by Sebastian et al. (2012), which assesses both cognitive and affective ToM development. The ToM computer task runs on Cogent 2000, a toolbox of MATLAB that presents stimuli and accurately records response times.

There are 10 cartoon scenarios designed for each condition (Cognitive ToM, Affective ToM, and Physical Causality), each portraying two individuals within three story-frames, and a final screen with two choices of ending. The task begins with an instruction screen saying "What happens next?", followed by the three story-frames, which are then each followed by a 'chosen ending' screen in which the participant selects the one ending out of two options that they deem most appropriate using a keypress. The affective ToM trial required participants to infer how a character would respond to another character's affective state, and the cognitive ToM trial required participants to infer how a character would act, based on the character's intentions or beliefs. The physical causality (control) trial requires no understanding of mental states, and instead only requires an understanding of cause and effect, e.g. sunshine melting a snowman (Sebastian et al., 2012).

The order of these three conditions is randomised for each participant. The task consists of 30 cartoon trials, displayed in five sets of six trials, with each trial lasting 15 seconds, and 15 seconds between each set, thus a total task time of approximately 9-10 minutes (Sebastian et al., 2012). See Figure 3.1 for examples of the cartoon vignettes used in the ToM computer task.

This approach has the benefit of reducing demands on reading ability, compared with a written vignette design. It is an easily understood task, and suitable for use with both adolescents and adults: Sebastian et al (2012) used the same task for adolescents (aged 11-16) and adults (aged 24-40). It is also fast to conduct, which was particularly important in the context of a secondary school setting where minimising the time each student was taken out of their lessons was vital.

Across the whole sample at Wave 1 of data collection, there was a good level of internal consistency across the reaction times and error rates for Affective ToM, Cognitive ToM and Physical Causality conditions, as determined by a Cronbach's alpha of .791, .753 and .707 respectively. At the second wave of data collection, there was a good level of internal consistency across the reaction times for Affective ToM, Cognitive ToM and Physical Causality conditions, as determined by a Cronbach's alpha of .835, .817 and .809 respectively.

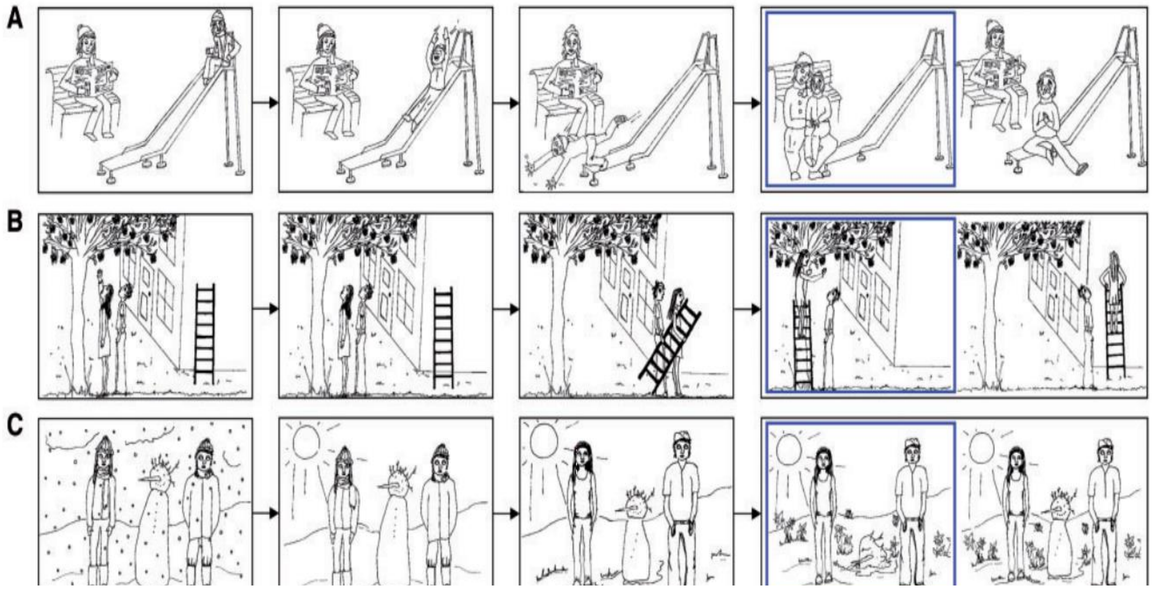


FIGURE 3.1 EXAMPLES OF THE CARTOON VIGNETTES USED IN THE TASK FOR AFFECTIVE TOM (A), COGNITIVE TOM (B), AND PHYSICAL CAUSALITY (C) CONDITIONS (SEBASTIAN ET AL., 2012) COPYRIGHT © IS HELD BY THE AUTHORS. FIGURE MADE AVAILABLE FOR REUSE UNDER A CREATIVE COMMONS LICENSE (CC BY-NC LICENSED: PERMITTING REUSE FOR NON-COMMERCIAL PURPOSES)

The high level of internal consistency remained in the Affective ToM condition when error rate scores were also included in the analysis (Cronbach's alpha based on standardized items=.793), however for the other conditions the Cronbach's alphas based on standardized items were just below the recommended value of 0.7 (DeVillis, 2003): for Cognitive ToM=.640, for Physical Causality =.681.

Vocational interests and self-confidence for the future

Vocational interests measures considered

A number of vocational interest measures were considered to be used in this study.

Some measures were discarded as options due to the age: for example, the most recently revised version of Holland's Vocational Preference Inventory (VPI) is from 1985, so remains a simple, self-administered, paper inventory (Holland, 1985; McDermott & Dell., 2013). The test is comprised of 160 occupations, of which participants mark *yes* or *no* depending on their interest or disinterest in the occupation. Being the original test for assessing Holland's RIASEC themes, there is obviously a decent fit with assessing vocational interests in relation to existing literature. However, McDermott and Dell (2013) have commented that evidence for both the validity and reliability of the inventory are considerably outdated, with a large amount of the validity evidence being over 30 years old. With an inventory that has not been updated since 1985, it does not acknowledge nor reflect the dramatic technological developments and changes in the labour force, particularly seen in its use of traditional gender roles in classifying certain vocational interests (McDermott and Dell, 2013).

There are many vocational interest measures that are available to the general population, but are not necessarily suitable for use in academic research. For example, The Unisex Edition of the ACT Interest Inventory (UNIACT), the most recent of which was published in 2009 (ACT, Inc. 2009). The UNIACT is based on the framework of Holland's (1997) six RIASEC basic interest scales, with 12 items per scale, and thus a total of 72 items. Instead of being presented with a list of occupations, vocation-related activities are listed (e.g. drawing cartoons, or exploring a science museum), accounting for the fact that some individuals are unfamiliar with or have incorrect perceptions of certain jobs. Participants are required to answer using a three-choice response format, selecting whether they like, dislike, or are indifferent to the activity presented. In the 1995 edition, there were 90 items, which typically took participants 10 to 15 minutes to complete (Prediger & Swaney, 1995), thus with the revised version having fewer items, the length of time required would be even shorter. Another benefit of the UNIACT is that there are two versions, Level 1 (designed for adolescents in grades 8-12) and Level 2 (intended for postsecondary college students and adults), which would prove useful when ensuring the measures used are age-appropriate in both samples of this study. Still, there are 60 items in common with both Level 1 and 2, which means a large majority of the results would be comparable between the samples (ACT, Inc., 2009).

The UNIACT has been designed for career counsellors to utilise, and its intended use is for adolescents and young adults to find the career most suited for them, and therefore not to be used as a psychological research measure. However, it can be countered that vast numbers of studies assessing the reliability and validity of the UNIACT have found good evidence in support: Savickas et al. (2002), for example, found strong evidence of both convergent and discriminant validity for UNIACT in their study of interest inventories (ACT, Inc., 2009). There is consistent evidence to support UNIACT being in accordance with Holland's theory, with the most recent edition of the UNIACT manual listing all the studies supporting the UNIACT scale structure in relation to Holland's theory, data that represents over 215,000 individuals (ACT, Inc., 2009). However, attempts to locate peer-reviewed papers that have utilised UNIACT in academic research have proved unsuccessful: there was one study showing how UNIACT data was correlated with planned major, finding indications that across all students, the interest profile and planned major were related (ACT, Inc., 2009). This finding being part of an unpublished manuscript of ACT, Inc. (2008) as well as the manual stating "UNIACT is intended to facilitate career exploration…and was never intended to be used to seek exactness" (ACT, Inc., 2009. p.24) casts doubt on its suitability for use in academic research.

Additionally, a crucial consideration when choosing the vocational interest measure was the brevity of the task. Despite choosing efficient methods of testing ToM and IQ (as discussed below in section 3.3.4), these two tasks alone took approximately 25 minutes per person. To reduce the amount of time spent away from lessons, a quick and efficient measure of vocational interests was necessary. This meant well-established measures such as Strong Interest Inventory, even in their most recently condensed forms, would be too time-consuming, with Strong et al. (2004) stating completion of their test typically requires between 30 and 45 minutes. Other options such as Tracey's (2002) Personal Globe Inventory (PGI), which incorporates Holland's (1997) RIASEC types as well as Prediger's (1982) two dimensions, were discarded for similar reasons: even using one part of the PGI consisted of 226 items.

Chosen method

The shortest measure of vocational interests found, and the one chosen for use in this study, was Svedholm-Häkkinen and Lindeman's (2016) vocational interest scale. Svedholm-Häkkinen and Lindeman (2016) based their methods on the analysis of Prediger's three factor-model by Su, Rounds and Armstrong (2009). Prediger's (1982) model suggests that underlying Holland's RIASEC types are two theory-based dimensions: data vs ideas and things vs people. Svedholm-Häkkinen & Lindeman (2016) therefore used a scale that asked participants to rate the importance of different themes in their study or occupation. The scale does not use separate numerous items to calculate which area each participant's field of work or study is mainly focused in. Instead, it requires the participant to evaluate and rate the extent to which their field focuses either on Data, People, Ideas or Things. While in its existing state, the scale was deemed inappropriate for use in school pupils, so was adapted to ask students to rate the extent to which their desired field of work or study focuses on the areas of Data, Ideas, People and Things. This method was chosen for two reasons: firstly, it is very quick to administer and easy to understand, and secondly, because we decided we would also have open-ended response questions for specific idealistic and realistic occupation choices alongside this 4-item scale. These specific occupations could be coded for their associated vocational interest dimension scores as described in Chapter 6.

Two 4-item vocational interest measures were used in the study. Additionally, one 4-item measure assessing self-confidence for the future was also used. The measures are outlined in more detail below:

(1) a 4-item measure of self-confidence for the future. This measure was developed as part of the Student Experiences of Non-Shared Environment Scales: (SENSES; Yerdelen et al., 2018). The measure stated: "We are interested in how confident you feel about your future. Please indicate how true each of these statements are for you?". Participants then rated on a scale of 1 (not at all true) to 5 (very true) how confident they felt in: living up to what their parents and teachers expect of them, and living up to what they expect of themselves. The fourth item asked

them to rate on the same scale of one to five how true the statement "I have a clear plan for what I hope to do next" is for them. These four items make up the subscale of 'PLANS-2' in the Student Experience of Non-Shared Environment Scales (SENSES) (Yerdelen et al., 2018). Validation research has shown good internal consistency of the subscale, with a Chronbach's alpha score of .82, although as a relatively new measure, the scales would benefit from further validation (Yerdelen et al., 2018). As the measure assesses self-confidence in ones' ability to achieve goals in the future, the results were used to consider the role of self-efficacy on career aspirations in Chapter 6 – although it should be clarified that this measure did not explicitly assess self-efficacy. The measure was used in its original format, with the question and answers unchanged for use in this study.

(2) A measure of the extent to which an individual's desired field of work or study focuses on the areas of Data, Ideas, People and Things (based on the measure developed by Svedholm-Häkkinen & Lindeman, 2016). We based our measure on the English translation of the original Finnish measure developed by Svedholm-Häkkinen and Lindeman (2016). We also altered the wording of the question, changing "To what extent does your field of work or study focus on each of the following areas?" to "To what extent does your *desired* field of work or study focus on each of the following areas?" for the Year 10 sample. The four options (Data, Ideas, People and Things), their descriptions and the answering scale (1 to 4) were unchanged from Svedholm-Häkkinen and Lindeman's (2016) measure.

(3) A measure of confidence about one's abilities in the areas of Prediger's (1982) Data vs Ideas and Things vs People model (also based on the measure developed by Svedholm-Häkkinen & Lindeman, 2016). Again, we based our measure on the English translation of the original Finnish measure developed by Svedholm-Häkkinen and Lindeman (2016). We also

altered the wording of the question, so it was no longer focusing on to the extent of which the desired field of work focuses on different areas, and instead asked “How confident are you in your abilities in each of the following areas?” The four options (Data, Ideas, People and Things), their descriptions and the answering scale (1 to 4) were unchanged from Svedholm-Häkkinen and Lindeman’s (2016) measure.

Background Variables

Participants were asked about their gender and date of birth, the gender and dates of birth of their biological siblings (and a separate question regarding step-siblings and/or adopted or foster siblings), and either the GCSE options they are currently studying (if Year 10 and 11 participants) or their degree subject (for the final-year university students). We looked at gender only to correct for any sex differences, rather than as a variable for analysis (with the exception of Chapter 6). An item regarding any current career plans or aspirations was also included. One of these items focused on idealistic occupational choice, the occupation that would be chosen in an ideal world, and the other asks for the more realistic choice, the occupation that participants feel they are more likely to have. A copy of the questionnaires administered to university students and Year 10 students can be found in Appendix 11.3.

Gender

As highlighted above, participants were asked to provide their gender when filling out their questionnaires. We obtained this information in order to correct for any gender differences on ToM scores.

It is frequently and consistently reported that there is an effect of gender on empathy and empathising - with a large body of evidence supporting female superiority in these abilities.

Baron-Cohen (2002), in his discussion of the Empathising and Systemising brain types, outlines how more females than males tend to have the ‘female brain’ type: where empathising is more developed than systemising. Greenberg et al (2018) found evidence to support the Empathising-Systemising theory: across their sample (‘discovery’ dataset, *n*=671,606) including autistic and typically developing individuals, females scored significantly higher on the empathising quotient than males (Cohen’s d=.039). A number of other studies have provided further evidence to support this argument - from research using both self-reported measures and behavioural tasks. O’Brien et al (2013), in their exploration of self-reported empathy in three large samples (*N*=75,263) found significant gender differences, with women reporting higher scores in both perspective taking and empathic concern than men. A multilevel meta-analysis of 551 effect sizes from 215 samples has additionally shown females to have a small overall advantage on emotion recognition tasks, with a small but significant effect size (Cohen’s *d*=.019) (Thompson & Voyer, 2014).

Empathising is a broader term that has been defined as encompassing ToM, so the gender effect discussed above is relevant to our study. However, the female advantage extends to the literature focusing on ToM specifically. In studies conducted on children, there is evidence of this same gender effect in ToM ability. Calero et al (2013), for example, found significant differences between boys and girls in their research on 6 to 8-year-olds. Across all six ToM tasks, girls performed significantly better than boys. Devine and Hughes (2013) tested *N*=230 8- to -13-year-olds on a ‘Silent Films’ task, and the Strange Stories task, and found a significant gender difference - again showing female advantage - on ToM performance. Both male and females were matched on age, verbal ability and socioeconomic status, so the gender differences found are not due to female advantage in these other variables. Interestingly, through examining the raw scores on the different tasks separately, Devine and Hughes (2013) found the gender difference seen is possibly driven by the Silent Films task. While the Strange Stories task provides participants with contextual information, none is given on the Silent Films task, thus is possibly more difficult. Devine and Hughes (2013) conclude that “female superiority on theory-of-mind tasks may only manifest in these more challenging scenarios” (p.999). While the ToM task used in our own study is arguably more straightforward than the Silent Films task, participants are still faced with a scenario in which very little context is provided. Therefore, the gender effect of ToM was important to control for even in this more straightforward task.

While the literature is more limited in adolescence, there is still evidence to suggest a gender effect exists on ToM performance during this period. Białecka-Pikula et al. (2017), for example, tested 13 and 16-year olds on advanced Theory of Mind, finding that in both age-groups females scored higher than males, though the gender difference was more pronounced in the later stage of adolescence. They additionally found that females performed equally well on affective and cognitive tasks, however male participants showed better ability in cognitive tasks compared to the affective task. The evidence to suggest girls are particularly strong on affective ToM tasks supports the general findings from the empathising literature.

However, other studies have found contradictory findings regarding the gender effect on affective ToM in adolescence. Vetter, Altgassen, et al., (2013), in their examination of the associations between executive functions and affective ToM in adolescence, found gender did not significantly explain the variance in the affective ToM task they used (The Faces test - a task that asks participants to pick the adjective that appropriately describes the complex emotions expressed by various actors on a computer screen). However, the gender distribution in their sample was uneven, with 23% of the N=139 participants being male, which could have influenced the results. However, the lack of significant gender differences in affective ToM was similarly found in Gabriel et al's (2019) research, which used a larger and more evenly distributed sample size (*N*=643, 58.6% female). This study did find female participants demonstrated superior performance on cognitive ToM tasks, which they suggest could be due to structural brain development differences between genders (Blakemore, 2008), or alternatively due to lasting effects of play-behaviour differences in boys and girls: 'female' play tends to promote verbal communication whereas 'male' play tends to use and promote spatial abilities (Devine and Hughes, 2013; Gabriel et al., 2019).

Opposing findings have been found in tests of ToM in adult samples. Although a smaller sample (N=80, 50% female), Russell et al. (2007) found a male advantage on Happé's cartoon task (Happé et al., 1999). This task assesses ToM ability through asking participants to explain jokes: half of which required understanding of a physical condition, and the other half requiring understanding of mental states. Even when matched for age and years of education, Russell et al. (2007) found that the male participants performed better on both the mental state task (Cohen's *d*=0.53), and the physical state task (Cohen's *d*=0.86). Russell et al. (2007) explore a variety of reasons why the male participants gave superior performance to the females in their study, and they proposed that the males possibly use a 'systemising strategy' as this ToM measure, like many others, requires the ability to predict 'law-governed' behaviour. The task arguably requires one to develop rules about how it works, so the male advantage in systemising may be a possible explanation for this better performance. While the result could be reflective of the type of task used, as it demands less affective ToM ability, it could also suggest female superiority on ToM tasks may not extend into adulthood.

While there is mixed evidence suggesting a gender effect on ToM performance, of the studies conducted during adolescence, there does appear to be a consistently reported effect of gender on ToM. This study was not designed to investigate this gender effect, but to look directly at the relationship between ToM ability and other factors of vocational interests and birth order. Therefore, it was decided that ToM scores would be corrected for gender, to ensure any results found were not influenced by this possible gender effect.

Cognitive ability

Rationale

There is evidence to suggest a relationship exists between intelligence and ToM ability. The importance of controlling for verbal IQ in ToM tasks has been supported by studies; Milligan et al. (2007) conducted a meta-analysis that showed a moderate to large overall effect size of .43 between language ability and performance in false-belief tasks. It is important to note that this meta-analysis only included studies where the participants were children aged 7 and under, however there is evidence of significant correlations between verbal ability and ToM in older groups. For example, Vetter, Leipold, et al. (2013) tested both verbal and non-verbal ability using the WASI-II two-subtest IQ test, in order to estimate general cognitive ability, and assess both age groups to make sure they were comparable in their age-corrected verbal and non-verbal abilities. Furthermore, they expected verbal abilities to co-vary with their social cognition measures, and indeed found a small but significant correlation between verbal ability and the Reading the Mind in the Eyes test (RMET) in the adult group (r=.26) (Vetter, Leipold, et al., 2013).

Baker, Peterson, et al (2014) found further evidence of the relationship between intelligence and performance on theory of mind tasks, specifically the RMET, in their meta-analysis. The analysis of 77 effect sizes and 3583 participants indicated that performance on the RMET correlates positively with intelligence (*r*=.24). The authors suggest that, at face value, the RMET requires less verbal reasoning than other ToM tasks, such as false belief tasks, which suggests their findings are of even higher value when considering the relationship between ToM and intelligence – there is a lack of verbal ability necessary to perform well on the RMET, yet there is evidence of a positive correlation between both verbal and performance IQ with RMET performance. This further supports the argument that a relationship exists between ToM and IQ. Additionally, a separate meta-analysis conducted by Kirkland et al. (2012) found a mean correlation (*r*=.29) between the RMET and other ToM tasks (the Strange Stories Task and the Faux Pas Test), suggesting all three ToM tasks are measuring the same underlying cognitive ability. Alternatively, it could suggest intelligence, rather than ToM ability, is responsible for the association between the tasks, although this is untested (Baker, Peterson, et al., 2014). Ultimately, the finding that both verbal and performance IQ correlate with performance on the RMET task provides further support for the importance of testing both verbal and non-verbal IQ, as there is not an exclusive relationship between verbal IQ and performance on ToM tasks.

The primary reason we decided to measure IQ was to correct for effects on ToM scores: there appears to be evidence to suggest a relationship exists between intelligence and performance on ToM tasks. Whilst some studies have assessed the relationship and found no significant results, suggesting ToM ability exists as a cognitive domain independent from intelligence (e.g. Rajkumar et al., 2008), the evidence from large meta-analysis studies finding small and moderate-large positive correlations between intelligence and performance on ToM tasks (e.g. Baker et al., 2014; Milligan et al., 2007) confirmed measuring IQ to be important in this study.

Additionally, the final-year university student group were likely less representative of the general population, as all were attending high-ranking, Russell group universities, whereas the mid-adolescent students were all attending non-selective state schools. Therefore, it was critical to correct the ToM scores for IQ when making any comparisons between the late-adolescent group and mid-adolescent group – as finding better performance on ToM tasks in the late-adolescent group could have been due to other cognitive ability that was higher in this group, and not necessarily due to ToM ability.

In summary, it was decided that correcting the ToM scores for gender and IQ across the sample was necessary as there is evidence to suggest that both gender and IQ can influence ToM ability and development. As this research aimed to explore the relationship between ToM and vocational interests and birth order, it was important to control for the effects of IQ and gender in order to eliminate the possible influential effects of these additional variables on the findings. Therefore, all ToM scores were corrected for IQ and gender in this study.

Measure of cognitive ability

The Wechsler Abbreviated Scale of Intelligence – Second Edition (WASI-II: Wechsler, 2011) was used to measure cognitive ability. A two-subtest form of the scale was administered, consisting of both verbal and non-verbal subtests, which took approximately 15 minutes per participant. In the verbal subtest, participants were asked to explain the meanings of words presented in the stimulus booklet, with words being both presented visually and orally. The non-verbal subtest required participants to select from five options the answer that completed the unfinished matrix or pattern in the stimulus book. The verbal subtest is a measure of crystallised intelligence and word knowledge (amongst other abilities such as verbal concept formation), and the non-verbal subtest measures spatial ability, perceptual organisation and fluid and visual intelligence (McCrimmon & Smith, 2013). The test was administered to students individually, with the verbal subtest first, followed by the non-verbal subtest. In line with the WASI-II manual, testing continued until participants gave three wrong answers in a row, at which point testing stopped.

The WASI-II (2011) manual provides tables which were used to convert the raw scores of the verbal and non-verbal subtest into T-scores, which were converted to FSIQ-2 scores. The average reliability coefficient for the FSIQ-2 composite has been found to be .93 for the child sample (ages 16-16 years), and .94 for the adult sample (ages 17-90 years) (McCrimmon & Smith, 2013). Even though it is a briefer measure, WASI-II scores have been found to correlate highly with scores of other intelligence measures: "Correlations between the WASI-II and the original WASI, WISC-IV, and WAIS-IV were acceptable (0.71) to excellent (0.92)." (McCrimmon & Smith, 2013. p.340).

3.4 Procedure

Full ethical approval was obtained from the University of York for both the main and pilot study. Ten secondary schools in the UK were contacted with an invitation to take part in the study. Two headteachers agreed to take part, and all members of Year 10 in these schools were invited to participate. School 1 facilitated testing of N=58 Year 10 students, and School 2 facilitated testing of N=26 participants. A personal contact facilitated testing of a group of N=7 Year 10 students from another comprehensive secondary school in Oxfordshire. An information sheet and consent form were sent to all parents by email, outlining the research and their child's right to not take part in the study or to withdraw at a later date. Parents provided consent by returning a filled in and signed consent form either via email or handed in as a hard copy. Informed consent was also collected from the participants at the time of testing. Students were tested in pairs, in order to make the data collection as efficient as possible. Participants were invited into the room, where they were provided with an information sheet about the study, and the consent form. Parental, university student and Year 10 student information sheets and consent forms can be found in Appendix 11.1 and 11.2 respectively.

Once all forms were read and filled in, the testing process began. Both students were firstly provided with a demonstration of how the ToM computer task works by showing them the practice trial and were given the opportunity to ask any questions before they began the task. Following completion of the computer task, one student was sent to sit outside to complete the questionnaire, while the WASI-II was conducted with the other student before swapping the students over (the verbal and non-verbal intelligence subtests must be conducted individually). All tasks were conducted in a quiet room away from distractions.

A convenience sample of university students was recruited via numerous methods: on social media, through personal contacts, emailing students via various departmental administrators, face-to-face recruitment at a stand erected in the university library main entrance, and online via the research recruitment website www.callforparticipants.com. Information about the research was presented at various Psychology in Education seminars and sign-up sheets were circulated following these short presentations. To encourage participation, potential participants were informed their names would be entered into a draw to win one of six prizes (1 x £50 Amazon giftcard, and 5 x £10 Amazon giftcards) if they took part in the research. Participants were tested individually, and in quiet rooms or areas away from distractions where possible. Typically for the university students, the questionnaire was filled in first, followed by the ToM task, with the FSIQ-II test being conducted last.

3.5 Pilot study

A pilot study was conducted in July 2017 of Year 10 and university students. Twelve Year 10 students were invited by the school to take part in the pilot study. The school was asked to select participants with varying abilities with an even distribution of gender. Eleven Year 10 students (6 female, 5 male; aged between 14 years 11 months and 15 years 9 months) participated (one invited student did not take part as their parent did not agree to give consent to the study). For the university students, 10 students participated (7 female, 3 male; aged between 21 years 5 months and 24 years 7 months) from various universities. With the exception of N=1 student, who was between second and third year of their undergraduate degree, and N=2 participants who had completed their postgraduate degrees more than one year previously, all students in the pilot study had recently completed the final year of either their undergraduate or postgraduate degree.

The pilot study was conducted to test the feasibility of the measures and to formulate an analysis plan. Any participants that fit the criteria for the main study were included as main study participants, as no changes were made to the measures between the pilot study and main study data collection: n=11 Year 10 students and n=7 university students were retained for the analysis.

3.6 Open Science Framework

All three studies presented in Chapters 4-6 were pre-registered using the Open Science Framework (OSF), at osf.io with the Center for Open Science (2020). The Open Science Framework (OSF) enables researchers to pre-register their research, including their hypotheses and full analysis plans prior to collecting their data or prior to analysis (Foster & Deardorff, 2017). The OSF is particularly helpful when multiple researchers collaborate on one study, as the tool provides a centralised workspace where data and files can be shared and stored (Foster & Deardorff, 2017). As an independent researcher, the data storage and collaborative nature of the OSF were less important, but pre-registration of the studies was carried out largely to join the effort to encourage transparency in research. Additionally, the process of formulating hypotheses based in existing research, and subsequently developing an analysis plan was very useful in conducting the research. As Klein et al. (2018) state, the steps taken to become an open science researcher "not only improve the efficiency of individual researchers, they enhance the credibility of the knowledge generated by the scientific community" (p.2).

Open science has been encouraged to increase both reproducibility and credibility of findings. Encouraging researchers to outline specific research processes, report full methodology and materials, and share data, enables reproducibility of research findings by other researchers (Klein et al., 2018; Nosek et al., 2015) Additionally, through prevention of numerous questionable research practices, such as 'HARKing' (Hypothesizing After the Results are Known) (Kerr, 1998), pre-registration aims to discourage deliberate manipulation of data with the intention of reporting and publishing significant results (Yamada, 2018).

In summary, this thesis reports a series of cross-sectional and longitudinal analyses of data gathered from two groups of adolescents (mid and late), using reliable and valid measures and an open, transparent approach to analysis.

4 Study 1: A Cross-Sectional Exploration of Theory Of Mind, Birth Order and Vocational Interests at Mid- and Late-Adolescence

4.1 Context

As described in Chapter 2 there is reason to believe that Theory of Mind (ToM) may continue to develop in adolescence, at a time when future planning increases in importance. It has been suggested that ToM and prospection (envisioning the future) share common functional anatomy, reflecting workings of the same core brain network (Buckner & Carroll, 2007). Additionally, as highlighted in Chapter 2, there are reasons to believe that ToM may be associated with both vocational interests and position in the family. Research is needed to consider how and when the most effective careers advice can be implemented. Findings presented in Chapters 5 and 6 explore the timing aspect in more detail, whereas the current findings focus more on exploring the associations between ToM, birth order and vocational interests.

ToM, the ability to accurately and appropriately ascribe mental states to other individuals, has been suggested to develop throughout adolescence (e.g. Choudhury et al., 2006; Dumontheil et al., 2010). However, empirical evidence of ToM development in adolescence is somewhat limited. Therefore, the first aim of this study was to assess whether final year university students (late-adolescents) have better ToM than Year 10 students (mid-adolescents).

ToM is an area that has not often been considered in relation to vocational interests, largely because the literature on ToM development during adolescence is still emerging. Despite this, there is evidence to suggest that there may be a link between ToM and vocational interests: Baron-Cohen et al's (2003) empathising-systemising theory, in which the concept of empathising encompasses ToM, alongside processes of mentalising, 'sympathy' and ‘empathy’, was assessed in relation to occupational choice and vocational interests (Svedholm-Häkkinen & Lindeman, 2016). Svedholm-Häkkinen and Lindeman (2016) found that individuals with high empathising ability and low systemising ability were more likely to express people-based vocational interests, whereas individuals with low empathising ability and high systemising ability, were more likely to show interest in ‘Things’ – showing an increased likelihood to be undertaking scientific occupations: IT, technology, and the ‘exact’ sciences of physics, chemistry and mathematics.

Similarly, the potential effect that birth order has on the development of vocational interests has been largely neglected in the literature. While recent large-scale studies have found no evidence of a relationship between birth order and personality (e.g. Damian & Roberts, 2015b), large birth order differences in college major choice have been identified. Barclay et al. (2017) found that first-borns were more likely than later-borns to apply to law, life sciences, engineering programmes, whereas later-born siblings were found to be more likely to make applications for art, business and journalism. A handful of studies have identified a significant relationship between ToM development and birth order in pre-schoolers and young children (e.g. Ruffman et al., 1998; Cassidy et al., 2005), but this has not been explored in adolescence, so this study aims to fill this gap in the literature.

Given the evidence that ToM may develop throughout adolescence (e.g. Dumontheil et al., 2010; Sebastian et al., 2012) and that ToM may be associated with birth order (e.g. Cassidy et al., 2005; Ruffman et al., 1998) and vocational interests (e.g. Svedholm-Häkkinen & Lindeman, 2016), we took a cross-sectional approach by collecting data from a sample of N=91 14-16 year-olds (mid-adolescents) and N=73 20-24 year olds (late-adolescents) to explore whether ToM scores were higher in the older group, and whether associations between ToM and birth order and vocational interests were observed.

This study also explored whether any associations found between birth order and vocational interests were mediated by ToM development – as there is evidence of a relationship between birth order and ToM development, and evidence of a relationship between ToM and vocational interests (see Chapter 2 for full justification). Changing social role transitions, and new understanding of extended biological growth, have led to the suggestion that adolescence should encompass the age range of 10-24 years (Sawyer et al., 2018). Thus, in this study, the Year 10 group represents mid-adolescence (age 14-16), and the university student group represents late adolescence (age 21-24). Please see Chapter 2 for a more detailed review of the literature on ToM, birth order and vocational interests.

4.2 Research Questions

1. Do final year university students (late-adolescents) have better cognitive and affective Theory of Mind than mid-adolescents?

2. Is there a relationship between ToM and birth order in mid-adolescence and late adolescence?

3. Is ToM associated with vocational interests in mid-adolescence and late adolescence?

4. Is birth order associated with vocational interests in mid-adolescence and late adolescence?

5. Are relationships between birth order and vocational interests mediated by ToM?

4.3 Methods

4.3.1 Participants

Participants were *n*=164 (62 male and 102 female) adolescents. Of these, *n*=91 (46 male and 45 female) were Year 10 pupils (mid-adolescents) and *n*=73 (17 male and 56 female) were final-year university students (late-adolescents). See Chapter 3 for full description of participants.

4.3.2 Measures

Measures are described in full in Chapter 3.

4.3.3 Analysis

Outlined below are the study's hypotheses (related to research questions) and the statistical tests used to address them. All ToM scores were corrected for IQ – the raw scores showed the Year 10 group had a slightly lower mean FSIQ score than the final-year university student group (M=102.69, SD=12.64 vs 107.74, SD=11.42).

Pre-registration of the hypotheses and analyses presented in this chapter can be found at: https://osf.io/49rtb/?view_only=f4d5c27bddee44608771f75593f698ed. As specified in our OSF pre-registration, all analyses were run with outliers included and excluded. Cases were determined as outliers if their scores were +/- 3SDs above or below the mean, with outlier detection being conducted for each separate analysis. All analysis in this chapter is presented with outliers included (analyses with outliers removed are available in Appendix 11.4). There were no significant changes when outliers were excluded.

1. Do final year university students (late-adolescents) have better cognitive and affective Theory of Mind than mid-adolescents?

Hypothesis: University students will score higher than mid-adolescents on both cognitive and affective ToM.

An independent samples t-test was conducted to assess whether differences exist in ToM scores by age-group. The continuous dependent variable was ToM score (reaction time and mean % error rate for each condition were assessed separately), and the dichotomous independent variable was age-group (Year 10s (mid-adolescents) and final-year university students (late-adolescents)). Assumptions of normality (using the One-Sample Kolmogorov-Smirnov test) and homogeneity of variance (using Levene's Test for the Equality of Error Variances) were assessed.

2. Is there a relationship between ToM and birth order in mid-adolescence and late adolescence? (RQ2)

Hypothesis: Younger siblings will score higher than eldest or only children on both cognitive and affective ToM tasks.

A one way ANOVA was conducted to assess whether there is a significant difference in ToM score by birth order position. The dependent variable in the analysis was ToM score (reaction time and mean % error rate), and the discrete groups of birth order position were only child, first-born, middle-born, and last-born. Assumptions of normality (using the One-Sample

Kolmogorov-Smirnov test or Q-Q plots) and homogeneity of variance (using Levene's Test for the Equality of Error Variances) were assessed.

3. Is ToM associated with vocational interests in mid-adolescence and late adolescence? (RQ3)

Hypothesis: Individuals with higher levels of ToM (both affective and cognitive) will have more interest in People and Ideas than those with lower levels of ToM.

Pearson's rank-order correlations were used to assess the relationship between ToM scores (reaction time and mean % error rate) and vocational interests (Data, Ideas, People and Things).

4. Is birth order associated with vocational interests in mid-adolescence and late adolescence? (RQ4)

Hypothesis: Younger siblings are more likely to have higher interest in People and Ideas than eldest or only children. Eldest or only children are more likely to have higher interest in Data and Things.

A one-way ANOVA) was conducted to explore whether there is a significant difference in vocational interest score by birth order position. The dependent variable in this analysis was vocational interest scores (People, Ideas, Data and Things), and the discrete groups of birth order position were only child, first-born, middle-born, and last-born. Assumptions of normality (using the One-Sample Kolmogorov-Smirnov test or Q-Q plots) and homogeneity of variance (using Levene's Test for the Equality of Error Variances) were assessed.

5. Are relationships between birth order and vocational interests mediated by ToM? (RQ5)

Hypothesis: The relationships between birth order and vocational interests are mediated by ToM – younger siblings are more likely to have higher interest in people and Ideas than eldest or only children, and this will be mediated by their higher levels of ToM (both affective and cognitive).

A Baron and Kenny (1986) mediation analysis was planned to assess whether ToM score mediates the relationship between birth order and vocational interests. This analysis would take place only if a significant association between the variables was identified.

4.4 Results

Descriptive Statistics

Descriptive statistics were calculated for all main study variables for both samples and are presented in Table 4.1. We also compared the results of males and females as a preliminary step in order to check whether it would be necessary to correct for sex differences on any of the variables.

TABLE 4.1 DESCRIPTIVE STATISTICS FOR STUDY VARIABLES WITH SEX COMPARISON

Measures	Means and standard deviations for Year 10 data						ANOVA-effects of sex		Means and standard deviations for Final-year university student data						ANOVA-effects of sex	
	All		Females		Males		Sex		All		Females		Males		Sex	
	M (n)	SD	M (n)	SD	M (n)	SD	p	η^2	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Cog ToM RT (s)	2.54 (91)	.55	2.49 (46)	.46	2.58 (45)	.63	.426	.007	2.05 (73)	.40	2.03 (55)	.40	2.13 (18)	.38	.344	.013
Aff ToM RT (s)	2.41 (90)	.53	2.33 (45)	.45	2.49 (45)	.45	.159	.022	2.02 (73)	.35	1.94 (55)	.32	2.24 (18)	.35	.001	.139
Phys Caus RT (s)	2.46 (91)	.54	2.41 (46)	.46	2.51 (45)	.61	.348	.010	2.11 (73)	.41	2.09 (55)	.39	2.18 (18)	.49	.433	.009
Cog ToM % ER	5.43 (91)	10.08	3.65 (46)	6.49	7.25 (45)	12.58	.088	.032	3.51 (73)	7.14	3.38 (55)	6.99	3.89 (18)	7.78	.795	.001
Aff ToM % ER	13.53 (91)	17.31	10.60 (46)	17.25	16.52 (45)	17.03	.103	.030	6.42 (73)	9.69	5.76 (55)	9.39	8.46 (18)	10.59	.308	.015
Phys Caus % ER	9.45 (91)	12.99	10.25 (46)	12.70	8.63 (45)	13.38	.557	.004	9.89 (73)	12.32	11.86 (55)	13.08	3.89 (18)	6.98	.016	.079
Voc. Interest																
a Data	2.50 (90)	.94	2.35 (46)	.95	2.66 (44)	.90	.117	.028	2.92 (73)	.95	2.85 (55)	.95	3.11 (18)	.96	.325	.014
b Things	2.67 (89)	1.09	2.29 (45)	1.06	3.07 (44)	.97	.001	.130	1.86 (73)	.92	1.76 (55)	.79	2.17 (18)	1.20	.106	.036
c People	2.83 (90)	.95	2.98 (46)	.88	2.68 (44)	1.00	.140	.025	3.44 (73)	.80	3.55 (55)	.77	3.11 (18)	.83	.045	.056
d Ideas	2.88 (89)	.90	2.73 (45)	.92	3.02 (44)	.74	.131	.026	3.25 (73)	.81	3.35 (55)	.78	2.94 (18)	.87	.069	.046

RT = reaction time; ER = error rate; M= mean; SD = standard deviation; n = sample size; *p*= p-value of the effects of sex on variables; η^2 = eta-squared.

ToM scores presented in this table are the raw scores uncorrected for IQ

Theory of Mind descriptive statistics

Missed trials on ToM tasks were excluded from the analyses. Participants had a time limit of 5 seconds per trial to select their answer so if they did not respond in time, the task would move on and the computer would record their result as a missed trial. Missed trial rates were 4.54% across all conditions in the Year 10 group, and 1.75% across all conditions in the final-year university student group. ToM scores were calculated by averaging the scores on correct trials. We followed Sebastian et al's (2012) procedure and did not include missed trials and incorrect trials when averaging these scores.

When the Year 10 sample was divided by sex there were no significant differences across reaction time or error rate in any of the ToM conditions. When the final-year university student sample was divided by sex it was noted that the female group had a faster mean affective reaction time compared to males (M = 1.94s, SD = 0.32 vs M = 2.24s, SD = 0.35) and this was a statistically significant large effect size of sex (η_p^2=.139, *p*=.001). The male group had a much lower mean percentage error in the physical causality task compared to the female group (M = 3.89%, SD = 6.98 vs M = 11.86%, SD = 13.08), with the ANOVA showing this to be a statistically significant medium effect size of sex (η_p^2=.079, *p*=.016).

As there were statistically significant medium to large sized effects of sex on ToM scores in the final-year university student group, and there is increasing evidence that gender can affect ToM scores during mid-adolescence (e.g. Białeka-Pikul et al., 2017), it was decided that the ToM scores would be controlled for sex. Additionally, as explained in Chapter 3, all ToM scores were corrected for IQ. We conducted a regression on the raw ToM scores to create residualised scores, which were saved as new ToM variables corrected for sex and IQ. This was conducted separately for the mid-adolescent and late-adolescent groups. These scores are used for all research questions with the exception of RQ1.

Vocational Interests

Each of the four vocational interest areas were measured on a 1-4 scale (1=my desired field of work focuses on this area not at all; 4=my desired field of work focuses on this area very much). ANOVA analyses of the Year 10 group found no significant sex differences for vocational interests in Data, People or Ideas, but a statistically significant sex difference in the vocational interest of Things. The overall mean interest in Things was 2.67 (SD= 1.09), with males being statistically more interested in Things than females (M=3.07, SD=.97 vs M=2.29, SD=1.06), (η_p^2 =.130, p=.001), a medium effect size.

For the final-year university student group, the overall mean interest in People was 3.44 (SD=.80), with females statistically more interested in People than males (M=3.55, SD=.77 vs M=3.11, SD=.83), (η_p^2 =.056, p=.045), a medium effect size. It was interesting to note that the final-year university student group did not replicate the Year 10 finding of the statistically significant sex difference in the vocational interest in Things, yet did have a statistically significant sex difference in the vocational interest in People, although this was likely reflective of the uneven gender divide in the late-adolescent sample (fewer males).

As there were statistically significant medium effects of sex on Things in the mid-adolescent group, and People in the late-adolescent group, and evidence that the People-Things vocational interests are regularly seen to be on a ‘gendered’ dimension (Su et al., 2009; Lippa, 2010a; Lippa 2010b), it was decided that the People and Things scores in each groups would be controlled for the effects of sex. Again, this correction was conducted separately for the mid-adolescent and late-adolescent groups.

Do final year university students (late-adolescents) have better cognitive and affective Theory of Mind than mid-adolescents? (RQ1)

Independent-samples t-tests were run to explore whether final-year university students performed better on the cognitive and affective ToM tasks than the Year 10 student sample. As the ToM scores restandardised for sex and IQ were calculated for both Year 10 and final-year university student groups separately, it meant all individual ToM scores had a mean of 0.00. As a result, independent-samples t-tests could not measure for any differences between the two groups. Therefore, in this analysis, ToM scores corrected for IQ across the whole group were used, and only the ToM conditions that were found to have sex effects were corrected for the effects of sex. Physical causality % error rate and affective ToM RT scores in the university group were corrected for both the effect of sex and IQ and compared with the Year 10 group scores that were only corrected for IQ. Additionally, independent-samples t-tests comparing the raw ToM scores of the Year 10 and final-year university student groups were also conducted. To correct for multiple comparisons, a Benjamini-Hochberg FDR correction was applied. The results of the t-tests using the raw ToM scores can be seen in Table 4.2, and the results of the t-tests using the restandardised ToM scores can be seen in Table 4.3 below. Due to the unequal sample sizes, Hedges' *g* effect size measure was used. Additionally, bar graphs of these results are presented after the tables in Figures 4.1 and 4.2.

Both the raw and restandardised ToM scores were normally distributed for cognitive and affective ToM RT in both groups, and physical causality ToM RT in the Year 10 group, as assessed by Shapiro-Wilk's test (p>.05). However, ToM scores were non-normally distributed for % error rate in either group for affective, cognitive, physical causality ToM conditions, and also the physical causality RT for the final-year university student group. We continued with the t-test as it is fairly robust against non-normality (Rasch & Guiard, 2004). The assumption of homogeneity of variances was violated in several cases when using both the raw and restandardised data, as assessed by Levene's test for equality of variances: for cognitive ToM RT (*p*=.002 in raw scores, *p*=.003 for restandardised), for affective ToM RT (*p*=.001 raw, *p*=.003 restandardised), for the control variable RT (*p*=.005 raw, *p*=.006 restandardised), and for the affective % ER (*p*=.002 for both raw and restandardised). There was homogeneity of variances, as assessed by Levene's test for equality of variances, for cognitive % ER (*p*=.074 raw, *p*=.061 restandardised) and the control variable % ER (*p*=.992 raw, *p*=.935 restandardised). In the cases where there was not homogeneity of variances, the results of a Welch's t-test are used.

TABLE 4.2 MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS BY GROUP: YEAR 10 (MID-ADOLESCENCE) AND FINAL-YEAR UNIVERSITY STUDENT (LATE-ADOLESCENCE) – (RAW TOM DATA)

	Year 10		Univ. students		*t*-value	df	*p*	Hedges' *g*
	M (n)	SD	M (n)	SD				
Affective ToM RT	2.41 (90)	.53	2.02 (73)	.35	5.65	155.26	.000**	.85
Cognitive ToM RT	2.54 (91)	.55	2.05 (73)	.40	6.61	160.38	.000**	1.00
Phys Caus (control) RT	2.46 (91)	.54	2.11 (73)	.41	4.67	161.67	.000**	.72
Affective ToM % ER	13.53 (91)	17.31	6.42 (73)	9.69	3.32	146.20	.001**	.49
Cognitive ToM % ER	5.43 (91)	10.08	3.51 (73)	7.14	1.38	162.00	.170	.22
Phys Caus (control) % ER	9.45 (91)	12.99	9.89 (73)	12.32	-.222	162.00	.824	.03

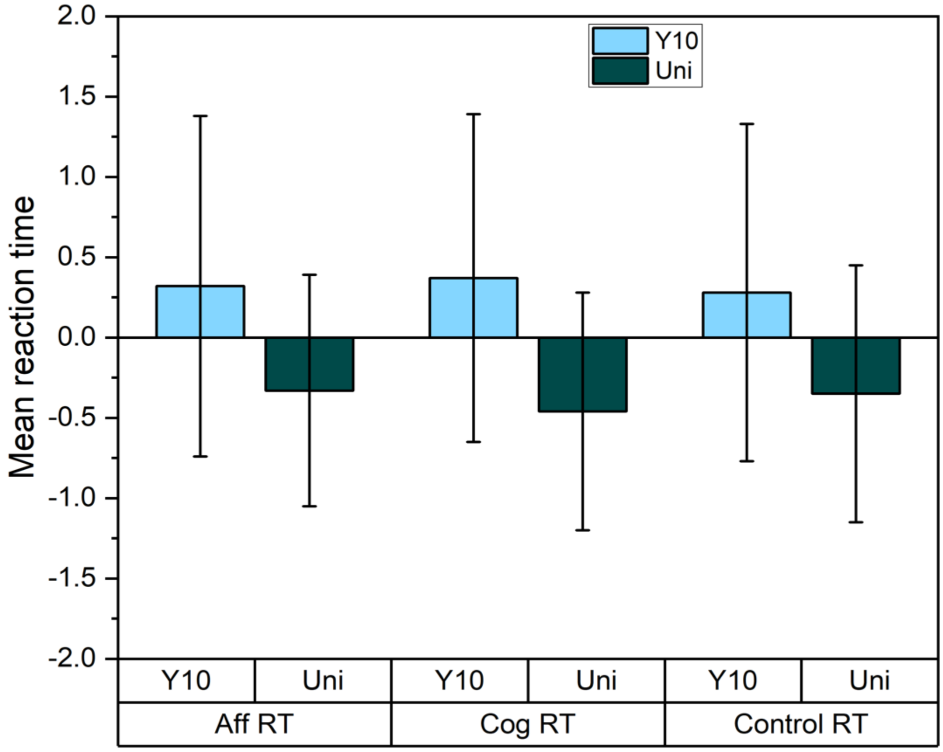
Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 4.3 MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS BY GROUP: YEAR 10 (MID-ADOLESCENCE) AND FINAL-YEAR UNIVERSITY STUDENT (LATE-ADOLESCENCE) (RESTANDARDISED TOM SCORES)

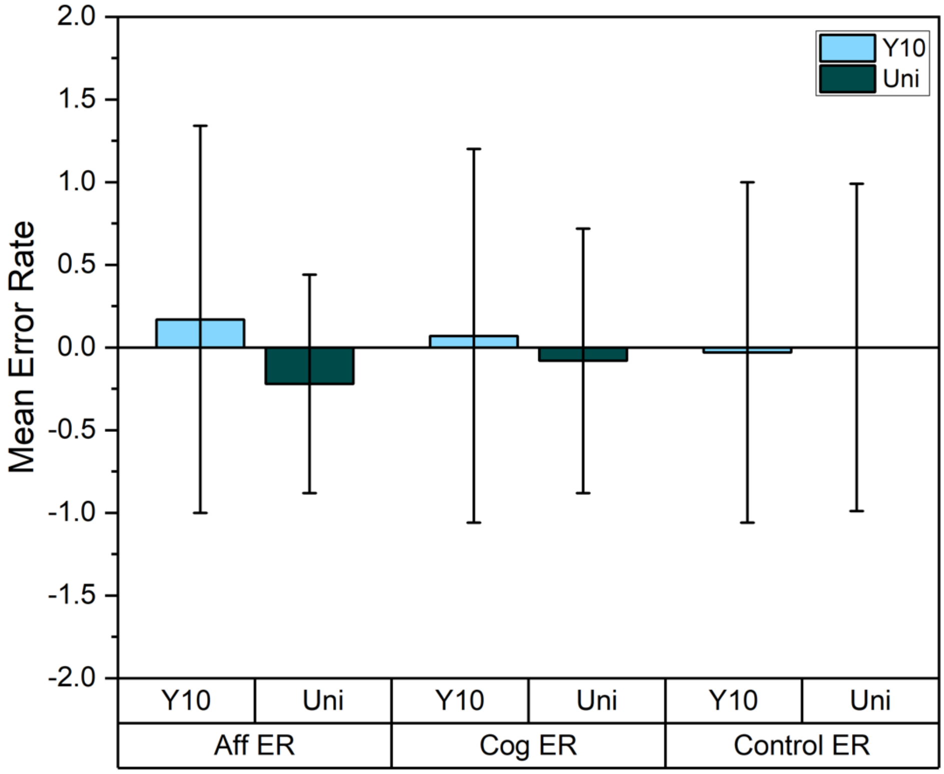
	Year 10		Univ. students		*t*-value	df	*p*	Hedges' *g*
	M (n)	SD	M (n)	SD				
Affective ToM RT	.32 (90)	1.06	-.33 (73)	.72	4.70	156.43	.000**	.70
Cognitive ToM RT	.37 (91)	1.02	-.46 (73)	.74	6.03	160.58	.000**	.92
Phys Caus (control) RT	.28 (91)	1.05	-.35 (73)	.80	4.35	161.66	.000**	.67
Affective ToM % ER	.17 (91)	1.17	-.22 (73)	.66	2.69	146.68	.008**	.40
Cognitive ToM % ER	.07 (91)	1.13	-.08 (73)	.80	.942	162.00	.348	.15
Phys Caus (control) % ER	-.03 (91)	1.03	.00 (73)	.99	-.220	162.00	.826	.03

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

In the analysis using both the raw scores and the scores corrected for IQ and sex, the final-year university student group performed significantly faster on both cognitive and affective ToM tasks than the Year 10 group. They also performed significantly faster on the physical causality (control) task, so this suggests the final-year university student (late-adolescent) group were purely faster at reacting to the task, and therefore we cannot infer that they have more advanced ToM based on these results. Exploring the effect sizes of the analysis using the restandardised ToM scores, however, shows that the effect size is larger in both the affective ToM RT (g=.70) and cognitive ToM RT (g=.92) than the control task RT (g=.67). Additionally, the final-year university student group did make significantly fewer errors on the affective ToM task than the Year 10 group (g=.40), and fewer errors on the cognitive ToM task too (although this did not reach significance, and was a much smaller effect size of g=.15), whereas the difference on the physical causality (control) task was not significant and had a much smaller effect size (g=.03), with the results showing the Year 10 group actually made fewer errors than the university group. It is important to note that higher IQ is not the explanation as the ToM scores were corrected for this.



4.1 Year 10 and Univ. students ToM Reaction Times



4.2 Year 10 and Univ. Students ToM % Error Rates

TABLE 4.4 MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS BY GROUP: YEAR 10 (MID-ADOLESCENCE) AND FINAL-YEAR UNIVERSITY STUDENT (LATE-ADOLESCENCE) – OUTLIERS EXCLUDED

	Year 10		Univ. students		*t*-value	df	*p*	Hedges' *g*
	M (n)	SD	M (n)	SD				
Affective ToM RT	.30 (87)	1.07	-.33 (68)	.71	4.38	149.38	.000**	.68
Cognitive ToM RT	.33 (87)	1.03	-.50 (68)	.69	6.00	149.69	.000**	.93
Phys Caus (control) RT	.22 (87)	1.03	-.42 (68)	.65	4.72	146.92	.000**	.72
Affective ToM % ER	.04 (87)	.93	-.25 (68)	.61	2.39	149.26	.018*	.36
Cognitive ToM % ER	-.07 (87)	.78	-.20 (68)	.57	1.20	152.31	.232	.19
Phys Caus (control) % ER	-.17 (87)	.78	-.08 (68)	.86	-.702	153.00	.484	.11

When the outliers were excluded from the analysis, there were some slight differences found in the effect sizes, as can be seen in Table 4.4 above. While the results still show the final-year university student group perform faster than the Year 10 group across all the tasks, the effect size is larger in the control task (*g*=.72) than in the affective ToM task (*g*=.68). Additionally, some of the significance is lost in the affective ToM % error rate differences (M=.04, SD=.93 vs M= -.25, SD =.61, *t*(149.26)=2.39, *p*=.018), although the effect size is similar (*g*=.36).

Our results therefore partially support our hypothesis that university students (late-adolescents) will score higher than Year 10s (mid-adolescents) on both cognitive and affective ToM.

Theory of Mind and birth order: Is there a relationship between ToM and birth order in mid-adolescence and late-adolescence (RQ2)

A one-way ANOVA was used to explore whether reaction times and % error scores on the cognitive and affective ToM tasks varied dependent on specific birth order position in both the Year 10 (mid-adolescent) group and the final-year university student (late-adolescent) group. The results can be seen in Table 4.5 below, and in bar graphs beneath the table (Figures 4.3-

4.6). Due to the small size of the only-child group in the Year 10 sample (*n*=4), this group was left outside of the analysis. The final-year university student group of only-children was larger (*n*=8), so was retained for analysis. Data were normally distributed for cognitive and affective reaction times in the first-born, middle-born and last-born groups (for both Year 10 and final-year university student groups), as assessed by Shapiro-Wilk's test (p>.05). Data was normally distributed for affective % error rate in all of the birth order groups, with the exception of the first-born group in both the Year 10 and final-year university student group. Data was not normally distributed for cognitive % error rate in any of the birth order groups for both Year 10 and final-year university student group. We decided to continue with the one-way ANOVA as it is generally considered robust to non-normality (e.g. Maxwell et al., 2017).

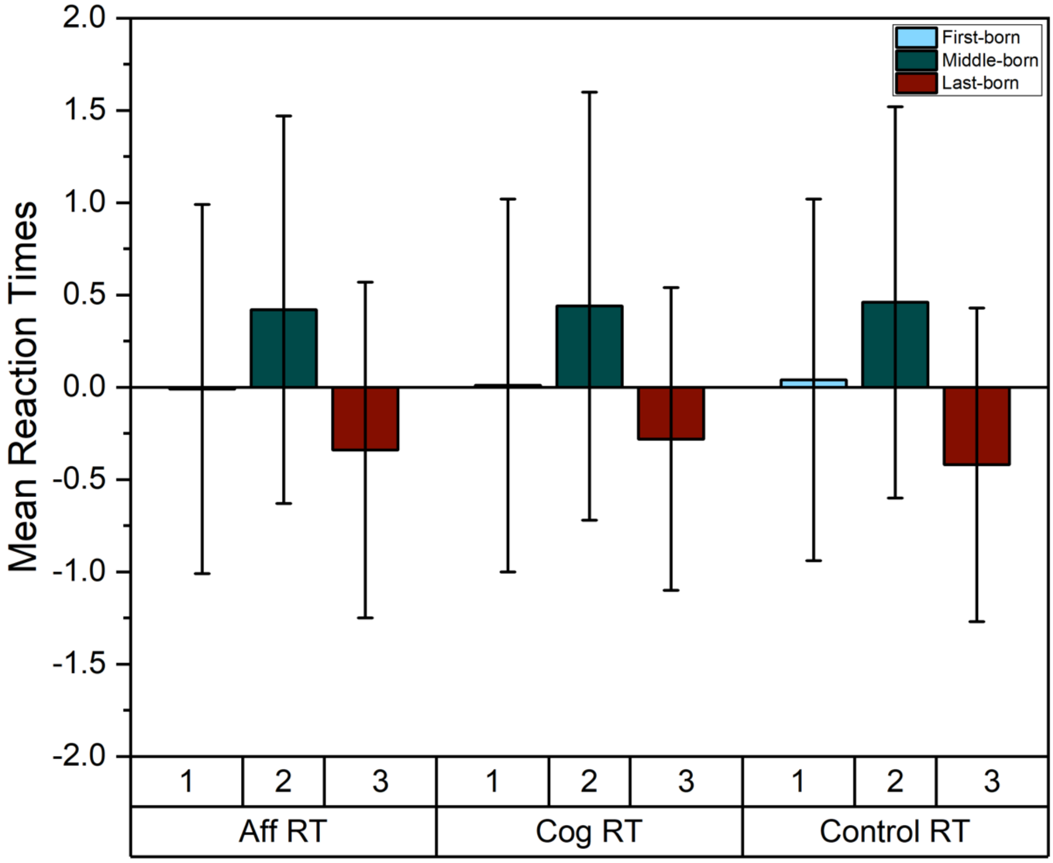
In the Year 10 group, there was homogeneity of variances in all cases, as assessed by Levene's test for equality of variances: for cognitive ToM RT (p=.48), for affective ToM RT (p=.76), for cognitive ToM % ER (p=.24) and for affective ToM % ER (p=.17). In the final-year university student group, there was homogeneity of variances as assessed by Levene's test for equality of variances: for cognitive ToM RT (p=.11), and for affective ToM RT (p=.45). However, there was heterogeneity of variances for cognitive ToM % ER (p=.03) and affective ToM % ER (p=.00), so the result of the Welch's ANOVA is used for this variable instea

Table 4.5 Means, standard deviations and ANOVA results by birth order position for Year 10 group (mid-adolescence) and final-year university student group (late-adolescence)

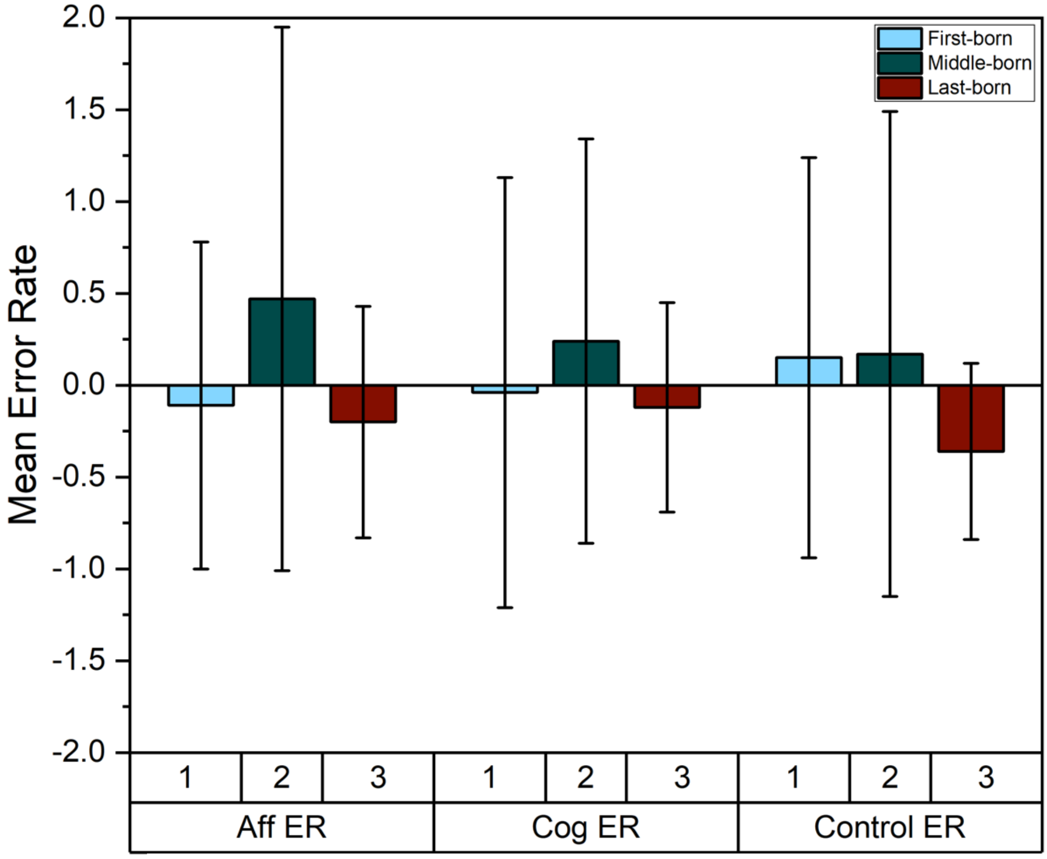
Measures	Means and standard deviations for raw data including outliers										ANOVA-effects of birth order position	
	Year 10 (mid-adolescence) group											
	All		First-born		Middle-born		Last-born		Only-child		Birth order	
	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
1 Cog ToM RT (s)	-.00 (86)	1.01	.01 (44)	1.01	.44 (16)	1.16	-.28 (26)	.82	-	-	.076	.060
2 Aff ToM RT (s)	-.03 (85)	1.00	-.01 (44)	1.00	.42 (15)	1.05	-.34 (26)	.91	-	-	.063	.065
3 Phys Caus RT (s)	-.02 (86)	1.00	.04 (44)	.98	.46 (16)	1.06	-.42 (26)	.85	-	-	.016	.095
4 Cog ToM % ER	-.01 (86)	1.01	-.04 (44)	1.17	.24 (16)	1.10	-.12 (26)	.57	-	-	.517	.016
5 Aff ToM % ER	-.03 (86)	.98	-.11 (44)	.89	.47 (16)	1.48	-.20 (26)	.63	-	-	.072	.061
6 Phys Caus % ER	.00 (86)	1.01	.15 (44)	1.09	.17 (16)	1.32	-.36 (26)	.48	-	-	.020 ^{w}	.033 (ω^2)
7 Voc Interest - a Data	2.45 (85)	.92	2.53 (43)	.88	2.37 (16)	1.03	2.35 (26)	.94	-	-	.674	.010
b Things	-.03 (84)	.99	-.23 (42)	.94	.18 (16)	1.00	.15 (26)	1.02	-	-	.202	.039
c People	.03 (85)	1.01	-.02 (43)	.95	.23 (16)	1.07	-.01 (26)	1.08	-	-	.698	.009
d Ideas	2.87 (85)	.91	2.86 (43)	.92	2.63 (16)	.81	3.04 (26)	.96	-	-	.362	.024
	Final-year university student (late-adolescence) group											
1 Cog ToM RT (s)	.00 (73)	.99	-.05 (30)	.85	.07 (12)	1.50	.01 (23)	.86	.05 (8)	1.06	.982	.002
2 Aff ToM RT (s)	.00 (73)	.99	.06 (30)	.96	.28 (12)	1.24	-.04 (23)	.79	-.54 (8)	1.13	.319	.049
3 Phys Caus RT (s)	.00 (73)	.99	.06 (30)	1.04	.06 (12)	1.29	-.13 (23)	.77	.07 (8)	.98	.905	.008
4 Cog ToM % ER	.00 (73)	.99	.14 (30)	1.10	.18 (12)	1.35	-.19 (23)	.70	-.25 (8)	.52	.422 ^{w}	-.010 (ω^2)
5 Aff ToM % ER	.00 (73)	.99	.07 (30)	.93	.62 (12)	1.55	-.22 (23)	.68	-.55 (8)	.13	.001** ^{w}	.079 (ω^2)
6 Phys Caus % ER	.00 (73)	.99	.02 (30)	1.17	.15 (12)	1.06	-.03 (23)	.79	-.19 (8)	.72	.858 ^{w}	-.034 (ω^2)
7 Voc Interest - a Data	2.92 (73)	.95	2.83 (30)	.83	2.58 (12)	1.24	3.17 (23)	.94	3.00 (8)	.93	.335	.048
b Things	.00 (73)	.99	.19 (30)	.99	-.11 (12)	1.29	-.03 (23)	.94	-.48 (8)	.51	.367	.044
c People	.00 (73)	.99	.16 (30)	.97	-.25 (12)	1.31	-.08 (23)	.75	.01 (8)	1.24	.654	.023
d Ideas	3.25 (73)	.81	3.33 (30)	.76	3.58 (12)	.52	2.96 (23)	.93	3.25 (8)	.89	.148	.074

RT = reaction time; ER = error rate; M= mean; SD = standard deviation; n = sample size; *p*= p-value of the effects of birth order on variables; η^2 = eta-squared; w=homogeneity of variances violated, Welch test used instead

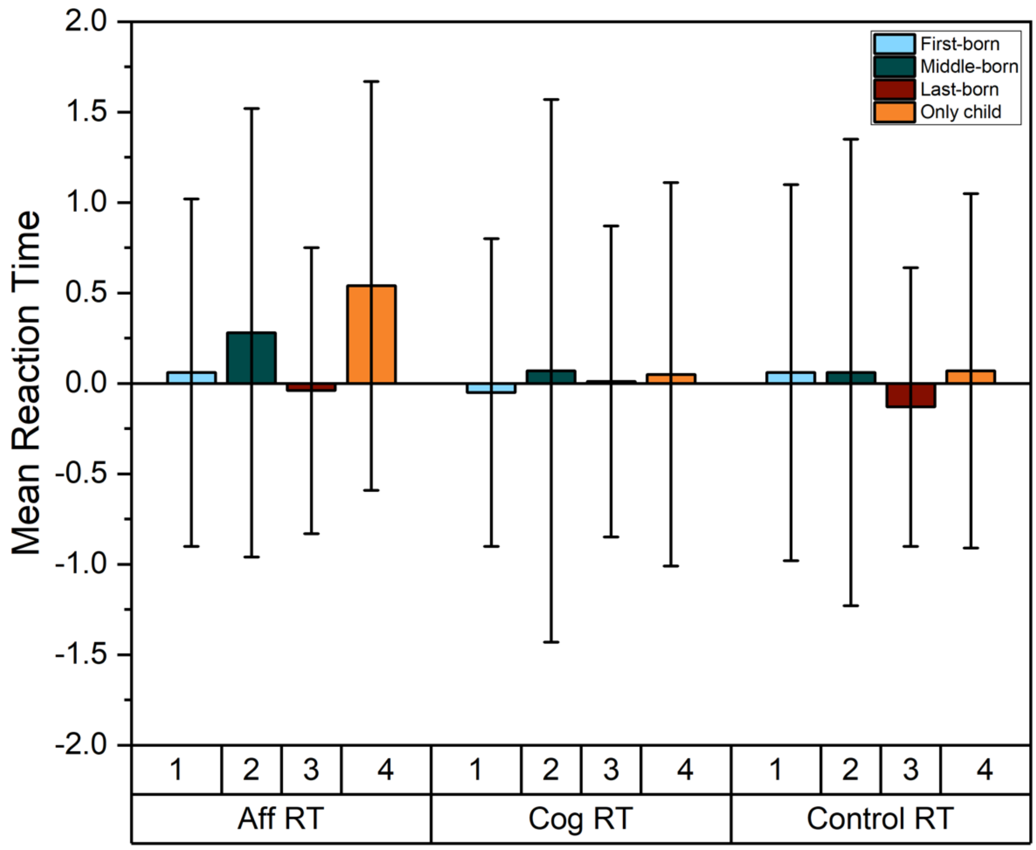
Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR



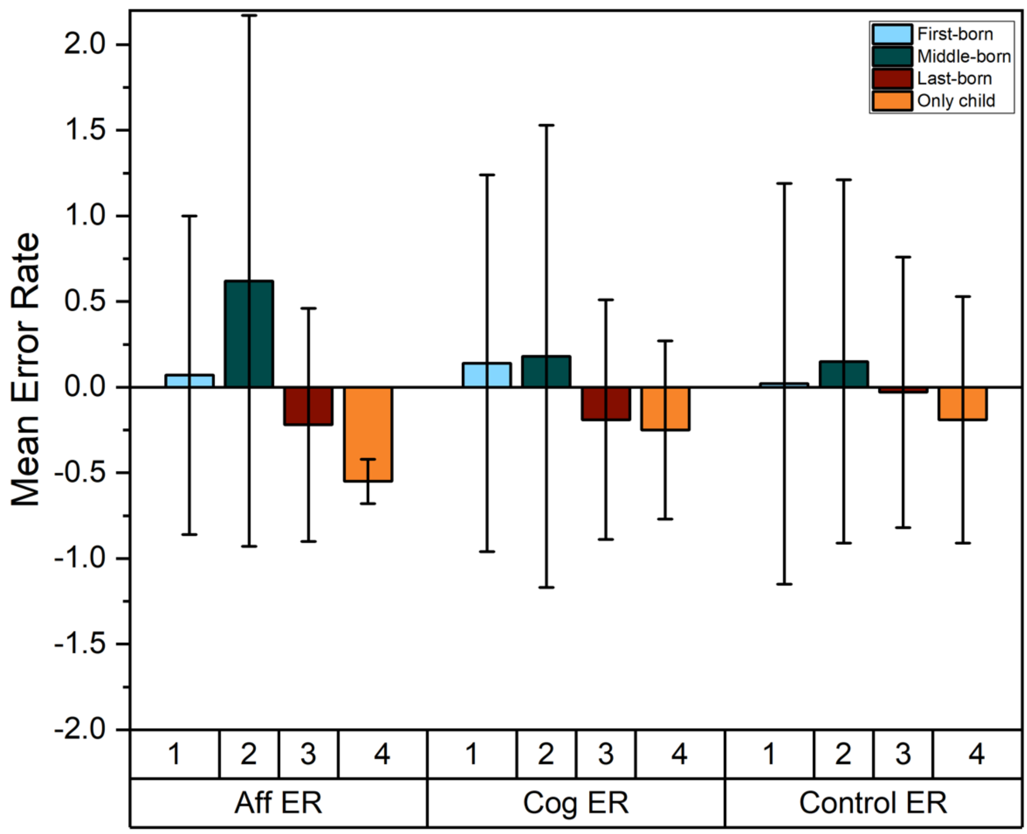
4.3 Year 10 ToM Performance (Reaction Times) by Birth Order Position



4.4 Year 10 ToM Performance (% Error Rates) by Birth Order Position



4.5 UNIV. STUDENT TOM PERFORMANCE (REACTION TIMES) BY BIRTH ORDER POSITION



4.6 UNIV. STUDENT TOM PERFORMANCE (% ERROR RATE) BY BIRTH ORDER POSITION

There were no statistically significant effects of birth order position (first-born, middle-born and youngest-born) on any of the reaction times or % error scores on either the cognitive or affective ToM tasks in the Year 10 group. In the final-year university student group, the only result that was statistically significant between the different birth order groups was in affective ToM % error rate, Welch's $F(3, 31.015) = 7.193$, $p=.001$, $\omega^2=.079$, a medium effect size. Only children made fewer mistakes than first-born children (M= -.55, SD=.13 vs .07, SD=.93), and Games-Howell post hoc analysis revealed that this difference (.62, 95% CI [.15, 1.09]) was statistically significant ($p=.006$). The differences between the other birth order groups were not significant.

The results therefore do not support our hypothesis that younger siblings will score higher than eldest or only children on cognitive and affective ToM tasks.

Theory of Mind and vocational interests: Is ToM associated with vocational interests in mid-adolescence and late-adolescence? (RQ3)

Pearson's correlations were run to assess the relationships between different vocational interests and reaction times on both the cognitive and affective ToM tasks, and can be seen in Table 4.6 (below). To correct for multiple comparisons, a Benjamini-Hochberg FDR correction was applied. Not all variables were normally distributed, as assessed by Shapiro-Wilk's test ($p>.05$), so the non-parametric test of a Spearman's rank-order correlation was also conducted. The results are presented in Table 4.7 below. There were no substantially different results so the results of the Pearson's correlations are discussed. When outliers were excluded from the analysis, there were no additional or substantially different results (outlier tables for both Pearson's and Spearman's rank-order correlations can be found in Appendix 11.4).

In the Year 10 group, there was a statistically significant, negative correlation between the vocational interest in Things and the reaction times for both affective ToM, *r*(88)= -.38, *p*=.000, and cognitive ToM , *r*(89)= -.32, *p*=.002. This means that as ToM reaction times decreased, interest in Things increased. It is important to note that there was a statistically significant, negative correlation between Things and the reaction time for the physical causality (control) trial as well, *r*(89)= -.37, *p*=.000, which is a stronger correlation than cognitive ToM, and a similar correlation of equivalently high significance to affective ToM.

There were no significant correlations found between any of the vocational interests and ToM scores in the final-year university student group.

The results therefore do not support our hypothesis that individuals with higher levels of ToM will have more interest in People and Ideas than those with lower levels of ToM. Our results suggest lower cognitive and affective ToM is associated with higher interest in Things, which could suggest an association between ToM and vocational interests, but as there was also a correlation found between the control trial and Things, it cannot be argued that, based on these results, there is an association between ToM and vocational interests.

TABLE 4.6 PEARSON'S CORRELATIONS BETWEEN TOM AND VOCATIONAL INTERESTS

(Year 10: mid-adolescent group)
(*N*=91 in all ToM conditions except Affective RT (*N*=90). VI sample sizes vary: VI Data:*N*=90, VI Things:*N*=89, VI People:N=90, VI Ideas:*N*=89).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.79**	-								
3 Phys Caus (RT)	.75**	.69**	-							
4 Cognitive (% ER)	.21	.14	.25	-						
5 Affective (% ER)	.25	.37**	.33**	.55**	-					
6 Phys Caus (% ER)	.04	.08	.17	.41**	.46**	-				
7 VI Data	-.20	-.10	-.15	-.03	-.00	-.04	-			
8 VI Things	-.32**	-.38**	-.37**	-.00	-.04	.05	.10	-		
9 VI People	.22	.23	.28**	-.06	.02	-.18	.17	-.17	-	
10 VI Ideas	-.13	-.16	-.13	.08	.10	.19	.68	.05	.08	-

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

(Final-year university student: late adolescent group) (*N*=73)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.65**	-								
3 Phys Caus (RT)	.73**	.54**	-							
4 Cognitive (% ER)	.22	.12	.30	-						
5 Affective (% ER)	.17	.21	.14	.02	-					
6 Phys Caus (% ER)	.36**	.11	.36**	.05	.22	-				
7 VI Data	-.05	-.07	-.05	-.10	-.16	-.06	-			
8 VI Things	-.05	.02	.02	-.01	-.06	.08	.27	-		
9 VI People	-.02	.15	.06	-.00	-.15	-.03	-.05	.06	-	
10 VI Ideas	-.02	.21	.02	.09	.04	.03	-.10	-.08	.08	-

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 4.7 Spearman's Rank Order Correlations between ToM and Vocational Interests
(Year 10: mid-adolescent group)
(*N*=91 in all ToM conditions except Affective RT (*N*=90). VI sample sizes vary: VI Data:*N*=90, VI Things:*N*=89, VI People:*N*=90, VI Ideas:*N*=89).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.77**	-								
3 Phys Caus (RT)	.72**	.69**	-							
4 Cognitive (% ER)	.11	.11	.16	-						
5 Affective (% ER)	.26*	.38**	.32**	.32**	-					
6 Phys Caus (% ER)	.00	.08	.12	.26*	.34**	-				
7 VI Data	.19	-.12	-.12	-.08	-.02	.04	-			
8 VI Things	-.31**	-.35**	-.36**	-.13	-10	.08	.20	-		
9 VI People	.17	.20	.26*	-.09	.11	-.13	-.14	-.14	-	
10 VI Ideas	.17	-.19	-.15	.09	.13	.23	.02	.08	.08	-

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

(Final-year university student: late adolescent group) (*N*=73)										
Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.63**	-								
3 Phys Caus (RT)	.71**	.57**	-							
4 Cognitive (% ER)	.09	.07	.15	-						
5 Affective (% ER)	.15	.14	.13	.09	-					
6 Phys Caus (% ER)	.30	.03	.24	-.00	.22	-				
7 VI Data	-.12	-.12	-.02	-.02	-.19	-.03	-			
8 VI Things	-.03	-.06	.02	.06	-.16	-.03	.24	-		
9 VI People	.01	.19	.13	.10	-.01	.07	-.09	.07	-	
10 VI Ideas	-.03	.18	-.01	.09	.09	.00	-.08	-.14	.12	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Birth order and vocational interests: Is birth order associated with vocational interests in mid-adolescence and late-adolescence? (RQ4)

A one-way ANOVA was conducted to explore whether vocational interests varied dependent on specific birth order position in both the Year 10 group and the final-year university student group. The results can be seen in Table 4.5 on page 121.

In both the Year 10 and final-year university student group, data was normally distributed, as assessed by visual inspection of Normal Q-Q Plots. In the Year 10 group, there was homogeneity of variances in all cases, as assessed by Levene's test for equality of variances: for Data (p=.68), for Ideas (p=.90), for People (p=.55) and for Things (p=.97). In the final-year university student group, there was also homogeneity of variances in all cases, as assessed by Levene's test for equality of variances: for Data (p=.11), for Ideas (p=.29), for People (p=.14) and for Things (p=.19).

There were no statistically significant effects of birth order position (first-born, middle-born and youngest-born in the Year 10 group, and only-child, first-born, middle-born and youngest-born in the final-year university student group) and any of the vocational interests.

Are relationships between birth order and vocational interests mediated by ToM? (RQ5)

The mediation analysis was not run because there were no significant effects of birth order position on any of the vocational interests. Additionally, there were only limited associations found between ToM and vocational interests in this study (the negative correlation between ToM reaction time and Things), and only one association found between ToM and birth order (that only children made fewer mistakes than first-born children).

4.5 Discussion

Do final year university students (late-adolescents) have better cognitive and affective Theory of Mind than mid-adolescents?

We hypothesized that our late-adolescent group would perform faster and make fewer mistakes on the ToM tasks than the Year 10 (mid-adolescent) group. The final-year university student group was significantly faster on all ToM tasks, including affective ToM and cognitive ToM, but also on the control physical causality task. These results remained the same when outliers were excluded, and also when the effects of gender and IQ were regressed out. Because they were significantly faster at the control task, it suggests the final-year university student group did not necessarily have more developed ToM ability but were simply faster at performing the computer task: as the late-adolescent group were all at university, it is possible that they were more familiar with using computers. However, the effect sizes for the differences seen in the ToM tasks were larger than those seen in the control physical causality task (effect sizes calculated from the ToM scores corrected for the effects of IQ were: g=.70 in affective ToM, g=.92 in cognitive ToM, and g=.67 in the control task). The significant difference in reaction times on the ToM tasks remained after controlling for the effects of IQ, so the difference is unlikely to be due to group differences in our study. Sebastian et al.'s (2012) study did not find significant differences in reaction time between their adult and adolescent group, so this is an interesting finding.

The ToM task reaction time results provide some support for the argument that ToM develops throughout adolescence. It is important to note that when outliers were removed from the analysis, the effect size of the difference seen in the affective ToM reaction times decreased (g=.68), and was smaller than the effect size of the difference seen in the physical causality control task with outliers excluded (*g*=.72). However, the effect size of the difference seen in the cognitive ToM reaction times remained large (*g*=.93), suggesting performance based on reaction time particularly improves on the cognitive ToM task. While Sebastian et al. (2012) did not find any significant differences in the reaction times between their adult and adolescent group, our finding supports other studies that have found evidence of cognitive ToM development during adolescence. Gabriel et al (2019), for example, found a significant difference in performance on a first-order cognitive ToM task between a group of 13-14-year-olds and a group of 17- to 18-year-olds. Their study, however, also found significant differences between these groups on affective ToM. Interestingly, their results suggested a gender effect exists in cognitive ToM, with female participants outperforming male participants on cognitive ToM tasks, but no gender effect in affective ToM. As our late-adolescent sample was unequally split between genders (*n*=55 females and *n*=18 males), it is possible our results are influenced by this gender effect. Although we did test for gender differences and corrected the scores in cases where an effect was observed (affective ToM RT and control % error rate in the final year university student group), it is possible the small number of male participants in the final year university student group may have influenced this result.

Alternatively, it is possible that the large effect size seen in the difference in cognitive ToM reaction times between the two groups could be due to differences in working memory. Considering the raw scores of the ToM results, it is noteworthy that the late-adolescent group were not especially fast on the cognitive ToM task compared to the other two conditions, but that the mid-adolescent group were notably slower on the cognitive ToM task in comparison to the other two conditions. Gabriel et al (2019) found that working memory was a predictor of cognitive ToM, but not affective ToM, in adolescence, particularly in the 15-16 and 17-18-

year-old groups. In a study regarding visual working memory (VWM), Isbell et al (2015) found evidence that VWM capacity continues to develop throughout adolescence, finding in their study that even 16-year-olds did not reach adult levels (in their study the adult group age had a mean of 20.89 years (SD=1.32), so a similar age to the late-adolescents in our sample). As working memory has been shown as a predictor of cognitive but not affective ToM, and working memory has been seen to differ between mid-adolescent and late-adolescent (or early adult) age-groups, it is possible that this explains the difference seen in the cognitive ToM reaction times especially: the mid-adolescents in our sample may have performed more slowly on the cognitive ToM task due to their weaker working memory abilities. However, it may not be that the difference seen is due to mid-adolescents being especially slow on cognitive ToM tasks, but that late-adolescents are strong on cognitive ToM tasks in comparison, and this is not due to cognitive skills such as working memory. It is possible that, in line with results from studies such as Valle et al (2015) and Dumontheil et al (2010), the reason the late-adolescent group performed fastest on the cognitive ToM task is due to the improved propensity to consider others' perspectives, an ability improved through encountering a broader range of social interactions (Choudhury et al., 2006). As we did not include a measure of working memory, it is not possible to know whether this ability was responsible for the difference seen between the two groups in our study.

We found no statistically significant differences between the % error rates on the cognitive and physical causality (control) tasks between the final-year university student group and the Year 10s, but we did find statistically significant differences on the affective % error rate (g=.49 with raw data, and g=.40 with corrected data, a moderate effect size). Again, this remained statistically significant with outliers both included and excluded from the analysis, and when both using the raw scores and after regressing out the effects of gender and IQ. This supports the idea of affective ToM developing throughout adolescence, reflecting similar findings to those of Sebastian et al. (2012).

Sebastian et al's (2012) study found adults outperformed the adolescent group in terms of the number of errors made in both the cognitive and affective ToM tasks: for affective ToM the adolescent error rate was 13.00% (SD=11.77) compared to the adult error rate of 5.33% (SD=6.40), and for cognitive ToM, the adolescent error rate was 8.33% (SD=7.48) compared to the adult error rate of 5.67% (SD=6.23). Comparatively, for affective ToM the error rate for mid-adolescents in our sample was 13.53% (SD=17.31), compared to the late-adolescent group who had an error rate of 6.42% (SD=9.69). For the cognitive ToM task, the mid-adolescent error rate in our sample was 5.43% (SD=10.08), and the late-adolescent error rate was 3.51% (SD=7.14). Sebastian et al. (2012) had an adolescent group with a mean age of 14.18 years old (range=11.17-16.30), and an adult group with a mean age of 28.88 years (range=24.14-40.71). The cut-off point for our final-year university student was age 24, so although there is a slight overlap at the top end of our age-range, the final-year university student group represents a late-adolescent group that is not assessed in Sebastian et al's (2012) study.

The finding that the mid-adolescent group made more mistakes on the affective ToM task than the late-adolescent group provides further support that acquiring and developing affective ToM particularly continues throughout adolescence. There is previous behavioural evidence that suggests cognitive ToM develops earlier than affective ToM, for example, typically children pass second-order false belief tasks from around 6 or 7 years old (e.g. Perner & Wimmer, 1985), however understanding what somebody understands about what someone else *feels* takes place between the ages of 9 and 11 years old (Baron-Cohen et al., 1999). While the same core network of regions appear to be involved in all ToM processing, including the superior temporal sulcus at the temporo-parietal junction and the temporal pole (see Blakemore, 2008 for a review), fMRI studies have found that regions of the ventromedial prefrontal cortex (vmPFC) are activated significantly more in affective ToM tasks compared to control conditions in adolescents, but not in adults (e.g. Sebastian et al., 2012). The vmPFC has been suggested to be at least partly important for affective ToM; vmPFC-lesioned individuals have been seen to show deficits for affective ToM, impaired on recognising emotions (Heberlein et al., 2008), irony or faux pas (all affective mental states) (Shamay-Tsoory et al., 2006; Vetter et al., 2014). As Sebastian et al (2012) discuss, the idea that adults activate a particular region known to be crucial in cognitive tasks less, yet demonstrate better performance on these tasks, seems counterintuitive. However, Sebastian et al (2012) explain that "some complex cognitive processes become more automatic and rely less on prefrontal structures with increasing age" (p.62): essentially the vmPFC may play an important role in acquiring complex cognitive skills, such as affective ToM, during development, but are less important to successfully using these skills in adulthood. Our late-adolescent group had participants aged between 21 and 24, thus assessed an age-group not studied in Sebastian et al's (2012) study: our finding that this group made significantly fewer mistakes than the mid-adolescent group on the affective ToM task suggests this automatic ability to react and respond appropriately to emotions may be occurring during this specific period of late-adolescence.

Affective ToM ability has been seen to progressively improve with age (e.g. Meinhardt-Injac et al., 2020; Vetter, Altgassen, et al., 2013). Interestingly, a recent study has found this improvement in affective ToM ability with age (from 11 to 25-years-old) remains after controlling for covariates (such as improvements in language, inhibitory control and reasoning ability), but only in relation to social-perceptual tasks (Meinhardt et al., 2020). Social-perceptual tasks require participants to infer others' mental states only through non-verbal cues (such as facial expressions and eyes), whereas social-cognitive tasks require verbal reasoning about the mental states of others. It has been found that the age-related increase in the social-cognitive component of affective ToM was fully in line with the development of the covariates, indicating that social-perceptual ToM abilities develop specifically, with adolescence being the critical period this development takes place. Meinhardt et al (2020) suggested this development may "reflect increasing sensitivity to nuanced changes in emotional facial expressions across adolescence" (p.298), possibly driven by increasingly experiencing emotional states of more complexity. This finding is in line with other suggestions that emphasise that increasingly rich social experiences may be responsible for improved ToM performance (e.g. Dumontheil et al., 2010), however highlights that this is particularly evident in the social-perceptual aspect of affective ToM. The affective ToM task used in our study was non-verbal, requiring participants to decide the most likely action an individual would take based on their facial expressions and body movements. Arguably therefore, our study provides further evidence to support the argument that there is specific development of social-perceptual affective ToM ability during adolescence, and the difference seen between our age-groups is unlikely to be the consequence of other factors such as inhibitory control and reasoning ability.

Our late-adolescent sample performing at a similar level to Sebastian et al's (2012) adult sample could support the suggestion that affective ToM is more complex than cognitive ToM and is therefore still developing during late adolescence. However, the difference in affective ToM error rate between the two groups could also potentially be due to specific cartoons on the computer task. There were two particular affective ToM cartoons where the option that is technically classed by the experiment as 'incorrect' is an option that a lot of the Year 10s chose (see Figure 4.2 below). For example, there is a sequence where there are two toddlers arguing over a toy, and the 'correct' answer according to the experiment is that the toddler shares the toy with the other toddler. However, 28.57% of Year 10s chose the other option, where the toddler refuses to share. A further 12.09% of the Year 10 group missed this trial, not being able to select an answer in time. It could be argued that it is not that the Year 10s are not demonstrating affective ToM ability, but they instead considered that maybe children of this age would be more likely to not share their toys. Perhaps due to being younger themselves, they are more likely to be exposed to siblings or extended family that are of this young age, and therefore believe that it is more likely that a toddler would not share their toys, even if the other toddler is upset. There is another cartoon where two young boys are playing football and one is hit in the face with the ball, and again the 'correct' answer is that the friend goes over to comfort his injured peer. However, 28.57% of Year 10 students chose the option where the friend laughs at his peer instead. Technically, this option is classed as an error, although again, it could be reflecting that the younger students are more likely to be exposed to this type of situation, and genuinely consider it more likely that young boys would laugh at their injured friend.

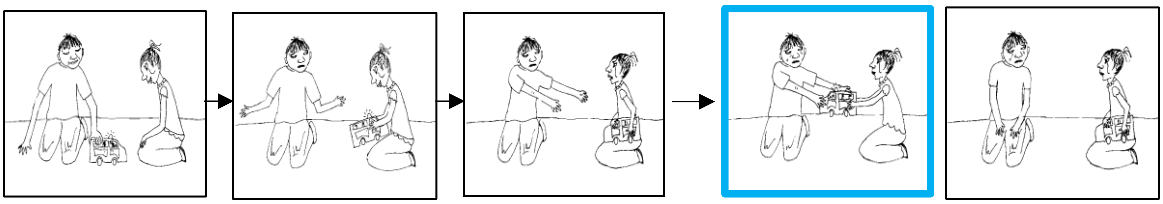


Figure 4.7 Example of Affective ToM Task (Sebastian et al., 2012) (Image used with permission from C.Sebastian)

The results from these particular affective ToM computer tasks do not necessarily mean that the mid-adolescent group have a less developed affective ToM: Sebastian et al (2012) base their work on Shamay-Tsoory et al's (2010) model that states affective ToM requires both cognitive ToM and intact empathy processing, which, according to Singer et al. (2009) is defined as “an ability to share and understand the emotional states of others” (p.335). The computer task asks the participant to predict how one character will react to another, but with no prior information about these characters’ personalities or previous behaviour. Therefore, in accordance to their definition of ‘intact empathy processing’, it could be argued that the Year 10s that chose the ‘incorrect’ answers on the above affective ToM cartoons do still have an ability to share the emotional states of others. These students may fully understand that the victims in these cartoons feel sad, but the computer task asks them to select how they expect the *other* individual in the cartoon to most likely respond, thus demanding the participants to consider the feelings of the neutral peer, and not the upset victim. The designers of the computer task have programmed the pro-social response where the neutral individual comfort others in pain to be the correct answer, but it does not necessarily mean that those choosing the antisocial option are lacking ToM ability.

It could instead be argued that those not choosing the pro-social outcome cannot be demonstrating *affective* ToM: Dvash and Shamay-Tsoory (2014) define empathy as “the link between knowing the thoughts and feelings of others, experiencing them, and responding to others in caring, supportive ways” (Dvash & Shamay-Tsoory, 2014. p.282). By not choosing the outcome where the individual in the cartoon comforts or supports their peer, one could argue the participants lack empathy, and thus do not demonstrate affective ToM ability. However, there are numerous definitions of empathy, and de Vignemont and Singer (2006) have argued that definitions regarding understanding another person’s feelings or ‘affect sharing’ that incorporate sympathy, ‘emotional contagion’ and personal distress are too broad. Instead, de Vignemont and Singer (2006) argue empathy is present if all four of the following conditions are satisfied “(i) one is in an affective state; (ii) this state is isomorphic to another person’s affective state; (iii) this state is elicited by the observation or imagination of another person’s affective state; (iv) one knows that the other person is the source of one’s own affective state” (p.435). de Vignemont and Singer (2006) argue that cognitive perspective-taking cannot meet the first condition; a participant can infer from the computer task, for example, that a child is upset because they are not allowed to play with a toy, but the participant themselves does not feel upset. Sebastian et al (2012) state that successful affective ToM processing requires the integration of cognitive ToM and empathy. If one has to themselves be in an affective state for empathy to be present, and cognitive perspective-taking prevents that from happening, this could suggest integrating cognitive ToM and empathy is not possible. Of course, there are numerous definitions of empathy, and Sebastian et al. (2012) focus mostly on successful affective ToM processing requiring both an ability to infer about beliefs and motivations (cognitive ToM) and intact empathy processing, defined as “an ability to share and understand the emotional states of others” (p.53). If their definition of intact empathy processing only requires an ability to understand others’ emotional states, perhaps the cartoon vignette computer task is not sophisticated enough to assess whether affective ToM processing is actually occurring, as the assessment of whether participants are demonstrating successful affective ToM is determined by whether they choose the pro-social behaviour. The participants could arguably be understanding the emotional state of the other individual: they think it is also funny that the peer gets hit in the face with a ball.

Another important limitation of the ToM task to acknowledge is that the ToM measure was likely too easy for a number of the participants, as the distributions of the error rates appear to show there were ceiling effects of the measure. In both the Year 10 and final-year university student group, the distributions show a large proportion of the sample got a perfect score, with zero errors (in the cognitive ToM condition, 64.8% of the Year 10s and 75.3% of the final-year university students achieved perfect scores). While the distributions are slightly more evenly spread in the affective ToM task, with fewer participants achieving a perfect result (39.6% of Year 10 students and 60.3% of final-year university students), the ceiling effect of the measure was still clearly a limitation. Holl et al (2018), who also used this ToM measure in a longitudinal study in late-childhood/early-adolescence, found there were ceiling effects in their study, particularly in the later stages of the research when the participants were older. They discuss how ceiling effects make it more difficult to identify participants with particularly strong ToM ability, and also make it more challenging to detect ToM effects on other variables. While the low error rates on the ToM task are a limitation, the reaction times on the ToM task were normally distributed across both groups, so finding evidence of faster performance in the late-adolescent group is still an important result. However, future research would benefit from using a ToM measure where the error-based scoring element does not suffer from ceiling effects.

Additionally, future analysis could benefit from conducting analysis separately on larger groups of males and females when comparing the mid-adolescent and late-adolescent groups. Sebastian et al. (2012) focused on only testing males for a variety of reasons, including there being evidence of sex differences in the trajectory of structural brain development during adolescence (e.g. Lenroot & Giedd, 2010; Raznahan et al., 2010). Sebastian et al (2012) highlight that averaging results across males and females could result in ‘noisy’, unrepresentative data. While this is likely to have a more noticeable effect on their fMRI data, there could also be effects at the behavioural data level. As we were limited by our sample size and wanted to have as much statistical power as possible, we conducted the full analysis with both sexes included in the total sample. We did correct the raw ToM scores within each group for the effects of sex, although this resulted in a mean of 0 across all task meaning the age-groups could not be directly compared with all conditions corrected for sex. Instead, we corrected the conditions where the ANOVA showed there was an effect of sex. If there were any substantial influences of sex on the differences seen between the late-adolescent and mid-adolescent group, this would have corrected for them. However, future research with larger sample sizes would benefit from splitting the sample by sex when analysing the data.

Our results partially support our hypothesis that late-adolescents would demonstrate better performance on ToM tasks than mid-adolescents. The final-year university student (late-adolescent) group performed significantly faster on the ToM tasks (both cognitive and affective) than the Year 10 (mid-adolescent) group. The late-adolescent group also performed significantly faster on the control task than the mid-adolescent group, possibly suggesting they were simply faster at performing the computer task, though the effect size is larger in both the affective ToM RT (g=.70) and cognitive ToM RT (g=.92) than the control task RT (g=.67). Our finding that the late-adolescent group made significantly fewer errors than the mid-adolescent group on the affective ToM task supports the idea that affective ToM particularly develops throughout adolescence.

Is there a relationship between ToM and birth order in mid-adolescence and late adolescence? (RQ2)

We hypothesised that younger siblings would score higher than eldest or only children on both cognitive and affective ToM tasks. The results discussed here are not significant. Overall, in the Year 10 (mid-adolescent) sample, last-born children performed best, followed by first-born children, with middle-borns performing worst. While some of the descriptive data in the Year 10 sample did support the hypothesis, such as the last-born children performing best, there were no statistically significant group differences between birth order position on any of the ToM scores in the mid-adolescent group. It is important to note that the groups are not of equal sizes: first-borns comprise nearly half the sample (N=44), with N=16 middle-borns, and N=26 last-borns. The unequal and small sample sizes are likely responsible for the lack of significant findings.

The final-year university student (late-adolescent) group results did not support our hypothesis. Again, the results discussed in this paragraph are not significant. Only and last-born children made fewest mistakes on the ToM tasks, followed by first-borns, with middle-borns making the most mistakes. Reaction time was very similar across all birth-order positions on the cognitive ToM task, but only-children actually performed slowest on the affective ToM task, followed by last-borns, then first-borns, then middle-borns performing fastest. It is notable that only and last-born children performed slowest, but made the fewest mistakes, and middle-borns performed fastest but made most mistakes – it could be suggested that the middle-born participants made most mistakes as they were trying to complete the task as quickly as possible, and the results do not necessarily reflect differences in ToM ability.

There was only one statistically significant group difference between birth order position and ToM score in the final-year university student (late-adolescent) group, on the affective ToM task. We observed that only-children performed best on the affective ToM task, with the fastest reaction time and making fewest mistakes compared to the other birth-order groups, Welch's $F(3, 31.015) = 7.193$, $p=.001$, $\omega^2=.079$, a medium effect size. Games-Howell post hoc analysis revealed that the difference in affective ToM % error rate between only-children and first-born children (.62, 95% CI [.15, 1.10]) was statistically significant ($p=.006$). This is not in line with our hypothesis that later-born children would perform better on ToM tasks than first-born or only children, based on studies that have suggested having older siblings is beneficial to ToM development at preschool age (e.g. Ruffman et al., 1998; Ruffman et al., 1999). However, our results do partly support the findings from Leblanc et al. (2017), who found first-born children performed significantly more poorly than both later-borns and only children. This finding is unexpected, as the literature suggests the presence of siblings promotes better ToM (e.g. Perner et al., 1994), yet the first-borns performed more poorly than only children. Leblanc et al. (2017) suggest this could be explained by only children receiving more attention from parents, perhaps increasing opportunities to talk about mental states, compared to children with infant siblings, whose parents' time is divided amongst children. Additionally, infant siblings do not provide as many opportunities to learn about mental states as older siblings do: infant siblings are not yet able to engage in conversations, conflict, or pretend play. Thus, Leblanc et al. (2017) outlined that the presence of younger siblings both failed to promote ToM, and in fact appeared to hinder its development. The results in our study should be interpreted cautiously as it is dealing with very small numbers (n=8 only children in late-adolescent group).

The suggestion that first-born children's ToM performance could be impacted by both changes in parent-first-born interactions, and fewer opportunities to engage in meaningful conversations, is plausible for preschool aged children, however seems unlikely for late-stage adolescents. By this later stage of adolescence, ToM ability has been suggested to improve due to an increasing propensity to consider other individuals' perspectives, rather than specific cognitive skills (Dumontheil et al., 2010). All the participants in our sample will have likely experienced a wide range of social interactions by this stage, yet we hypothesised those individuals with siblings to have had an even richer social experience than those without, thus expected them to demonstrate better performance on ToM tasks. Therefore, finding that only-children performed significantly better than first-born children on the affective ToM task was unexpected. We hypothesized the last-borns would perform better than first-borns due to benefiting from a richer, more sophisticated social experience, and, similarly to Leblanc et al

(2017), we did find last-born children made fewer mistakes on the affective ToM task than first-born children in the late-adolescent group. It could be suggested that only-children performed better than all other birth-order groups due to an even richer social experience at home – perhaps only-children encounter more sophisticated perspective-taking opportunities as their main interactions are with parents rather than a combination of parents and younger siblings. It is important to note the small and unequal group sizes (n=8 in the only-child group, n=30 first-borns, n=12 middle-borns and n=23 last-borns). It would be beneficial to see if these significant differences between only-children and first-born children remain in a larger sample.

Is ToM associated with vocational interests in mid-adolescence and late adolescence? (RQ3)

We hypothesised that those individuals with higher levels of both cognitive and affective ToM would have more interest in People and Ideas. We did not find any correlations that were significant in relation to the vocational interests of People and Ideas, but did find some significant correlations between ToM and the vocational interest of Things.

The findings from both the Year 10 and the final-year university student sample did not support our hypothesis, and instead, opposing findings were found. The following results discussed in this paragraph are not significant. In the Year 10 group, those with higher levels of affective and cognitive ToM were generally less interested in vocations involving People (barring one exception: there was a very small correlation between interest in People with cognitive % error rate, as error rate decreased, interest in People-based vocations very slightly increased). Additionally, in the final-year university student group, there were small negative correlations between interest in People with affective % error rate, and also with cognitive ToM RT. These were both very small correlations and of no significance.

Additionally, in the Year 10 group, as affective and cognitive ToM performance improved (with faster reaction times), so did interest in working with Things. These were statistically significant correlations: for affective ToM, $r(88)= -.38$, $p=.000$, and cognitive ToM , $r(89)= -.32$, $p=.002$. Svedholm-Häkkinen and Lindeman (2016), whose vocational interest questionnaire item was used (in a slightly adapted form) in this study, found interest in working with Things was positively associated with 'systemizing' and negatively associated with 'empathizing', terms outlined in the Empathising-Systemising theory (Baron-Cohen et al., 2003). According to Baron-Cohen et al (2003), the term 'empathizing' encompasses ToM, mentalising, 'sympathy' and 'empathy'. Svedholm-Häkkinen and Lindeman's (2016) study found results in line with the Empathising-Systemising theory, with interest in working with people being positively correlated with empathizing and negatively correlated with sympathising. Both Svedholm-Häkkinen and Lindeman's (2016) results and Baron-Cohen et al's (2003) definition of 'empathising' encompassing ToM as an element supported the proposed hypothesis in our own study that individuals with higher levels of ToM ability would be more interested in vocations associated with working with People. However, Svedholm-Häkkinen and Lindeman (2016) also noted that interest in the humanities field was equally popular in both low empathising and high empathising individuals, with the main predictor being low talent and interest in systemising. In the full literature review on the relationship between ToM with vocational interests, it was highlighted that we should be aware that it could in fact be a lack of interest and ability in systemising that leads to vocational interests in People developing, rather than high empathising ability or strong performance in ToM tasks. This could explain the findings in the Year 10 group – students are interested in jobs involving People not due to higher levels of cognitive or affective ToM, but instead simply a lack of ability or interest in systemising (Things).

It is important to note that there was also a statistically significant, negative correlation between Things and the reaction time for the physical causality (control) trial as well, $r(89)= -.37$, $p=.000$, which is a stronger correlation than cognitive ToM, and a similar correlation of equivalently high significance to affective ToM. We therefore cannot argue that, based on these results, there is an association between ToM and vocational interests.

Is birth order associated with vocational interests in adolescents and undergraduates? (RQ4)

We hypothesised that younger siblings are more likely to have higher interest in People and Ideas than eldest or only children, and eldest or only children are more likely to have higher interest in Data and Things. There were no statistically significant differences between birth order position (first-born, middle-born and youngest-born in the Year 10 group, with the additional only-child group also analysed in the final-year university student group) and any of the vocational interests. The results discussed here are not significant, and are in regard to the Year 10 (mid-adolescent) group only. First-borns and last-borns had higher interest in Ideas than any of the other vocational interests, and both were least interested in Data. Before correcting for the effect of sex, middle-borns had the highest interest in People compared to any of the other vocational interests, and after correcting for the effect of sex, middle-borns had the highest interest in People across the birth order position groups. Both middle-borns and last-borns favouring vocational interests involving People supports the hypothesis that younger siblings are more likely to have higher interest in People, although first-borns having their lowest interest in Data and Things counters our hypothesis that eldest children are more likely to have higher interest in these vocational interests.

The descriptive results from the final-year university student group also largely counter our hypothesis. Again, the results discussed here are not significant. Last-born children were most interested in Data compared to every other birth order position, but did favour People over all three of the other vocational interests. However, first-borns and only children both favoured vocational interests involving People and Ideas over Data and Things, with the first-born group favouring People-based vocations most compared to the other birth order positions, the opposite of what was hypothesised. Middle-borns similarly favoured People and Ideas more than Data and Things, which is in line with our hypothesis, although again it should be noted that the group sizes are unequal (*n*=30 first-borns, *n*=12 middle-borns, *n*=23 last-borns and *n*=8 only children).

Our hypothesis was based on various birth-order studies, including a recent large-scale research that has found large birth order differences in college major choice. Barclay et al. (2017) studied cohorts born between 1982 and 1990, finding first-borns more likely to apply to law and long-term engineering programmes, and later-borns more likely to apply to art, business and journalism. The questionnaire used in our current study asks, “To what extent does your desired field of work or study focus on each of the following areas?”, asking the students to rate each vocational area on a scale of 1-4. While this should separate the vocations that clearly focus on some areas more than others (e.g. lab research would more likely focus on Data and Things than People), it could be argued that in vocations such as a medical doctor, or businessman, the field of work focuses on People to the same level as it focuses on Data. This could result in some participants rating typically ‘opposing’ vocational interests (such as People and Things, as Svedholm-Häkkinen and Lindeman’s (2016) study highlighted) or even all four vocational interests at the same level on the vocational interests item in our questionnaire. Therefore, coding the idealistic and realistic job aspirations the students have also provided in their questionnaires, and using these in addition to the current vocational interest, will provide a variable that could potentially more accurately reflect their vocational interest. compromise. Additionally, the final-year university student group were heavily made up of social sciences or humanities students (64.79% of the sample were studying subjects classed as social sciences, 23.94% were studying humanities, and only 11.27% were studying sciences), with more than a third of the sample (33.80%) being drawn from psychology or psychology in education degree programmes, which again could have had an effect on our data.

Next steps

The next chapter will explore the longitudinal relationships between these same variables (ToM, birth order and vocational interests), but focusing on the stage of mid-adolescence. We returned to retest the Year 10s one year later when they were in Year 11, and tested them on the same ToM task, as well as asked them to fill out the same questionnaire regarding their vocational interests and plans for the future.

5 Study 2: A Longitudinal Exploration of Theory of Mind Development During Mid-Adolescence, in Relation to Birth Order and Vocational Interests

5.1 Introduction

The aim of the study is to explore whether vocational interests are shaped by Theory of Mind (ToM) and/or birth order across adolescence. Chapter 4 compared the relationships between these variables between the mid-adolescent group and the late-adolescent group. This chapter presents the longitudinal data from participants tested in Year 10 and again in Year 11, so is focused on the development during mid-adolescence. Numerous studies have explored ToM development during adolescence, but through cross-sectional research: comparing ToM scores between groups of adolescents with groups of adults (e.g. Dumontheil et al., 2010; Valle et al., 2015). This was the approach we took in Chapter 4. There are very few studies that have longitudinally tested ToM development during adolescence, so the first research question our longitudinal research explores is whether there is any evidence of ToM developing between Year 10 and Year 11 (approximately between the ages of 14 to 15). Additionally, it has been suggested that during adolescence, vocational interests crystallise: this is a period of cognitive and socio-emotional development and important identity formation (Low & Rounds, 2007). As far as we are aware, there are no studies assessing the relationship between ToM and vocational interests, and there are few recent studies looking at the relationship between birth order and vocational interests specifically. This study explores the potential influence ToM and birth order have on vocational interests during this stage, and the longitudinal nature of the research allows the opportunity to assess these relationships at two important time-points.

5.2 Research questions

1. Does Theory of Mind (ToM) develop during mid-adolescence i.e. between Year 10 and Year 11?
2. Is there a relationship between birth order and ToM development in mid-adolescence?
3. Does ToM at Year 10 predict vocational interest choice in Year 11?
4. Is there an association between birth order and vocational interest change in mid-adolescence?
5. Are longitudinal relationships between birth order and vocational interests mediated by ToM in mid-adolescence?

Study hypotheses are presented in section 5.4.

5.3 Methods

Participants

Participants were *n*=72 Year 11 pupils (37 male and 35 female). At the first wave of testing, reported in Chapter 4, there were *n*=91 (46 male and 45 female) Year 10 pupils, of which n=80 had consented to taking part in the research a year later (*n*=11 Year 10 pupils in the first wave of testing were pilot participants tested in July 2017, so were one academic year ahead of the main study participants, and therefore could not take part in the second wave of the research because they were too old at the point of follow-up data collection). Of the *n*=80 who had consented to take part in the second wave of testing, *n*=72 were retested. Absence from school due to illness and appointments, alongside an all-day food technology exam in one school, was the cause of the slightly smaller sample size at wave two.

We recalculated mean ages for the Year 10 sample that was re-tested in Year 11. The mean age at Year 10 was 14.91 years (SD=.41, range=14.31-16.29), with the mean age for male students being 14.92 years (SD=.42, range=14.31-16.29), and the mean age for female students being 14.90 (SD=.40, range=14.31-16.07). At Year 11, the mean age was 15.91 (SD=.41, range 15.29-17.29), with the mean age for male students being 15.92 years (SD=.42, range=15.29-17.29), and the mean age for female students being 15.90 (SD=.40, range=15.31-17.09). We only tested one year group, so anticipated the age range to be between 14.30 and 15.81 (based on the assumed youngest birthdate for the year group of August 31st 2003 being tested at the earliest time point, and the oldest birthdate of September 1st 2002 being tested at the latest time point). There were no students younger than the anticipated minimum age, but there were n=2 students aged over 16.00 at the first wave of testing (and therefore over 17.00 at the second wave of testing).

Measures

This study used the same measures as the cross-sectional chapter (Chapter 4), with the exception of the FSIQ task. It was decided that the FSIQ task would not be conducted again due to it taking 15-20 minutes per participant to conduct, and a number of longitudinal studies have found IQ to be highly stable over time, particularly from childhood (Deary et al., 2004; Schneider et al., 2014). The same ToM computer task and questionnaire were used at the second wave. These are outlined in full in Chapter Three (Methods).

Procedure

This study used the same procedure as the cross-sectional chapter (Chapter 4), with the exception of the FSIQ task (as noted above). The ToM computer task and questionnaire used were the same as in the first wave. Please see Chapter Three (Methods) for a full outline of the procedure used.

Analysis

As discussed in Chapter 3, the study and all analyses were pre-registered with the OSF (see: https://osf.io/6mzwy?view_only=7087badd2dd04b3a917396087fa46c25).

As specified in our OSF pre-registration, all analyses were run with outliers included and excluded. Cases were determined as outliers if their scores were +/- 3SDs above or below the mean, with outlier detection being conducted for each separate analysis. All analysis in this chapter is presented with outliers included (analyses with outliers removed are available in Appendix (11.5). There were no significant changes when outliers were excluded, with the exception of RQ4. Therefore, for this section (5.4.4), analysis is presented with both outliers included and excluded.

Outlined below are the study's hypotheses (related to research questions) and the statistical tests used to address them.

1. Does Theory of Mind (ToM) develop during mid-adolescence i.e. between Year 10 and Year 11?

Hypothesis: ToM will increase a small amount between Year 10 and Year 11.

A paired-samples t-test was conducted to assess whether differences exist in ToM scores as age increases. The continuous dependent variable was ToM score (reaction time and mean % error rate for each condition was assessed separately), and the dichotomous independent variable was age. Assumptions of normality (using the Shapiro-Wilk test of normality and visual inspections of Normal Q-Q Plots) and homogeneity of variance (using Levene's Test for the Equality of Error Variances) were assessed.

2. Is there a relationship between birth order and ToM development in mid-adolescence?

Hypothesis: Younger siblings will score higher than eldest or only children on both cognitive and affective ToM tasks.

An Analysis of Variance (one way ANOVA) was conducted to assess whether a relationship exists between birth order position and ToM score in the Wave 2 data. The dependent variable in the analysis was ToM score (reaction time and mean % error rate for each condition was assessed separately), and the discrete groups of birth order position were only child, first-born, middle-born, and last-born. Assumptions of normality (using the Shapiro-Wilk test of normality and visual inspections of Normal Q-Q Plots) and homogeneity of variance (using Levene's Test for the Equality of Error Variances) were assessed.

One-way repeated measures ANOVAS were additionally conducted to determine whether there were any statistically significant differences found in ToM performance over the one-year period in each of the birth-order groups separately. Additionally, two-way mixed ANOVAs were conducted to assess whether there was an interaction between birth-order position and time on ToM performance, in order to assess whether there is a longitudinal effect of birth-order position on ToM development.

3. *Does ToM at Year 10 predict vocational interest choice in Year 11?*

Hypothesis: Those individuals with higher levels of ToM (both affective and cognitive) will have more interest in working with people, and those individuals with lower levels of ToM (both affective and cognitive) will have more interest in working with things.

a) A Pearsons *r* correlation was used to assess the relationship between the predictor (independent) variable ToM score (reaction time and mean % error rate for each condition will be assessed separately) and outcome (dependent) variable vocational interest (each vocational interest area - Data, Ideas, People and Things - was assessed on an individual basis) in the Wave 2 data. Cohen's *d* will be used to evaluate the correlation coefficient for each vocational interest area where 0.10 to 0.29 = weak association, 0.30 to 0.49 = moderate associate and 0.50 or larger = strong association.

b) Stepwise multiple regression was used to explore whether ToM in Year 10 predicts Theory of Mind in Year 11 (controlling for the effects of Theory of Mind in Year 11). We put Year 10 VI data and Year 11 ToM data into Step 1 (with Year 11 VI as the dependent variable). We then put Year 10 ToM data into Step 2, to assess whether Year 10 ToM is predictive of Year 11 VI, over and above the other variables.

4. Is there an association between birth order and vocational interest change in mid-adolescence?

Hypothesis: Younger siblings are more likely to have higher interest in people and Ideas than eldest or only children. Eldest or only children are more likely to have higher interest in data and things.

An Analysis of Variance (one-way ANOVA) was also conducted to determine whether there is a significant difference in vocational interest score by birth order position in the Wave 2 data. The dependent variable in the analysis was vocational interest score (People, Ideas, Data and Things will be assessed separately), and the discrete groups of birth order position were only child, first-born, middle-born, and last-born. Assumptions of normality (using the Shapiro-Wilk test of normality and visual inspections of Normal Q-Q Plots) and homogeneity of variance (using Levene's Test for the Equality of Error Variances) were assessed.

Repeated-measures ANOVAs were conducted to determine whether there were any statistically significant differences in vocational interests over the one-year period between Year 10 and Year 11 in each of the birth-order groups separately. Two-way mixed ANOVAs were also conducted to assess whether there was an interaction between birth-order position and time on vocational interests, in order to assess whether there is a longitudinal effect of birth-order position on vocational interest development.

5. Are longitudinal relationships between birth order and vocational interests mediated by ToM in mid-adolescence?

Hypothesis: The relationships between birth order and vocational interests are mediated by ToM – younger siblings are more likely to have higher interest in people and Ideas than eldest or only children, and this will be mediated by their higher levels of ToM (both affective and cognitive).

Maximum likelihood structural equation modelling (SEM) techniques were planned to test for mediation effects in both Wave 1 and Wave 2: to assess whether ToM score mediates the relationship between birth order (the independent variable) and vocational interests (the dependent variable). SEM techniques were chosen for the mediation analysis as they enable us to examine the interrelationships between a number of dependent and independent variables (Belsky et al., 2007). Additionally, “longitudinal data makes it possible to examine whether new variance in a mediator or outcome is predicted from earlier variance in a predictor or mediator, respectively, after accounting for stability of and prior associations between the variables.” (Belsky et al., 2007. p.1236). We planned to use SEM software AMOS and follow Cole and Maxwell’s (2003) guidelines for testing mediational hypotheses with longitudinal data.

5.4 Results

Descriptive Statistics

Descriptive statistics were calculated for all main study variables for both Year 10 and Year 11 samples and are presented in Table 5.1 (with outliers included). The total sample was *n*=72, however one Year 11 student had an error rate of 100% on the affective ToM task, so was removed from the affective ToM reaction time follow-up analysis as no reaction time could be calculated for them (only correct trials are used to calculate average reaction time). There are differences to the Year 10 data presented in the previous chapter as this analysis only uses data from the n=72 participants who provided data at both time points. Raw scores are presented in Table 5.1. Again, we ran ANOVAs to see the effects of sex on the ToM and vocational interest scores, which are also presented in Table 5.1. ToM scores corrected for IQ and gender are used in the analysis. These corrected scores were calculated for each group separately (at Year 10 and at Year 11), with the exception of RQ1, where the ToM scores were corrected for IQ and gender across the whole sample, in order for us to run paired t-tests. We also present the results of the paired t-tests in RQ1 using the raw ToM data.

TABLE 5.1 DESCRIPTIVE STATISTICS FOR STUDY VARIABLES AT TIME POINT 2 (YEAR 11) WITH SEX COMPARISON

Measures	Means and standard deviations for Year 10 data						ANOVA-effects of sex		Means and standard deviations for Year 11 data						ANOVA-effects of sex	
	All		Females		Males		Sex		All		Females		Males		Sex	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Cog ToM RT (s)	2.53 (72)	.53	2.46 (35)	.44	2.60 (37)	.59	.252	.019	2.28 (72)	.48	2.20 (35)	.48	2.35 (37)	.48	.176	.026
Aff ToM RT (s)	2.42 (72)	.52	2.30 (35)	.44	2.53 (37)	.57	.054	.052	2.20 (71)	.49	2.08 (35)	.43	2.32 (36)	.53	.041	.059
Phys Caus RT (s)	2.47 (72)	.55	2.40 (35)	.48	2.54 (37)	.61	.280	.017	2.32 (72)	.55	2.20 (35)	.47	2.43 (37)	.60	.074	.045
Cog ToM % ER	4.68 (72)	9.98	2.06 (35)	4.19	7.15 (37)	12.92	.030	.066	5.84 (72)	11.57	4.45 (35)	7.63	7.15 (37)	14.33	.327	.014
Aff ToM % ER	12.66 (72)	14.81	8.57 (35)	10.68	16.52 (37)	17.12	.022	.073	12.03 (72)	18.18	6.59 (35)	10.17	17.18 (37)	22.31	.012	.086
Phys Caus % ER	9.79 (72)	13.87	10.77 (35)	13.75	8.86 (37)	14.10	.563	.005	6.81 (72)	12.74	5.42 (35)	9.27	8.12 (37)	15.34	.373	.011
Voc. Interest																
a Data	2.51 (71)	.92	2.31 (35)	.90	2.69 (36)	.92	.083	.043	2.58 (72)	.95	2.54 (35)	2	2.62 (37)	.98	.727	.002
b Things	2.70 (70)	1.08	2.38 (34)	1.07	3.00 (36)	1.01	.016	.083	2.60 (72)	1.07	2.23 (35)	1.00	2.95 (37)	1.03	.004	.114
c People	2.89 (71)	.98	3.06 (35)	.94	2.72 (36)	1.00	.151	.030	3.19 (72)	.88	3.31 (35)	.76	3.08 (37)	.98	.265	.018
d Ideas	2.82 (71)	.93	2.66 (35)	.97	2.97 (36)	.88	.155	.029	3.04 (72)	.81	2.94 (35)	.78	3.14 (37)	.79	.319	.014

RT = reaction time; ER = error rate; M= mean; SD = standard deviation; n = sample size; *p*= p-value of the effects of sex on variables; η^2 = eta-squared.

RQ1 Does Theory of Mind (ToM) develop during mid-adolescence i.e. between Year 10 and Year 11?

Paired-samples t-tests were conducted to explore whether students performed better on the cognitive and affective ToM tasks in Year 11 compared to Year 10. The scores, which were re-standardised and corrected for the effects of IQ and gender within each age-group, all had a mean of 0.00 (and therefore paired t-tests could not measure for any differences between the two time-points). In order to conduct the longitudinal analysis, we therefore used the raw ToM scores. Additionally, we ran the analysis again with ToM scores that were corrected for gender and IQ across the whole sample (meaning we could analyse the change in ToM scores between both groups while correcting for the effect of IQ and gender). Results from both analyses are presented in Table 5.2 below, and are also presented in bar graphs in Figures 5.1 and 5.2 below the table. Results with outliers excluded are presented in Appendix 11.5.

Data were approximately normally distributed for reaction times in both groups, as assessed by visual inspection of Normal Q-Q Plots, however the error rate data was skewed to the right. To correct for multiple comparisons, a Benjamini-Hochberg FDR correction was applied.

TABLE 5.2 MEANS, STANDARD DEVIATIONS AND PAIRED-SAMPLES T-TEST RESULTS BY GROUP

RAW YEAR 10 AND YEAR 11 TOM SCORES

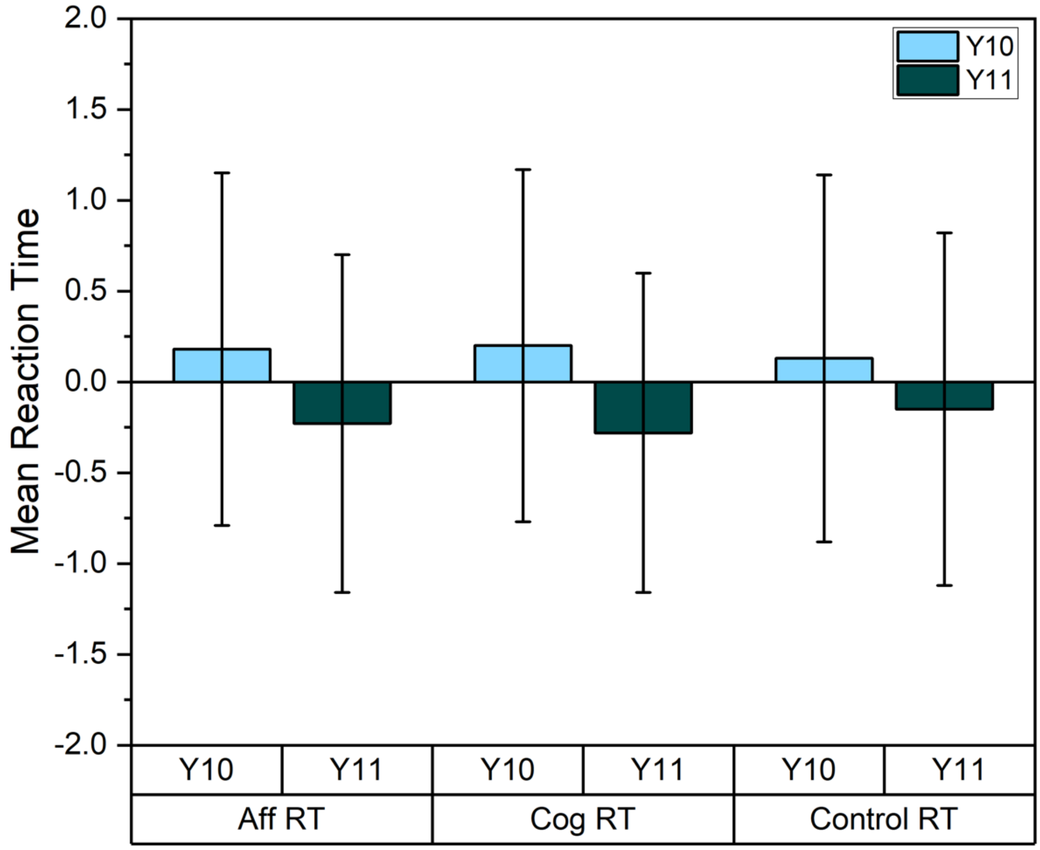
	Year 10		Year 11		*t*-value	df	*p*	Cohen's *d*
	M (n)	SD	M (n)	SD				
Affective ToM RT	2.41 (71)	.51	2.20 (71)	.49	4.04	70.00	.000**	.42
Cognitive ToM RT	2.53 (72)	.53	2.28 (72)	.48	5.23	71.00	.000**	.49
Phys Caus (control) RT	2.47 (72)	.55	2.32 (72)	.55	2.43	71.00	.018*	.27
Affective ToM % ER	12.66 (72)	14.81	12.03 (72)	18.18	.36	71.00	.723	.04
Cognitive ToM % ER	4.68 (72)	9.98	5.84 (72)	11.57	-1.08	71.00	.283	.11
Phys Caus (control) % ER	9.79 (72)	13.87	6.81 (72)	12.74	1.83	71.00	.072	.22

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

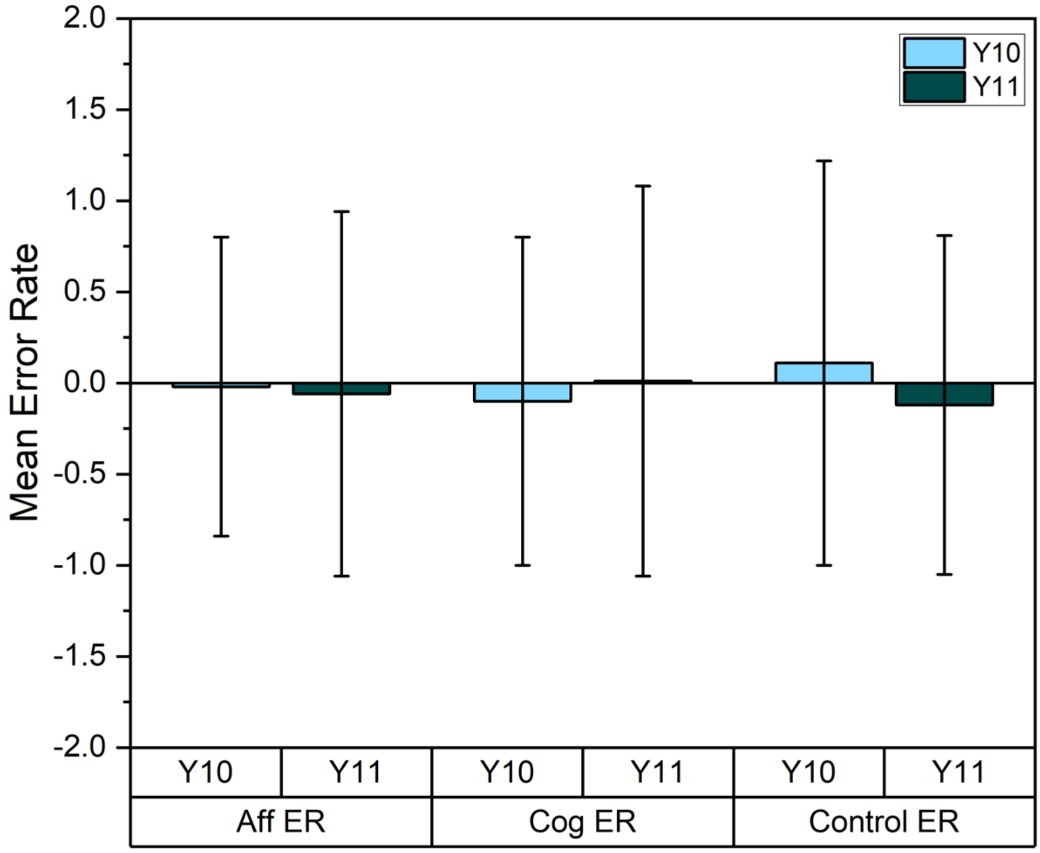
Corrected Year 10 and Year 11

	Year 10		Year 11		*t*-value	df	*p*	Cohen's *d*
	M (n)	SD	M (n)	SD				
Affective ToM RT	.18 (71)	.97	-.23 (71)	.93	4.04	70.00	.000**	.43
Cognitive ToM RT	.20 (72)	.97	-.28 (72)	.88	5.23	71.00	.000**	.52
Phys Caus (control) RT	.13 (72)	1.01	-.15 (72)	.97	2.43	71.00	.018*	.28
Affective ToM % ER	-.02 (72)	.82	-.06 (72)	1.00	.36	71.00	.723	.04
Cognitive ToM % ER	-.10 (72)	.90	.01 (72)	1.07	-1.08	71.00	.283	.11
Phys Caus (control) % ER	.11 (72)	1.11	-.12 (72)	.93	1.83	71.00	.072	.22

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR



5.1 Year 10 and Year 11 ToM Reaction Times



5.2 Year 10 and Year 11 ToM % Error Rates

The students performed significantly faster on the affective ToM task in Year 11 compared to Year 10, M=2.20s vs 2.41s, 95% CI [1.05, 3.10], t(70)=4.04, *p*=.000. The students also performed significantly faster on the cognitive ToM task in Year 11 compared to in Year 10, M=2.28s vs 2.53s, 95% CI [1.59, 3.55], *t*(71)=5.23, *p*=.000. However, the students also performed significantly faster on the control physical causality task, M=2.32 vs 2.47, 95% CI [.27, 2.74], *t*(71)=2.43, *p*=.018, which suggests the students have simply become faster at completing the task, and not necessarily developed their ToM ability. However, it is notable that we observed larger effect sizes for the cognitive and affective ToM task (*d*=.49 and *d*=.42 respectively) than the control task (*d*=.27). There were no differences in % error rate in any of the conditions between Year 10 and Year 11.

RQ2: Is there a relationship between birth order and ToM development in mid-adolescence?

A one-way ANOVA was used to explore whether reaction times and % error scores on the cognitive and affective ToM tasks varied dependent on specific birth order position in the participants at both Year 10 and Year 11. The results can be seen in Table 5.3 below. Bar graphs presenting the data from the Year 11 group can be seen in Figure 5.3 and 5.4 below the table (bar graphs including the full Year 10 sample can be found in the previous chapter in Figures 4.3 and 4.4). Data were normally distributed for ToM reaction times in all conditions in both Year 10 and Year 11 datasets, as assessed by visual inspection of Normal Q-Q plots, however for the % error rate on the ToM tasks, the Normal Q-Q Plots were skewed to the right. Homogeneity of variances was met in all cases of the second wave of data analysis, as assessed by Levene's test for equality of variances (p>.05), with the exception of affective ToM RT (*p*=.041). The assumption of homogeneity of variances was violated for the percentage error rates for the physical causality (control) (*p*=.037) and affective ToM (*p*=.020) conditions in the Wave 1 (Year 10) group. Therefore, the results of the Welch test were used for these three conditions instead.

In the Year 11 group, cognitive ToM RT was initially statistically significantly different for each birth order group, $F(2, 66) = 5.040$, $p=.009$, $\eta_p^2=.132$, a large effect size. Reaction times on the cognitive ToM task decreased from the middle-borns (M=.38, SD=.91), to the first-borns (M=.18, SD=1.00), to the last-born students who performed the fastest (M=-.55, SD=.80). Tukey post hoc analysis revealed that the mean decrease in time from the first-borns to last-borns (-.73, 95% CI [-1.36, -.10]), was statistically significant ($p=.019$), and the mean decrease in time from middle-borns to last-borns (-.93, 95% CI [-1.76, -.11]) was statistically significant ($p=.022$) but no other group differences were statistically significant. This supports our hypothesis that last-born children will outperform first-born children on ToM tasks. However, when corrected for multiple comparisons using Benjamini-Hochberg FDR, this result was no longer significant.

In the Year 10 group, physical causality percentage error rate was also statistically significantly different for each birth order group, Welch's $F(2, 26.155) =3.536$, $p=.044$, $\omega^2=.024$. Percentage error rate decreased from last-borns (M=-.38, SD=.46), to first-borns (M=.13, SD=1.06) to middle-borns, who made the most mistakes (M=.17, SD=1.33). Games-Howell post hoc analysis revealed that the mean increase from last-borns to first-borns (.50, 95% CI [.02, .99]), was statistically significant ($p=.042$), but no other differences between the groups were statistically significant. Additionally, physical causality reaction time was also statistically significantly different for each birth order group, $F(2,66)=3.233$, $p=.046$, $\eta_p^2=.089$. Reaction times on the control task decreased from middle-borns (M=.46, SD=.91), to first-borns (.07, SD =1.02), to the last-born students who performed the fastest (M=-.42, SD=.87). Tukey post hoc analysis revealed that the mean decrease in time from the middle-borns to the last-borns (-.88, 95% CI [-1.73, -.03]) was statistically significant. When corrected for multiple comparisons using Benjamini-Hochberg FDR, these results was no longer significant. As this was the control condition, it does not relate to our hypotheses regarding ToM and birth order.

When outliers were excluded from the one-way ANOVA no other differences were found.

TABLE 5.3 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY BIRTH ORDER POSITION FOR MID-ADOLESCENCE GROUP (IN YEAR 10 AND YEAR 11)

Measures	Means and standard deviations including outliers								ANOVA-effects of birth order position	
	Year 10									
	All		First-born		Middle-born		Last-born		Birth order	
	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
1 Cog ToM RT (s)	.01 (69)	1.00	.09 (38)	1.09	.39 (12)	.92	-.39 (19)	.76	.082	.073
2 Aff ToM RT (s)	-.01 (69)	1.00	.05 (38)	1.01	.42 (12)	.89	-.41 (19)	.93	.064	.080
3 Phys Caus RT (s)	.00 (69)	1.00	.07 (38)	1.02	.46 (12)	.91	-.42 (19)	.87	.046	.089
4 Cog ToM % ER	-.01 (69)	1.00	.07 (38)	1.24	.02 (12)	.69	-.20 (19)	.50	.628	.014
5 Aff ToM % ER	-.06 (69)	.94	-.02 (38)	1.12	.11 (12)	.66	-.24 (19)	.66	.363 w	-.013 ω^2
6 Phys Caus % ER	-.00 (69)	1.01	.13 (38)	1.06	.17 (12)	1.33	-.38 (19)	.46	.044 w	.024 ω^2
7 Voc Interest (Y10) - a Data	2.46 (68)	.91	2.49 (37)	.90	2.25 (12)	1.06	2.53 (19)	.84	.684	.012
b Things	-.05 (67)	.99	-.24 (36)	.94	.19 (12)	1.10	.18 (19)	.97	.216	.047
c People	.01 (68)	1.01	.04(37)	.92	.17 (12)	1.12	-.15 (19)	1.14	.673	.012
d Ideas	2.79 (68)	.94	2.76 (37)	.93	2.67 (12)	.89	2.95 (19)	1.03	.362	.024
	Year 11									
1 Cog ToM RT (s)	.01 (69)	.99	.18 (38)	1.00	.38 (12)	.91	-.55 (19)	.80	.009	.132
2 Aff ToM RT (s)	.03 (69)	.98	.12 (38)	1.12	.13 (12)	.53	-.20 (19)	.90	.418 w	-.009 ω^2
3 Phys Caus RT (s)	.00 (69)	.97	.11 (38)	1.09	.20 (12)	.65	-.33 (19)	.84	.208	.047
4 Cog ToM % ER	-.02 (69)	1.00	-.04 (38)	1.21	.06 (12)	.87	-.03 (19)	.53	.948	.002
5 Aff ToM % ER	-.10 (69)	.80	-.07 (38)	.87	.02 (12)	.66	-.23 (19)	.76	.666	.012
6 Phys Caus % ER	-.01 (69)	1.00	-.02 (38)	1.22	.17 (12)	.80	-.10 (19)	.56	.761	.008
7 Voc Interest (Y11) - a Data	2.57 (68)	.95	2.53 (38)	1.03	2.42 (12)	.90	2.79 (19)	.79	.500	.021
b Things	.02 (67)	.99	.01 (38)	.99	-.27 (12)	1.08	.23 (19)	.95	.388	.028
c People	-.00 (68)	1.00	.12 (38)	.93	-.15 (12)	1.02	-.22 (19)	1.13	.440	.025
d Ideas	3.03 (68)	.81	3.05 (38)	.77	2.83 (12)	1.03	3.16 (19)	.76	.560	.017

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity of variances violated, Welch test used instead.

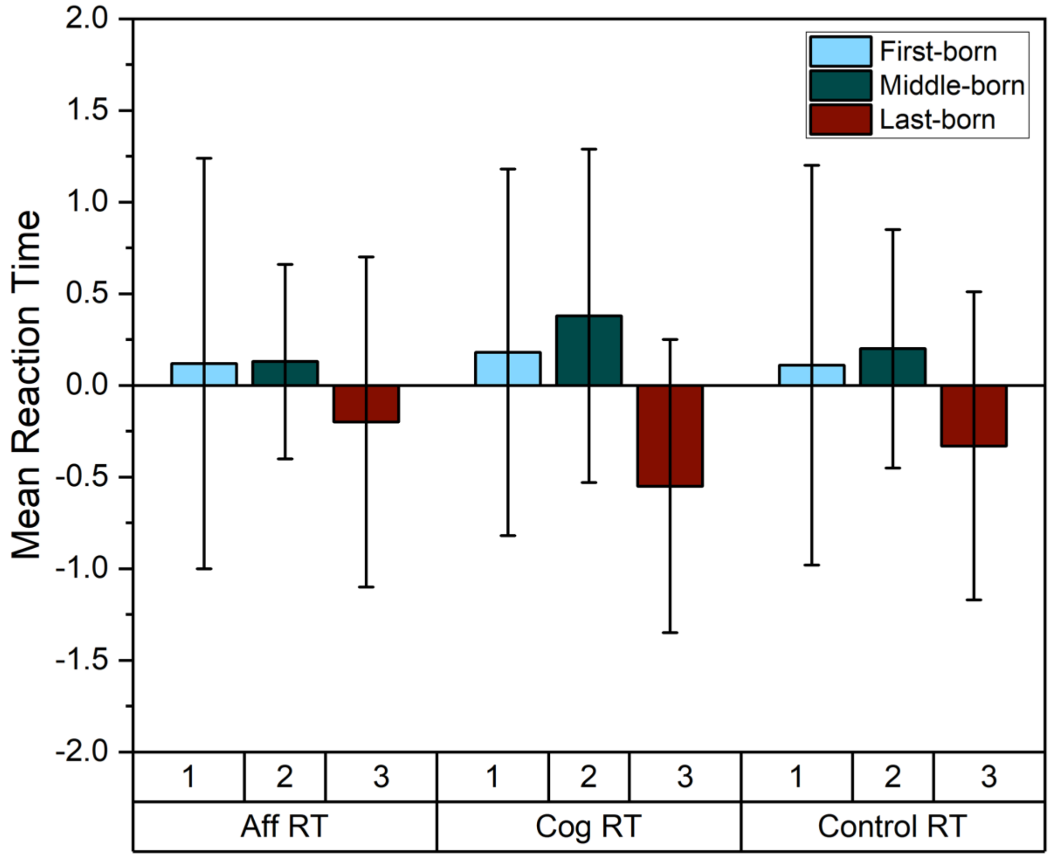
Sample size n=71 for ToM data as one student gave no birthdates for siblings at either time point so was not included in the analysis. Y10 vocational interest sample sizes also vary due to missing questionnaire data.

TABLE 5.4 MEANS, STANDARD DEVIATIONS AND REPEATED-MEASURES ANOVA RESULTS BY BIRTH ORDER POSITION FOR MID-ADOLESCENCE GROUP (IN YEAR 10 AND YEAR 11)

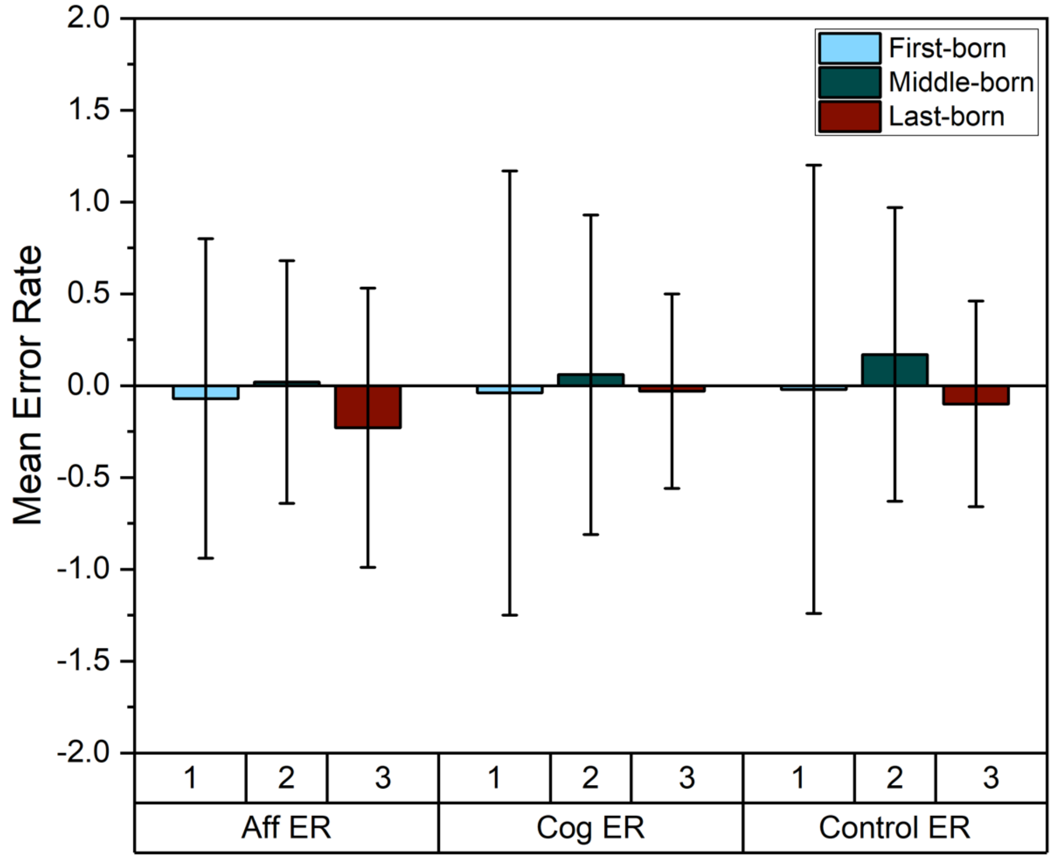
Measures	Means and standard deviations including outliers and results of repeated-measures ANOVAs **Year 10**																	
	All (N=69)				First-born (n=38)				Middle-born (n=12)				Last-born (n=19)				2-WayMixed ANOVA-effects	
	Year 10	Year 11			Year 10	Year 11			Year 10	Year 11			Year 10	Year 11				
	M (SD)	M (SD)	*p*	η_p^2	M (SD)	M (SD)	*p*	η_p^2	M (SD)	M (SD)	*p*	η_p^2	M (SD)	M (SD)	*p*	η_p^2	*p*	η_p^2
1 Cog ToM RT	.01 (1.00)	.01 (.99)	.994	.000	.09 (1.09)	.18 (1.00)	.490	.013	.39 (.92)	.38 (.91)	.972	.000	-.39 (.76)	-.55 (.80)	.293	.061	.556	.018
2 Aff ToM RT	-.01 (1.00)	.03 (.98)	.662	.003	.05 (1.01)	.12 (1.12)	.596	.008	.42 (.89)	.13 (.53)	.381	.070	-.41 (.93)	-.20 (.90)	.267	.068	.271	.039
3 Phys Caus RT	.00 (1.00)	.00 (.97)	.995	.000	.07 (1.02)	.12 (1.09)	.786	.002	.46 (.91)	.20 (.65)	.513	.040	-.42 (.87)	-.33 (.84)	.676	.010	.584	.016
4 Cog ToM % ER	-.01 (1.00)	-.02 (1.00)	.943	.000	.07 (1.24)	-.04 (1.21)	.424	.017	.02 (.69)	.06 (.87)	.845	.004	-.20 (.50)	-.03 (.53)	.355	.048	.473	.022
5 Aff ToM % ER	-.06 (.94)	-.10 (.80)	.704	.002	-.02 (1.12)	-.07 (.87)	.765	.002	.11 (.66)	.02 (.66)	.665	.018	-.24 (.66)	-.24 (.76)	.996	.000	.961	.001
6 Phys Caus % ER	-.00 (1.01)	-.01 (1.00)	.969	.000	.13 (1.06)	-.02 (1.22)	.334	.025	.17 (1.33)	.17 (.80)	.996	.000	-.38 (.46)	-.10 (.56)	.109	.136	.330	.033
7 Voc Interest a Data	2.46 (.91)	2.57 (.95)	.336	.014	2.49 (.90)	2.51 (1.04)	.868	.001	2.25 (1.06)	2.42 (.90)	.551	.033	2.53 (.84)	2.79 (.79)	.310	.057	.699	.011
b Things	-.05 (.99)	.02 (.99)	.649	.003	-.24 (.94)	.01 (.98)	.106	.073	.19 (1.10)	-.27 (1.08)	.350	.080	.18 (.97)	.23 (.95)	.876	.001	.230	.045
c People	.01 (1.01)	-.00 (1.00)	.910	.000	.04 (.92)	.15 (.92)	.595	.008	.17 (1.12)	-.15 (1.02)	.415	.061	-.15 (1.14)	-.22 (1.13)	.747	.006	.534	.019
d Ideas	2.79 (.94)	3.03 (.81)	.031	.067	2.76 (.93)	3.03 (.76)	.096	.075	2.67 (.89)	2.83 (1.03)	.551	.033	2.95 (1.03)	3.16 (.76)	.215	.084	.932	.002

Note. ** = statistically significant at *p*<.01, * = statistically significant at *p*<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Sample size n=69 for ToM data as one student gave no birthdates for siblings at either time point so was not included in the analysis. Due to missing questionnaire data in Y10, vocational interest sample sizes vary: (N=68 for Data, N=67 for Things, N=68 for People and N=68 for Ideas). As these participants with missing data were first-born children, the vocational interest sample sizes vary in this group (n=37 for Data, n=36 for Things, n=37 for People and n=37 for Ideas).



5.3 YEAR 11 ToM PERFORMANCE (REACTION TIMES) BY BIRTH ORDER POSITION



5.4 YEAR 11 ToM PERFORMANCE (% ERROR RATES) BY BIRTH ORDER POSITION

One-way repeated measures ANOVAS were additionally conducted to determine whether there were any statistically significant differences found in ToM performance over the one-year period in each of the birth-order groups separately. This analysis is presented in Table 5.4 above. The data was normally distributed at each time point, as assessed by Q-Q plots, in each ToM condition, with the exception of cognitive ToM and the control task % error rates, where the Q-Q plots were skewed slightly to the right. There were no statistically significant changes in ToM performance over time in any of the birth-order groups.

Additionally, two-way mixed ANOVAs were conducted to assess whether there was an interaction between birth-order position and time on ToM performance, in order to assess whether there is a longitudinal effect of birth-order position on ToM development. There was homogeneity of variances (p>.05) as assessed by Levene's test of homogeneity of variances in most conditions, with the exceptions of Affective RT in Year 11 (p=.041), Affective % ER in Year 10 (p=.020), and the control task % error rate (p=.037). Additionally, there was homogeneity of covariances (p>.001) as assessed by Box's M test in all cases, with the exception of Cognitive % ER (p=.000) and the control task % error rate (p=.000). There was no statistically significant interaction between birth-order position and time on ToM performance, with the exception of the physical causality control task, although once corrected for multiple comparisons using Benjamini-Hochberg FDR, this result was no longer significant. As this was the control task and there were no significant, substantial results found in either of the ToM conditions, no further investigation was conducted.

RQ3: Does ToM at Year 10 predict vocational interest choice in Year 11?

We hypothesised that those individuals with higher levels of ToM (both affective and cognitive) would have more interest in working with people, and those individuals with lower levels of ToM (both affective and cognitive) would have more interest in working with things. We firstly assessed the relationship between ToM scores and vocational interests cross-sectionally (running the analysis separately for both Year 10 and Year 11 scores). We then assessed the longitudinal relationship of the relationship between ToM score in Year 10 with vocational interest score in Year 11.

Pearson's correlations were run to assess the relationships between different vocational interests and reaction times on both the cognitive and affective ToM tasks, and can be seen in Tables 5.5-5.8 (below). To correct for multiple comparisons, a Benjamini-Hochberg FDR correction was applied. Not all variables were normally distributed, as assessed by Shapiro-Wilk's test (p>.05), so the non-parametric test of a Spearman's rank-order correlation was also conducted. There were no substantially different associations found between any of the ToM conditions and any of the vocational interests between the different correlations, so the results of the Pearson's correlations are discussed. The results of the Spearman's rank-order correlations are presented in Appendix 11.5.

When assessed cross-sectionally, there was only one vocational interest that correlated significantly with ToM scores. The Year 10 data presented in the tables below only includes the Year 10s who were re-tested at the second wave, and therefore there are differences with the results presented in Chapter 4. Pearson's correlations found significant, negative correlations between cognitive ToM reaction time and vocational interest in Things, r(70) = -

.329, *p*=.005, and affective ToM reaction time and vocational interest in Things, *r*(69) = -.347, *p*=.004. There additionally was a statistically significant negative correlation between reaction time in the physical causality (control) task and vocational interest in Things, *r*(70)= -.353, *p*=.003.

We ran Pearson's correlations between Y10 ToM scores and Y11 vocational interest scores as a pre-step for the stepwise multiple regression (results can be seen in Table 5.6 below). With outliers included, no statistically significant correlations were found between ToM scores and vocational interest scores. However, when the analysis was conducted with outliers excluded, we found a statistically significant positive correlation between percentage error rate in affective ToM % error rate and vocational interest in Ideas, *r*(68) = .311, *p*=.010; more mistakes on the affective ToM task correlated with higher interest in Ideas. There additionally was a statistically significant negative correlation between reaction time in the affective ToM task and vocational interest in Things, *r*(68) = -.329, *p*=.006, although there was also a significant negative correlation between reaction time in the control ToM task and vocational interest in Things, *r*(68)=-.389, *p*=.001, which was a stronger correlation. The results of the Pearson's rank order correlations with outliers excluded can be seen in Table 5.7.

TABLE 5.5 PEARSON'S CORRELATIONS BETWEEN YEAR 10 TOM AND YEAR 10 VOCATIONAL INTERESTS

N=72 in all ToM conditions except affective RT (*N*=71). *N*=71 in all VIs except VI Things (*N*=70).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.826**	-								
3 Phys Caus (RT)	.757**	.740**	-							
4 Cognitive (% ER)	.114	.130	.175	-						
5 Affective (% ER)	.252	.345**	.374**	.488**	-					
6 Phys Caus (% ER)	-.010	.023	.147	.461**	.483**	-				
7 VI Data	-.142	-.094	-.143	.023	.071	.001	-			
8 VI Things	-.297**	-.347**	-.353**	.032	.000	.115	.168	-		
9 VI People	.262	.290	.346**	-.101	.041	-.167	-.091	-.209	-	
10 VI Ideas	-.127	-.194	-.078	.089	.205	.215	.076	.033	.166	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 5.6 PEARSON'S CORRELATIONS BETWEEN YEAR 11 TOM AND YEAR 11 VOCATIONAL INTERESTS

N=72 in all conditions except affective RT (*N*=71).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.703**	-								
3 Phys Caus (RT)	.777**	.726**	-							
4 Cognitive (% ER)	.103	.162	.372**	-						
5 Affective (% ER)	.142	.199	.244	.433**	-					
6 Phys Caus (% ER)	.097	.151	.308**	.605**	.460**	-				
7 VI Data	.082	.032	.067	.196	.215	.121	-			
8 VI Things	-.291	-.093	-.270	.135	.092	.175	.146	-		
9 VI People	.187	-.034	.068	-.192	-.159	-.292	-.031	-.054	-	
10 VI Ideas	-.200	-.104	-.245	-.066	.098	.031	.060	.185	.084	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 5.7 PEARSON'S CORRELATIONS BETWEEN YEAR 10 TOM AND YEAR 11 VOCATIONAL INTERESTS (OUTLIERS INCLUDED)

(*N*=72 in all conditions except affective RT (*N*=71).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.826**	-								
3 Phys Caus (RT)	.757**	.740**	-							
4 Cognitive (% ER)	.114	.130	.175	-						
5 Affective (% ER)	.252	.345**	.374**	.488**	-					
6 Phys Caus (% ER)	-.010	.023	.147	.461**	.483**	-				
7 VI Data	-.110	-.061	-.107	.148	.137	.002	-			
8 VI Things	-.227	-.291	-.317**	.141	.079	.266	.146	-		
9 VI People	.086	.187	.105	-.260	-.025	-.039	-.031	-.054	-	
10 VI Ideas	-.092	.037	-.020	.010	.248	.140	.060	.185	.084	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 5.8 PEARSON'S CORRELATIONS BETWEEN YEAR 10 TOM AND YEAR 11 VOCATIONAL INTERESTS (OUTLIERS EXCLUDED)

(N=68)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.827**	-								
3 Phys Caus (RT)	.763**	.737**	-							
4 Cognitive (% ER)	.013	.162	.073	-						
5 Affective (% ER)	.245	.348**	.290	.316**	-					
6 Phys Caus (% ER)	-.206	-.120	-.085	.242	.331**	-				
7 VI Data	-.083	-.035	-.111	.146	.082	.068	-			
8 VI Things	-.286	-.329**	-.389**	.032	.036	.192	.183	-		
9 VI People	.138	.202	.149	-.031	.079	.111	-.014	.006	-	
10 VI Ideas	-.107	.004	-.057	.128	.311**	.146	.096	.183	.055	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

b) Stepwise multiple regression was used to explore whether ToM in Year 10 predicts vocational interests in Year 11 (controlling for the effects of Theory of Mind in Year 11).

As we found a significant correlation between affective ToM and VI in Ideas when outliers were excluded, we conducted the stepwise multiple regression on these variables on the dataset with outliers excluded. We put Year 10 VI Ideas and Year 11 affective ToM data into Step 1 (with Year 11 VI in Ideas as the dependent variable). We then put Year 10 affective ToM data into Step 2, to assess whether Year 10 affective ToM is predictive of Year 11 VI in Ideas, over and above the other variables. We ran the stepwise multiple regression twice: once with affective ToM reaction time, and again with affective ToM percentage error rate. The results of the analysis can be seen in Table 5.9 and 5.10 below. In both analyses there was independence of residuals, as assessed by Durbin-Watson statistic, and linearity as assessed by partial regression plots and a plot of studentized residuals against predicted values. All tolerance values were greater than 0.1, so no evidence of multicollinearity, and there were no leverage values greater than 0.2, or values for Cook's distance above 1. Q-Q plots of studentized residuals were inspected and the assumption of normality was met.

TABLE 5.9 STEPWISE MULTIPLE REGRESSION ANALYSIS PREDICTING VI IN IDEAS FROM AFFECTIVE TOM RT SCORES

Y11 Vocational interest in Ideas				
	Model 1		Model 2	
Variable	B	β	B	β
Constant	1.83**		1.78**	
Y10 VI Ideas	.43**	.50	.45**	.52
Y11 Affective ToM RT	.00	.00	-.09	-.11
Y10 Affective ToM RT			.15	.18
R^2	.25		.27	
F	10.75**		7.76**	
ΔR^2	.25		.02	
ΔF	10.75**		1.59	

Note: *N*=68. **p*=.05, ** *p*=.001

TABLE 5.10 STEPWISE MULTIPLE REGRESSION ANALYSIS PREDICTING VI IN IDEAS FROM AFFECTIVE TOM % ER SCORES

Y11 Vocational interest in Ideas				
	Model 1		Model 2	
Variable	B	β	B	β
Constant	1.90**		1.97**	
Y10 VI Ideas	.41**	.48	.39**	.45
Y11 Affective ToM ER	.14	.12	.06	.06
Y10 Affective ToM ER			.21	.22
R^2	.26		.31	
F	11.67**		9.39**	
ΔR^2	.26		.04	
ΔF	11.67**		3.81	

Note: *N*=68. *p*=.05, ** *p*=.001

The full model of Y11 affective ToM reaction time, Y10 vocational interest in Ideas score and Y10 affective ToM reaction time to predict Y11 vocational interest in Ideas was statistically significant, R^2=.27, F(3, 64)=7.76, p=.00, adjusted R^2=.23. The addition of Year 10 affective ToM RT score (Model 2) led to a small but non-significant increase in R^2 of .02, F(1, 64) = 1.59, p=.21.

A separate stepwise multiple regression was also run to determine whether the addition of Year 10 affective ToM percentage error rate score improved the prediction of vocational interest in Ideas over and above Year 10 vocational interest in Ideas score and Year 11 affective ToM percentage error rate alone. See Table 5.9 for full details on each regression model. The full model of Y11 affective ToM percentage error rate, Y10 vocational interest in Ideas score and Y10 affective ToM percentage error rate to predict Y11 vocational interest in Ideas was statistically significant, R^2=.31, F(3, 64)=9.39, p=.000, adjusted R^2=.27. The addition of Year 10 Affective ToM % error rate (Model 2) led to a small but non-significant increase in R^2 of .04, F(1, 64) = 3.81, p=.055.

When outliers were excluded from the Pearson's correlations, we additionally found a moderate, negative correlation of r=-.329 between Affective ToM RT and vocational interest in Things (and also a larger, significant negative correlation of r=.389 between the Physical Causality control RT and vocational interest in Things). We therefore additionally conducted a stepwise multiple regression on these variables. We put Year 10 VI Things and Year 11 affective ToM data into Step 1 (with Year 11 VI in Things as the dependent variable). We then put Year 10 affective ToM data into Step 2, to assess whether Year 10 affective ToM is predictive of Year 11 VI in Things, over and above the other variables. As a larger correlation was found with the Physical Causality control RT, we conducted a stepwise multiple regression with the control data, in order to compare. The results of these analyses can be found in Table 5.11 and 5.12 below. In both analyses there was independence of residuals, as assessed by Durbin-Watson statistic, and linearity as assessed by partial regression plots and a plot of studentized residuals against predicted values. All tolerance values were greater than 0.1, so no evidence of multicollinearity, and there were no leverage values greater than 0.2, or values for Cook's distance above 1. Q-Q plots of studentized residuals were inspected and the assumption of normality was met.

Model 1, which only included Y11 affective ToM reaction time score and Y10 vocational interest in Things score was not statistically significant, R^2=.05, $F(2, 64)$=1.54, p=.222, adjusted R^2=.02. The full model of Y11 affective ToM reaction time score, Y10 vocational interest in Things score and Y10 affective ToM reaction time score to predict Y11 vocational interest in Things was statistically significant, R^2=.13, $F(3, 63)$=3.14, p=.032, adjusted R^2=.09. The addition of Year 10 Affective ToM reaction time score (Model 2) led to a small and significant increase in R^2 of .08, $F(1, 63) = 6.09$, p=.016.

The full model of Y11 physical causality reaction time score, Y10 vocational interest in Things score and Y10 physical causality reaction time score to predict Y11 vocational interest in Things was statistically significant, R^2=.17, $F(3, 63)$=4.35, p=.008, adjusted R^2=.13. The addition of Year 10 physical causality reaction time score (Model 2) led to a small but non-significant increase in R^2 of .04, $F(1, 63) = 2.80$, p=.099.

Table 5.11 Stepwise Multiple Regression Analysis Predicting VI in Things from Affective ToM RT scores

Y11 Vocational interest in Things				
	Model 1		Model 2	
Variable	B	β	B	β
Constant	-.01		-.02	
Y10 VI Things	.16	.16	.08	.08
Y11 Affective ToM RT	-.12	-.12	.12	.12
Y10 Affective ToM RT			-.39*	-.39
R^2	.05		.13	
F	1.54		3.14*	
ΔR^2	.05		.08	
ΔF	1.54		6.09*	

Note: *N*=67. *p=.05, ** p=.001

Table 5.12 Stepwise Multiple Regression Analysis Predicting VI in Things from Physical Causality RT scores

Y11 Vocational interest in Things				
	Model 1		Model 2	
Variable	B	β	B	β
Constant	-.03		-.04	
Y10 VI Things	.13	.13	.06	.06
Y11 PC (Control) RT	-.34*	-.32	-.21	-.20
Y10 PC (Control) RT			-.25	-.25
R^2	.14		.17	
F	4.98*		4.35*	
ΔR^2	.14		.04	
ΔF	4.98*		2.80	

Note: *N*=67. *p=.05, ** p=.001

RQ4: Is there an association between birth order and vocational interest change in mid-adolescence?

A one-way ANOVA was used to test for a relationship between vocational interests and birth order position in Year 10 and Year 11. The results can be seen in Table 5.3 (above on page 165).

In both the Year 10 and Year 11 groups data was normally distributed as assessed by visual inspection of Normal Q-Q Plots. There was homogeneity of variances as assessed by Levene's test for equality of variances for all vocational interests in both Year 10 and Year 11 (p>.05). There were no statistically significant effects of birth order position (first-born, middle-born and last-born) and any of the vocational interests when analysing the results cross-sectionally.

Additionally, repeated-measures ANOVAs were conducted to determine whether there were any statistically significant differences in vocational interests over the one-year period between Year 10 and Year 11 in each of the birth-order groups separately. This analysis is presented in Table 5.4 (on page 166) above. The data was normally distributed at each time point, as assessed by Q-Q plots. While no significant differences in vocational interests over the one-year period were found within each birth-order group, the repeated-measures ANOVA showed there was a statistically significant increase in the vocational interest in Ideas across the whole sample, $F(1, 67) = 4.829$, p=.031, partial η2 = .067. Once corrected for multiple comparisons using Benjamini-Hochberg FDR, this result was no longer significant.

Furthermore, two-way mixed ANOVAs were conducted to assess whether there was an interaction between birth-order position and time on vocational interests, in order to assess whether there is a longitudinal effect of birth-order position on vocational interest development. There was homogeneity of variances (p>.05) as assessed by Levene's test of homogeneity of variances, and homogeneity of covariances (p>.001) as assessed by Box's M test in all cases. There was no statistically significant interaction between birth-order position and time on vocational interest scores.

RQ5: Are longitudinal relationships between birth order and vocational interests mediated by ToM in mid-adolescence?

No relationship was found between birth order and vocational interests in the Year 11 data, therefore mediation analysis was not conducted.

5.5 Discussion

RQ1 Does Theory of Mind (ToM) develop during mid-adolescence i.e. between Year 10 and Year 11?

The results of our paired t-tests showed improvement in both affective ToM reaction times (M=2.41s in Y10 to M=2.20s in Y11, p=.000), and cognitive ToM reaction times (M=2.53s in Y10 to M=2.28s in Y11, p=.000). However, reaction times on the physical causality (control) task also improved (M=2.47s in Y10 to 2.32s in Y11, p=.018). The results remained the same when IQ and sex were controlled for. This suggests students may have simply become faster at completing the computer task and have not necessarily shown genuine development in ToM ability, as the physical causality scenarios require an understanding of causality, but do not require any understanding of characters' mental states (Sebastian et al., 2012).

Although we expected to only see the improvement in performance in the cognitive and affective ToM task, performance on the physical causality task also improved. However, we did observe that the reduction in reaction times on the physical causality task between Year 10 and Year 11 is smaller and less significant than the reduction in the cognitive and affective ToM reaction times: we observed larger effect sizes for the cognitive and affective ToM task (d=.49 and d=.42 respectively) than the control task (d=.27). The physical causality condition was included in the ToM task as a control, as the cognitive ability of thinking about physical causality is different to intentional causality (ToM). Blakemore et al. (2007) found evidence to suggest there are differences in the underlying neural network when thinking about intentional and physical causality: one fMRI study found that both adolescents and adults recruit the medial prefrontal cortex (mPFC), the super temporal sulcus (STS) and the temporal poles during an intentional causality task relative to a physical causality task (Blakemore et al., 2007). Secondly, both adults and adolescents were significantly faster at responding to intentional causality questions compared to physical causality questions – an effect they suggest could be due to differing cognitive processing demands: understanding intentions is more 'intuitive', whereas understanding physical causality requires more explicit reasoning (Blakemore et al., 2007). This supports the use of the physical causality condition as a control in the ToM task, but it could also explain the higher level of significance for the improvement in reaction times on the cognitive and affective ToM task compared to those the physical causality task – as the adolescents have been exposed to more social experiences and have developed over a year, their ability to understand intentions has become more intuitive.

Additionally, as the students had completed the task before, it could be argued that they remembered some of the cartoon vignette endings, thus contributing to their faster reaction times on all three conditions. It is important to note, however, that there were no differences found in the percentage error rates in any of the conditions: if the faster reaction times can be explained by the students' familiarity with the task, one would expect accuracy on the task to improve too. However, the reason we did not see any noticeable differences in the percentage error rates may be due to the ceiling effects of the task. As discussed in the results section of Study 1, the ToM measure used was possibly too easy for the age of our sample. Although Sebastian et al. (2012) used the measure in their adolescent and adult sample, we did notice that the distributions show many of the students achieved a perfect score. Of the Year 10s who were included in this study, 38.9% of the group got every answer correct on the affective ToM task, with 69.4% achieving the same on the cognitive ToM task, and 48.6% achieving the perfect score in the control condition. In Year 11, 45.8% of the sample got every answer correct on the affective ToM task, with 65.3% achieving a perfect score in the cognitive ToM task, and 62.5% achieving a perfect score in the control condition. This ceiling effect would likely have influenced our ability to detect changes in ToM ability, or to identify individuals who may have particularly improved compared to their counterparts (Holl et al., 2018). However, the reaction times on the ToM tasks were normally distributed in both groups, and these provide arguably more valuable information, as they indicate the speed at which the social situations are read, processed and reacted to. Finding significant differences in the reaction times on the ToM tasks is therefore an important result.

Additionally, it is notable that we observed larger effect sizes for the cognitive and affective ToM task (d=.49 and d=.42 respectively) than the control task (d=.27). Various studies have found evidence to suggest both cognitive and affective ToM develop throughout adolescence. For example, Vetter, Altgassen, et al (2013) found age and affective ToM to be strongly, positively correlated in their sample of adolescents aged 12.08 to 22.92 years, and numerous other studies have found evidence of adolescents making more errors than adults on both cognitive (e.g. Dumontheil et al., 2010) and affective ToM tasks (Sebastian et al., 2012).

Our findings are also in line with cross-sectional studies focusing on this specific period of adolescence (Gabriel et al., 2019) and the one longitudinal study assessing ToM development in adolescence (Białecka-Pikul et al., 2020). In their cross-sectional study of *N*=643 adolescents, a ‘developmental step’ for both cognitive and affective ToM was found: 15-16-year-olds and 17-18-year-olds outperformed 13-14-year olds on both cognitive and affective ToM tasks (Gabriel et al., 2019). At the first wave of testing, the mean age of our Year 10 students was 14.91 years old, and at the second wave, the mean age of the Year 11 students was 15.91 years old. This particular period of mid-adolescence has been associated with specific neurodevelopmental changes: whole brain grey matter volumes have been seen to decrease substantially until the ages of 15 or 16, at which point the decrease slows down (Brain Development Cooperative Group, 2012), suggesting synaptic pruning processes occur, resulting in significant synaptic reorganisation (Blakemore, 2008; Gabriel et al., 2019).

The improvement in cognitive and affective ToM reaction times seen in our study therefore is in line with the results of Gabriel et al’s (2019) study, alongside numerous cross-sectional studies comparing adolescents with adults, providing further support that ToM develops throughout adolescence. To our knowledge, there is only one longitudinal study assessing ToM during mid-adolescence: Białecka-Pikul et al. (2020) tested one group of 13-year-olds and another group of 16-year-olds one year apart on their advanced ToM measure. They reported finding a small growth in advanced ToM in their group of early-adolescents (between the ages of 13 and 14): β = .18, 95% CI [−.02, .41]. Białecka-Pikul et al. (2020) similarly suggested that the repeated measure design meant participants were familiar with the ToM measure, which could have contributed to the growth in ToM score, and not necessarily be due to cognitive development.

Although there was also a significant reduction in reaction times on the control measure, returning to retest a group of mid-adolescents and observing larger effect sizes for the improvement in reaction times on the cognitive and affective ToM task is an important finding. Our results being in line with the one other longitudinal study measuring ToM development at this point in adolescence (Białecka-Pikul et al., 2020) suggest ToM development can possibly be observed approximately one year later. The similar findings support this argument even further in light of the fact both studies used very different ToM measures. Białecka-Pikul et al's (2020) research used a story-based task, the Modified Social Ambiguous Story Task (Bosacki et al., 2015). These deliberately ambiguous vignettes involved participants being told stories, before being asked four open-ended questions such as "What do you think will happen next?" and "Why do you think [character] will do this?" (Białecka-Pikul et al., 2020). Participants answers were coded for whether they included psychological perspectives (1 point for responses that did, 0 points for those that did not, maximum points possible to obtain are 8 across the two questions). Sufficient agreement was shown between coders on a sample of transcripts, and any discrepancies between coding were discussed to reach consensus (Białecka-Pikul et al., 2020). Arguably, Sebastian et al's (2012) cartoon vignette task, which we used, may be more accurate in assessing ToM development: using a more specific measure of reaction speeds can indicate evidence of faster reading of and reaction to social situations involving others' perspectives. There was no measurable reaction time element in Białecka-Pikul et al's (2020) study, and additionally the subjective nature of the coding method used could be influenced by coder opinion, which could develop or change over a year. Their method has benefits in accessing deeper or more complex perspective-taking that the cartoon vignette task cannot replicate, although the binary coding method would arguably mean those layers of advanced perspective-taking are minimized. In combination, however, the studies suggest ToM development is occurring at this stage of mid-adolescence, and this development can be observed through various advanced ToM measures.

RQ2: Is there a relationship between birth order and ToM development in mid-adolescence?

Some of our results supported the hypothesis that later-born children will have better performance on ToM tasks than first-born children. The mean decrease in reaction time from the first-borns to last-borns in the cognitive ToM task in Year 11 (-.73, 95% CI [-1.36, -.10]), was statistically significant (p=.019). Essentially, last-born children performed at faster speeds on the cognitive ToM task than first-born children. At a descriptive level, last-born children consistently performed at faster speeds and made fewer mistakes than first-borns across all ToM tasks in both Year 10 and Year 11, with the exception of the cognitive ToM condition in Year 11, where first-born children made slightly fewer mistakes (M=-.04, SD=1.21 vs M=.03, SD=.53). Additionally, the mean decrease in time from middle-borns to last-borns on the cognitive ToM task in Year 11 (-.93, 95% CI [-1.76, -.11]) was also found to be statistically significant (p=.022). Last-born children were therefore shown to perform at significantly faster speeds than middle-borns, as well as first-borns, in the cognitive ToM task. These findings are in line with other studies, such as Ruffman et al. (1998) who found number of older siblings specifically correlated with better false belief understanding, with younger siblings presenting no benefit. However, it is crucial to be aware that this study, along with the majority looking at the relationship between ToM and birth order, was assessing pre-schoolers. In a group of slightly older children (aged 6-8), no effect of number of siblings or birth order on ToM performance was found (Calero et al.,, 2013).

Support for the relationship between ToM and birth order in adolescence is an important contribution to the literature. As discussed in Chapter 2, the reasoning for why we predicted later-born children to demonstrate better ToM ability than first-born children is due to the increased likeliness of later-born children being exposed to conversations involving more advanced mental terminology, and talking about mental states, often in relation to sibling conflict. This effect was posited to be stronger and more obvious in pre-schoolers for two reasons: pre-schoolers are going through the process of developing first-order false belief understanding, therefore at this level, ToM development is easier to measure and distinctions between participants can be made on the grounds of whether or not they pass false-belief tasks. Results from measures assessing advanced ToM development, including the one used in this study, are based on reaction time or error rate differences, thus have more variation across participants, which could result in weaker associations. Secondly, pre-schoolers have not yet reached school, where we suggested social experiences tend to ‘level out’ across all children: as other important peer relationships develop, the effect of siblings diminishes. However, our results suggest having older siblings benefits ToM development during adolescence. Longitudinal research has shown that ToM continually progresses at a regular rate throughout childhood between the ages of 2 and 13 (Peterson & Wellman, 2019) and participation in conversations has been seen to be influential in ToM understanding in children (see de Rosnay & Hughes, 2010 for a review). The combination of these studies in relation to our results suggests having older siblings may contribute to an even richer social experience, promoting better ToM ability.

We additionally conducted one-way repeated measures ANOVAs to determine whether there were any statistically significant differences found in ToM performance over the one-year period in each of the birth-order groups separately. We did not find any statistically significant changes in ToM performance over time in any of the birth-order groups. In line with our hypothesis that later-borns would show better ToM ability than first-borns, it would be expected that later-borns would possibly show faster development in ToM than first-born children, and thus we would see improvement in ToM performance over the year. Considering the descriptive, non-significant data, there are no clear patterns: average performances across the groups showed later-born children to improve their cognitive ToM reaction time scores ($M=-.39$ in Year 10 vs $M= -.55$ in Year 11), but worsened their affective ToM reaction time scores ($M=-.41$ in Year 10 vs $M= -.20$ in Year 11). First-born children worsened both their cognitive ToM reaction time scores ($M=.09$ in Year 10 vs $M=.18$ in Year 11) and affective ToM reaction time scores ($M=.05$ in Year 10 vs $M=.12$ in Year 11). The differences observed were very small and therefore the lack of statistical significance of the changes within each group was not unexpected. Additionally, when two-way mixed ANOVAs were conducted to assess the longitudinal effect of birth-order position on ToM development, no significant interactions between birth-order position and time on ToM performance were found. Although it is plausible that birth-order position could influence ToM development during adolescence, much larger sample sizes tested over multiple years are required to investigate this fully.

This study found preliminary evidence to suggest a relationship exists between birth-order position and ToM development in adolescence, but further research is needed to assess the possible factors that mediate this relationship. Peer relationships have been found to be important influences on psychosocial functioning (Foulkes & Blakemore, 2018). van Harmelen et al. (2017), for example, found self-reported friendship support to positively predict both immediate and longer-term psychosocial functioning. Beyond peer relationships, the family has been highlighted as a key source of socioemotional development in adolescence, although a large focus has been on the role of parents, and not siblings (Lam et al., 2012). Of the studies assessing the influence of siblings in adolescent socio-cognitive development, a number of associations have been found: sibling relationship quality positively influences identity formation of younger siblings (Wong et al., 2010); sibling affection is positively associated with prosocial behaviours in early adolescence (Padilla-Walker et al., 2010) - a relationship seen to be mediated by the level of sympathy (Harper et al., 2014). Our findings suggesting a relationship exists between birth order and ToM in adolescence is novel and important but should not be taken at face-value. The presence of a sibling, whether older or younger, does not necessarily increase prosocial behaviour and empathy. If an individual has a sibling but poor sibling relationship, the presence of the sibling alone will not necessarily enhance the individuals' social experience. There are a number of covariates, as highlighted in these other studies investigating the role of siblings in adolescent socio-emotional development, that could have influenced our findings. Future research should investigate firstly whether this association between birth order and ToM exists in a larger sample, and secondly how particular covariates, such as the quality of sibling relationships, may mediate this relationship.

RQ3: Does ToM at Year 10 predict vocational interest choice in Year 11?

When looking longitudinally at the associations between Year 10 ToM scores and Year 11 vocational interest scores, we found a statistically significant positive correlation between percentage error rate in affective ToM and vocational interest in Ideas, $r_s(68) = .311$, $p=.010$. Making more mistakes on the affective ToM task in Year 10 correlated with reporting higher interest in Ideas in Year 11. We ran stepwise multiple regression to assess whether the addition of Year 10 affective ToM error rate scores improved the prediction of vocational interest in Ideas in Year 11 over and above Year 10 VI in Ideas score and Year 11 affective ToM error rate score alone, and a very slight improvement was found, although this was not statistically significant.

The association between percentage error rate in affective ToM and vocational interest in Ideas is the opposite to what we would have expected to see: but as discussed in the previous results chapter, Svedholm-Häkkinen and Lindeman (2016) found interest in working in the humanities field was equally popular in both low empathising and high empathising individuals. Additionally, the Ideas vocational interest category covers a broad area (in the questionnaire the examples given are "inventing, insight, interpretation, abstract ideas, science, art"). The vocational interest of Ideas is the opposite variable to Data on Prediger's (1982) proposed dimensions, however a number of students hoping to pursue a career in a scientific field could have scored Ideas highly due to the wording on the questionnaire. Ideas is also next to the vocational interest of Things, with Holland's (1997) RIASEC variable of Investigative mapped between them – a RIASEC type associated with various scientific roles, e.g. Physicist, Surgeon, Chemist. Therefore, the result that higher interest in Ideas correlates strongly with poorer accuracy on the affective ToM task could support Svedholm-Häkkinen and Lindeman's (2016) findings that interest in working with Things was negatively associated with 'empathising' (a term Baron-Cohen et al. (2003) state encompasses ToM).

However, there additionally was a statistically significant negative correlation between reaction time in the affective ToM task in Year 10 and vocational interest in Things in Year 11, $r(68) = -.329$, $p=.006$. Faster performance on the affective ToM task in Year 10 correlated with reporting higher interest in Things in Year 11. We ran a stepwise multiple regression to assess whether the addition of Year 10 affective ToM RT improved the prediction of vocational interest in Things in Year 11 over and above Year 10 VI in Things score and Year 11 affective

ToM RT alone, and a small, statistically significant improvement was found. As a similarly-sized, significant correlation was also found between the control physical causality task reaction time in Year 10 and vocational interest in Things in Year 11, a stepwise multiple regression was also run using these variables to see whether there were any differences between the ToM trial and the control trial. The addition of Year 10 physical causality RT improved the prediction of vocational interest in Things in Year 11 over and above Year 10 VI in Things score and Year 11 physical causality RT alone, and a small but not significant improvement was found.

The association between affective ToM RT and vocational interest in Things was again the opposite to what was hypothesized: we expected those demonstrating better ToM ability in Year 10 to be more interested in roles involving People in Year 11, which is the opposing dimension to Things. As discussed previously, Svedholm-Häkkinen and Lindeman (2016) assessed empathizing and systemizing as independent factors, and found variation in the 'balanced brain type' group: individuals can have High-High status (high levels of social intelligence and strong ability in physics), and there can also be individuals with Low-Low status (low levels of social intelligence and poor ability in physics). It therefore is not necessarily the case that strong ToM ability will be associated with people-based interests, as strong ToM ability can also be found with those individuals with strong interest and ability in scientific, systemizing areas. This could potentially explain the medium-sized correlation found between affective ToM reaction time and vocational interest in People in the Year 10 correlations (Table 5.4): better performance on ToM tasks was associated with lower interest in people-based jobs. The Low-Low and High-High variations of the 'balanced brain type' group mean good ToM ability does not necessarily always correlate with people-based vocational interests, and poorer ToM ability does not correlate only with scientific, Things-based roles.

Another possible explanation for the positive correlation between fast performance on the ToM tasks and vocational interest in Things is that those individuals who are interested in machines, such as computers (which are key elements of the Things vocational interest), are likely more familiar with using computers. The ToM task used was computer-based, and although it was not a complex task, it could be possible that those individuals who performed the tasks more quickly were able to because of their interest and ability in using computers, and not necessarily due to their ToM ability. This could then possibly explain why those individuals with faster affective ToM performance were more likely to have vocational interests involving Things. This argument is supported by the correlations run at both time-points: with the exception of affective reaction time in Year 11, the positive correlations between fast performance on all ToM tasks (including the control trial) and vocational interest are consistently stronger in Things compared to the other vocational interests.

However, while the medium-sized correlation between affective reaction time and vocational interest in Things is evident in Year 10, and also when correlating affective reaction time in Year 10 with vocational interest in Things in Year 11, the correlation between Year 11 affective reaction time and vocational interest in Things in Year 11 is smaller and not significant. Additionally, the stepwise regression showed that the addition of Year 10 affective ToM RT improved the prediction of vocational interest in Things in Year 11 over and above Year 10 VI in Things score and Year 11 affective ToM RT alone, with a small but significant improvement found. This provides some preliminary evidence to suggest that ToM ability in mid-adolescence may be a useful indicator of the development of particular vocational interests in subsequent years.

Alternatively, it could be argued that these measures of vocational interest are too broad to find meaningful, explainable correlations with ToM scores. We collected more personal qualitative data from all the participants: idealistic and realistic career aspirations, which in addition to the current vocational interest measures, will provide a variable that could potentially more accurately reflect vocational interests. This data will be presented in the next results chapter where we tested Gottfredson's (2002a) theory of circumscription and compromise. The associations between ToM and vocational interest development found in both chapters are discussed in full in the overall discussion.

RQ4: Is there an association between birth order and vocational interest change in mid-adolescence?

There were no statistically significant effects of birth order position (first-born, middle-born and last-born) and any of the vocational interests, cross-sectionally or longitudinally. In line with our main hypothesis regarding birth order and vocational interests, it would be logical to predict the different birth order categories would possibly intensify their vocational interests we predicted they would most likely prefer (e.g. laterborns would increase their vocational interests in People or Ideas). While vocational interest in Ideas increased across the whole sample between Year 10 and Year 11, this was not especially notable in last-born children, as similar increases were also seen in first-born children. The lack of association will be discussed in the General Discussion chapter (Chapter 7).

Summary

This study is one of the first to assess ToM development longitudinally during mid-adolescence. Additionally, we explored the relationships between ToM and other related constructs: although limited by sample size and thus statistical power, our findings suggest the association between birth-order position and ToM ability may be evidenced in adolescence as well as in childhood. Additionally, evidence of a negative longitudinal relationship between affective ToM and vocational interest in Ideas was found, and also of a positive longitudinal relationship between affective ToM and vocational interest in Things. Although not in line with our prediction of a positive longitudinal relationship between affective ToM and vocational interest in People, these findings in a small sample provides support for the idea that cognitive constructs such as ToM could be useful in relation to predicting vocational interests. The role of ToM in stability of vocational interests and career aspirations is explored in more detail in the next chapter.

6 Study 3: Exploring Stability of Career Aspirations Over Time: A Longitudinal Test of Gottfredson's Theory of Circumscription and Compromise

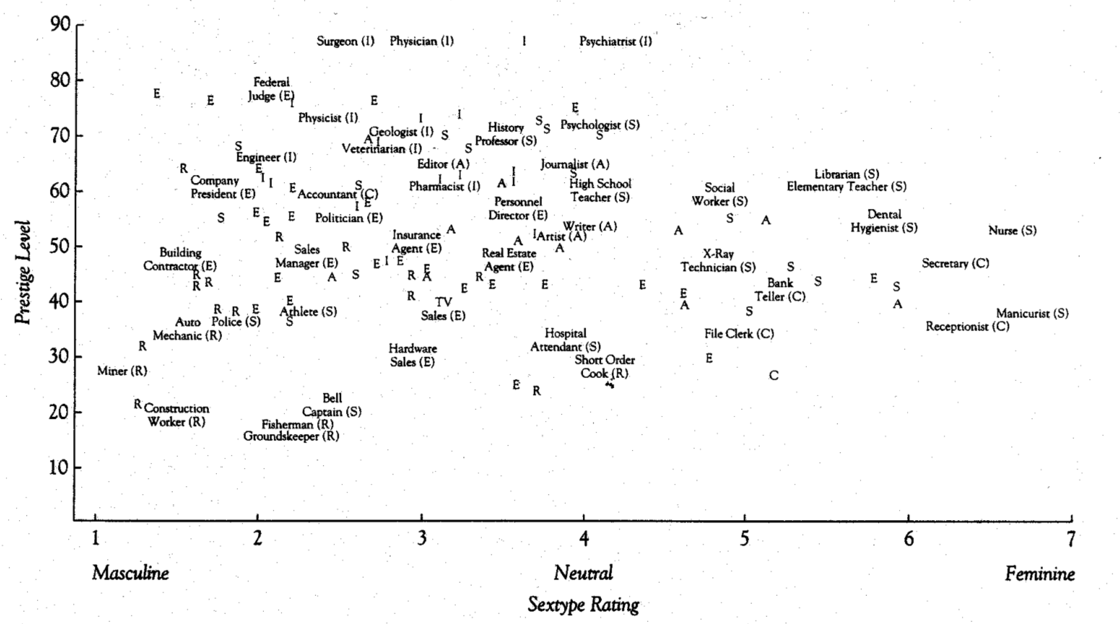
6.1 Context

Introduction

Adolescence is a vital time for career preparation. Characterised by important cognitive and socio-emotional development, adolescence also involves being increasingly exposed to new experiences and making significant subject and/or occupational choices (Low et al., 2005; Low & Rounds, 2007). It is also a stage when vocational interests have been found to crystallise (Low & Rounds, 2007). Although recent meta-analyses have found that vocational interests are moderately to highly stable across the life-span, peak stability has been observed between ages 18 and 21.9 (Low et al., 2005). Despite there being evidence of a strong, dynamic, bidirectional relationship between vocational interests and career aspirations (Hirschi, 2010), there are notably fewer studies investigating the *stability* of career aspirations in adolescence. With this in mind, the study presented in this chapter was designed to investigate the stability and development of career aspirations in mid- and late-adolescence, particularly in relation to Gottfredson's theory of circumscription and compromise (C&C).

Gottfredson's theory of circumscription: Stages 1 to 3

Gottfredson's (1981, 1996, 2002a) theory of C&C did not set out to explain how children and adolescents develop occupational aspirations generally, but to provide an explanation of how well-documented differences in aspirations by sex, race and social class develop. As children grow, their thinking progresses from being intuitive at preschool, to concrete in primary school, to abstract in adolescence. Alongside this progression in thinking, every child develops an increasingly individualized self-concept as a product of their genes, the environment and the interplay between the two. As children grow and are exposed to an increasing variety of occupations, their occupational world-view becomes more complex, with every individual forming a *cognitive map of occupations* - an organisation of the images of occupations along dimensions such as sex-type and prestige level (see Figure 6.1 below for an illustration of a cognitive map of occupations).



Note: Occupations are denoted by a letter indicating their Holland types: R = Realistic, I = Investigative, A = Artistic, S = Social, E = Enterprising, C = Conventional.

FIGURE 6.1 ***COGNITIVE MAP OF OCCUPATIONS (GOTTFREDSON 2002A; COPYRIGHT © 2002 BY JOHN WILEY & SONS, INC.) (FIGURE 6.1 IS TAKEN FROM GOTTFREDSON, 2002A, AND IS A REFORMATTED VERSION OF THE SAME FIGURE FROM GOTTFREDSON 1981; COPYRIGHT © 1981 BY THE AMERICAN PSYCHOLOGICAL ASSOCIATION.***

As children develop, they start making vocational choices through the process of circumscription: defined as the process of "eliminating occupational alternatives that conflict with self-concept" (Gottfredson, 2005. p.77). They dismiss various occupations for being socially unacceptable, ruling out large sectors as they begin to understand and consider their own compatibility with different roles. The four stages of circumscription that Gottfredson (2005) theorises all children move through is represented in Figure 6.2 below.

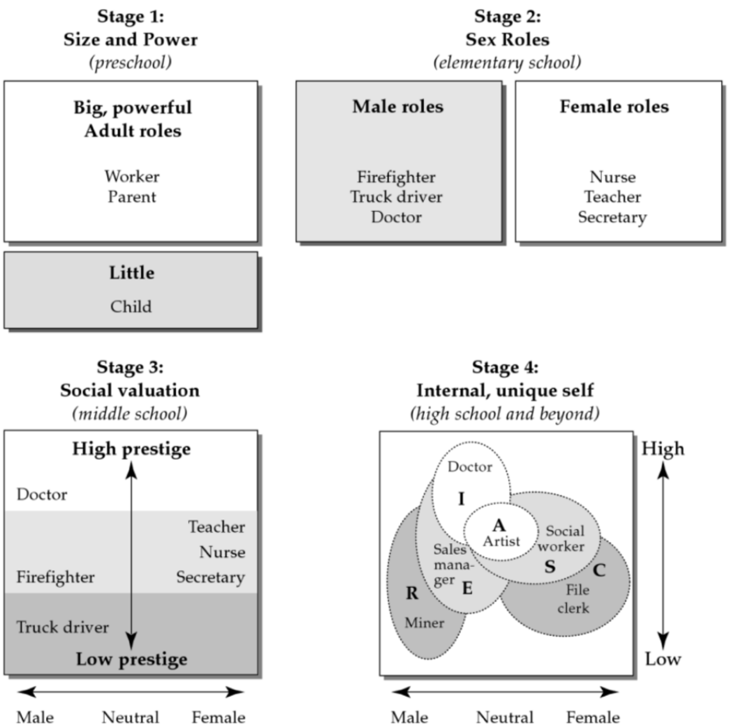


FIGURE 6.2 STAGES OF CIRCUMSCRIPTION (GOTTFREDSON, 2005)
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By age 14, most individuals should theoretically have progressed through stages 1 to 3 of circumscription, so will have recently orientated to social valuation (Gottfredson (2002a) put this at ages 9-13). Adolescents at this stage have learned which jobs and careers would be rejected as unacceptably low (or high) in social standing by their families and communities. As adolescents incorporate these ideas of social class into their self-concepts, they reject occupational options that are not acceptably prestigious enough. It is not only social standing taken into account at this stage – individuals will have also incorporated their own ability into their self-concepts. In her theory, she suggests that teachers and parents encourage adolescents who are brighter to aim higher, reinforcing this pattern (Gottfredson, 2002a). In the current study we measured the relationships between socioeconomic status (SES) and cognitive ability with occupational expectations and aspirations.

6.1.1.1 The relationship between SES and career aspirations

A number of studies have found significant relationships between SES and occupational aspirations, with those students from low SES backgrounds having lower career aspirations. In their longitudinal analysis of occupational aspiration choice in early, mid- and late adolescence, Rojewski and Yang (1997) found significant positive correlations between SES and occupational aspirations (those from lower SES backgrounds had lower career aspirations). They analysed data from n=18,311 students, obtained from the NELS:88 (US) database (1988) and found the influence of SES on occupational aspirations to be substantially more than the effect of gender or ethnicity, with longitudinal analysis indicating that approximately 10% of the variance seen in occupational aspirations can be accounted for by SES alone (Rojewski & Yang, 1997). The importance of SES as a predictor of career and educational aspirations has been supported in numerous recent studies (e.g. Cochran et al., 2011; Rojewski & Kim, 2003).

Measures of aspirations and SES both vary substantially across the literature. For example, in their longitudinal study of n=2823 adolescents, Baker, Sammons, et al (2014) found having a mother with a university degree or post-graduate qualification significantly predicted high aspirations. ‘High aspirations’ in their study, however, were defined as those attaching high importance to achieving an undergraduate degree. Other studies that have looked at aspirations more specifically in terms of prestige of specific idealistic and realistic career choices have also found correlations with SES (e.g. Schoon & Polek, 2011; Howard et al., 2011). However, SES in these cases is often measured by classifying participants on the basis of eligibility for free school meals (e.g. Howard et al., 2011), or as a composite measure of parental education and occupation (e.g. Schoon & Polek, 2011), so does not assess the effect of parental education on prestige-level of career aspirations specifically. Our study therefore adds to the existing literature by assessing the relationships between prestige level of career aspirations, expectations and SES as measured by both occupation and education.

When evaluating the literature regarding SES and career aspirations/expectations, it is important to consider the context and age of studies being used. The vocational aspiration-expectation gap has been explained by some with reference to experiences of oppression, and awareness of the strong likelihood of encountering barriers when pursuing vocational goals, particularly among youth of colour (Arbona, 1990). However, it has been suggested that explanations for the vocational aspiration-expectation gap should be re-examined as a number of studies that are used in reviews are outdated (Perry et al., 2009). Similarly, while Rojewski and Yang’s (1997) study, as cited earlier, presented rich longitudinal analysis of a large dataset, the data used is over thirty years old. Recent educational interventions have focused on increasing accessibility to higher education for those students from lower SES backgrounds across numerous Western countries, including the UK (Bowes et al., 2015). In their House of Commons briefing paper, Connell-Smith and Hubble (2018) highlighted that the numbers of disadvantaged young people entering higher education are at a record high having risen significantly since 2008. Whilst it has been generally agreed that SES-background consistently affects occupational aspirations, it is important to ensure the literature remains up to date, particularly in light of recent governmental initiatives to widen participation.

Other studies investigating the relationship between SES and career aspirations have in fact found SES-background has less influence on career aspirations than other literature suggests. Gore et al. (2015) conducted a study of 3504 Australian students, and expected to see those individuals in lower SES quartiles aim for less prestigious jobs. However, they found the vast majority of students across all of the SES quartiles to be interested in professional or skilled occupations: the top five occupations across all SES quartiles consistently included vet, teacher and sportsperson. The impact of SES was most apparent in the occupational choice of doctor, which was only in the top 5 for high SES students, and mechanic, which was only in the top 5 for those students from the lowest SES quartile (Gore et al., 2015). Another study analysing 6492 students in Australia found year level at school, prior achievement and gender were all stronger predictors of students' career aspirations than SES (Gore et al., 2017). Gore and colleagues (2017) suggest that the widening participation agenda has encouraged university outreach activities, emphasising the importance of 'raising' career aspirations of those from lower SES backgrounds. In their study, they found students from low SES backgrounds had similar levels of career aspirations to those students from higher SES backgrounds, so they posited that the underrepresentation of low SES students in higher education could be more likely due to the financial implications of attending university. They suggested that "student outreach activities need to move towards a stronger focus on nurturing rather than 'raising' aspirations" (Gore et al., 2017. p.1398). Recent longitudinal research complements this suggestion: Berger et al. (2019) found SES has a small to large effect on career aspirations, but their evidence suggests the influence of SES operates with other important variables, such as sex composition and academic achievement. Conflicting evidence regarding the relationship between SES and career aspirations highlights the need to continue exploring the development of career aspirations and expectations in mid and late-adolescence, particularly in light of recent initiatives to widen participation in higher education.

6.1.1.2 The relationship between cognitive ability and career aspirations

As explained previously, Gottfredson (2002a) suggests that during the process of circumscription, individuals begin to incorporate their own cognitive ability into their self-concepts. Gottfredson (2002a) defines self-concept as “one’s view of oneself – of who one is both publicly and privately” (p.88). Individuals develop an awareness of their own abilities, and therefore disregard occupations deemed too difficult or inaccessible based on this. The very process of decision-making requires *g* (general intelligence): Gottfredson (2003) writes that “any theory that uses the language of learning, information gathering, information processing, abstract thinking, decision making, reasoning, and problem solving is implicitly focusing on general intelligence...such skills affect how quickly children learn about themselves and the world of work” (p.127). Assuming that adolescents do develop an accurate understanding of the level of their own ability, one would expect to see a relationship between intelligence and career aspiration level. It is important to note that much of the literature in this area focuses on the relationship between *achievement* and career aspirations, and not specifically intelligence or cognitive ability. However, intelligence, or *g*, defined as the “working definition of intelligence for most researchers” (Gottfredson, 2002b. p.27), has been said to be the ability mostly measured in any test of mental aptitude or achievement (Gottfredson, 2002b). Therefore, for the purpose of this short review of the literature regarding cognitive ability and career aspirations, the majority of the studies explored concerned the relationship between achievement and career aspirations.

There is some evidence to suggest there is a relationship between ability and career aspirations. Cochran et al. (2011), for example, tested a sample of adolescents from a large national dataset, the NLSY79 (U.S. Department of Labor, 2004). In their analysis, they found ability was the strongest predictor of career aspirations (r=.34), in comparison to other predictor variables such as parental SES (r=.09) (Cochran et al., 2011). Patton and Creed (2007a) also found that students who reported achieving well at school were more likely to aim higher and have more defined goals.

Some studies have found evidence of an association between aspirations and educational attainment (e.g. Cuthbert & Hatch, 2008), with career aspirations increasing school engagement (e.g. Kenny et al., 2006). Policymakers have embraced this relationship, focusing policy on raising aspirations in a bid to increase educational attainment (Cabinet Office, 2011). This has led to an increase in aspirational levels, as seen by St. Clair et al. (2013) in their longitudinal study of 490 UK school students at the ages of 13 and 15. Consistent with other findings (e.g. Goodman & Gregg, 2010), St Clair et al (2013) commented that student aspiration levels across their sample “are very high indeed - far higher than the labour market can possibly support” (p.734). High aspirations are perceived to have a positive impact on educational attainment, however St Clair et al’s (2013) study found a key disparity between vocational aspirations and educational aspirations: students commonly wanted to be a lawyer, for example, but would only be undertaking three GCSE examinations, which is substantially less than needed to proceed with relevant further study. This therefore supports Khattab’s (2015) conclusion that “evidence to link raising aspirations with improving school achievement is either very slim or highly questionable” (p.732). Whilst Cochran et al. (2011) did find a relationship between ability and career aspirations, it is important to note that their analysis was conducted using data from individuals who were adolescents in the 1970s. There is therefore a need to test Gottfredson’s theory in a contemporary sample and evaluate whether recent initiatives to raise aspirations could have altered how career aspirations develop in relation to ability.

There is, however, evidence to suggest there is a relationship between general cognitive ability, *g*, and career success. A meta-analysis of longitudinal research concerning the relationship between intelligence and success (as measured by education, occupation and income) found intelligence to be a powerful predictor (Strenze, 2007). The meta-analysis however additionally took into account parental SES, a variable that has been argued by some to be a better predictor of success than intelligence (e.g. Fischer et al., 1996). The meta-analysis found parental SES was positively related to career success, but intelligence had greater predictive power, with Strenze (2007) concluding "intelligence is an independent causal force among the determinants of success" (p.416).

However, evidence has suggested that there is a positive relationship between socioeconomic status and intelligence: von Stumm and Plomin (2015) found that family SES is associated with intelligence. Children from lower SES backgrounds performed worse on IQ tests at the age of 2 years than those from higher SES backgrounds - with an average of 6 IQ points separating children from the highest and lowest SES backgrounds, an IQ gap that had almost tripled by the time the participants had reached age 16 (von Stumm and Plomin, 2015). While there is evidence to suggest the relationship between intelligence and career success is not necessarily mediated by family SES, there is evidence to suggest a relationship between SES and intelligence. Therefore, we control for the effects of SES when measuring the relationship between intelligence (FSIQ) and career aspirations in this study.

Gottfredson's theory of circumscription: Stage 4

At Stage 4 of the circumscription process, Gottfredson (2002a) theorises that individuals go through the process of orientation to the internal, unique self (suggested to occur from age 14 onwards). She outlines that adolescents learn more about their psychological profiles, and how this affects one’s public self: ‘the public presentation of who we can and want to be” (p.100). Adolescents often struggle to ascertain their own interests, abilities and values, and these factors are often not fully established – thus requiring further experience to fully understand and develop their strengths, weaknesses, likes and dislikes. As adolescents reflect on their interests, personalities, and values, they begin to consider which occupational choices are both preferable and accessible.

There is some evidence to support stages 3 and 4 of Gottfredson’s theory of circumscription. Helwig (2001) examined the occupational aspirations of a sample of students over a ten-year span, with the data collection undertaken at two year intervals from second grade (age 7) to twelfth grade (approximately age 17). It was found that the proportion of children choosing professional, technical and managerial occupational aspirations, deemed as ‘higher social value’ occupational occupations, did significantly increase from second grade to eighth grade, consistent with stage 3 of the circumscription process (Helwig, 2001). Choosing occupational aspirations based on their social value continued into the early teenage years. However, as the students progressed into tenth and twelfth grade, Helwig (2001) found the students increasingly were choosing occupational aspirations that were more in line with their own vocational interests than the associated social values. 93% of eight-grade students aspired to work in occupations of high social values (professional, technical and managerial), though this dropped to 81% by the time the students reached twelfth grade, when more personal factors such as vocational interests appeared to be more important: supporting stage 4 of Gottfredson’s hypothesis (Helwig, 2001).

There were limitations to consider with Helwig’s (2001) test of Gottfredson’s theory. Firstly, the study had a small sample. At the first wave of data collection, n=208 second graders were tested, but by twelfth grade, the sample size had reduced to n=103, an attrition rate of 50% over the ten-year time span (Helwig, 2001). Obviously examining the same participants at five time-points across ten years provides valuable data, especially necessary in the context of testing a developmental career theory. The sample in our study is small too and, although longitudinal, only covers a 1-year period – much larger, longitudinal studies are needed to provide more evidence in relation to Gottfredson's theory of circumscription. Additionally, Helwig (2001) categorised the social value of occupations using a relatively broad measure: using the first digit of the 'DOT' codes, those beginning with a 0 or a 1 were classed as either professional, technical or managerial in nature. It was this measure that was used to differentiate between children as to whether they were aspiring to higher or lower social value occupations. When measuring the social value, or prestige, of occupations, more sophisticated measures that create a composite variable of specific vocational preparation (SVP) and mean annual salary (as used by Junk and Armstrong (2010)) are necessary, particularly when accurately measuring stability or change. Although our study has a relatively small sample and only covers a 1-year period longitudinally, it does incorporate these more sophisticated measures to more accurately assess prestige.

Gottfredson's theory of compromise

Once adolescents have reached the final stage of circumscription, this then leads on to 'compromise': where dream career aspirations are adjusted and realistic career expectations begin to form (Gottfredson, 2002a). Gottfredson discusses both anticipatory and experiential compromise. 'Anticipatory compromise' takes place when "people begin to moderate their hopes (assessments of compatibility) with their perceptions of reality (assessments of accessibility). As they do, the aspirations they voice will shift away from their ideal and toward the expected" (Gottfredson, 2002a, p.101). These anticipatory compromises are based on perceived ideas of inaccessibility, and not actual experiences trying to gain roles – so can occur earlier in the developmental process for adolescents (Armstrong and Crombie, 2000), so compromise was measured in both mid-adolescent and late-adolescent groups. Additionally, as anticipatory compromises are based on perceived ideas of inaccessibility (Gottfredson, 2002a), we also proposed exploring the relationship between self-efficacy for the future with occupational expectations and aspirations. Gottfredson (2002a) proposes that the dimensions that emerge first developmentally (sex-typing of roles), are closest to the core of the self-concept and most protected during the process of compromise. Vocational interests are compromised first, then prestige, and finally, sex type. We tested this theory of compromise in both our mid-adolescent and late-adolescent groups.

Gottfredson (2002a) also outlines another type of compromise: experiential. This takes place when individuals are confronted with barriers in striving for their most-preferred aspirational choice, experiences gained when attempting to gain employment – resulting in aspirations being modified. Barriers can include availability of roles, family obligations, hiring practices and so on. We therefore measured experiential compromise in our final-year university student sample, to assess whether, of those presenting a career compromise between their aspirational occupation choice at Wave 1 and their actual current job stated at Wave 2 (following graduation), the order of stability follows Gottfredson's predictions.

6.1.1.3 Studies testing Gottfredson's theory of compromise

Gottfredson's (1981, 1996, 2002a) theory of compromise has not been fully supported in the literature. Leung and Plake (1990) tested 246 undergraduate students using the Occupational Choice Dilemma Inventory (OCDI), essentially asking participants to choose between pairs of occupations, requiring them to sacrifice either prestige or masculine/feminine (dependent on the participants' gender) sex-typing of the roles. Overall, they found prestige, rather than sex-type, was more likely to be preferred when making these hypothetical occupational choices. There was one exception: when male participants were confronted with choosing between a masculine occupation of lower prestige and a feminine occupation of higher prestige, they would more likely sacrifice prestige to maintain the masculine sex-type (Leung & Plake, 1990). Hesketh et al. (1990) also tested Gottfredson's theory, though using a different measure: the Computerised Fuzzy Graphic Rating Scale. Participants were asked to state their preferred zone on various prestige, sex-type and interest scales, which were then used in a paired-comparisons exercise where participants were faced with choosing between hypothetical jobs that varied on these scales (Hesketh et al., 1990). They tested both a group of volunteers largely from a university setting (n=73, M=29 years), and separately a group of high school students. For the older, university-based group, they found interests were considered to be significantly more important than prestige, and prestige was considered significantly more important than sex type – a pattern that was repeated in the high school student sample – and again shows the opposite pattern to the one Gottfredson suggested (Hesketh et al., 1990).

Alternative suggestions regarding the way occupational choices are compromised have been put forward. Elmslie (1988) suggested an alternative account of compromise, and Gottfredson (1996) revised her theory to expand upon the principles of compromise, particularly the conditional priorities when making compromises. Elmslie (1988) suggested career conscription should be viewed as cumulative: "the integration of each psychological structure in the self-concept incorporates previous experiences" (Hesketh et al., 1990. p.50). Those factors that influence career choice at a later stage, such as vocational interests, incorporate the earlier influences of prestige and sex-type, and are therefore the most important ones (Elmslie, 1998; Hesketh et al., 1990). Both Leung and Plake's (1990) and Hesketh et al's (1990) findings support this idea of an alternative account of compromise. However, Gottfredson (1996) argued that researchers need to take into account the *severity* of the compromise required to be made. It is only when faced with major compromises that individuals will sacrifice their interests before then sacrificing prestige, followed by sex-type. Gottfredson (1996) writes "vocational interests are always of moderate concern… but they are overshadowed by concerns for either prestige or sextype, except when both the latter are close to optimal" (p.200). If individuals are only having to make small trade-offs, and prestige and sex-type of occupations are good enough in all options, that is when vocational interests get highest priority (Gottfredson, 1996).

A test of Gottfredson's (1996) revised theory found partial support in relation to which variables are sacrificed depending on the severity of the compromises being made. Blanchard and Lichtenberg (2003) tested 119 university students (aged between 18 to 34, M = 19.36). Firstly, they asked participants to sort occupations into three categories: "Acceptable", "Uncertain" or "Unacceptable", with those occupations deemed "Acceptable" representing the zone of acceptable career alternatives for that individual, reflecting the process of circumscription (Blanchard & Lichtenberg, 2003). The computer randomly assigned participants to a low, moderate or high compromise group, and asked participants to rank eight occupations from most preferred to least preferred. The low compromise group ranked occupations they deemed "acceptable", the moderate compromise group ranked occupations deemed "uncertain" and the high compromise group were forced to rank the "unacceptable" occupations. For the low compromise condition, Blanchard and Lichtenberg (2003) found individuals rated interests significantly higher than prestige and sex-type, and prestige significantly higher than sex-type, thus supporting Gottfredson's (1996) revised theory. However, in the moderate and major compromise condition, they found prestige and sex-type were significantly more important when making compromises than vocational interests, although no significant differences between prestige and sex-type were found (Blanchard & Lichtenberg, 2003). This therefore does not support Gottfredson's (1996) theory that in situations requiring a high degree of compromise, individuals will firstly sacrifice their interests, then prestige, most importantly protecting sex-type. Blanchard and Lichtenberg (2003) suggested by asking participants to rank occupations from 'most likely to do' to 'least likely to do' instead of 'most preferred' to 'least preferred', would have demanded participants to consider the accessibility and compatibility of occupations more carefully, important concepts in Gottfredson's (1981, 1996) theory. Our study asked participants to outline their idealistic aspirations and realistic expectations, with the expectation question asking participants "What do you think you will most likely do for a job?", thus demanding participants to consider accessibility and compatibility.

Amongst the studies that have tested Gottfredson's (1981, 1996) theory, there is a lack of consistency in how compromise is measured, with a large number requiring participants to rank-order occupations in lists (e.g. Blanchard & Lichtenberg, 2003; Leung & Plake, 1990), which has been seen to represent a *simulation* of the compromise process rather than the actual compromise process (Armstrong & Crombie, 2000; Junk & Armstrong, 2010). Leung and Plake (1990) acknowledged the limitation themselves: "being asked to choose between two occupations paired together by a researcher is very different from a real-life situation in which the individual simultaneously considers a number of occupational alternatives of his or her own choosing" (p. 405). These studies do not demand participants to state their actual career aspirations; ranking hypothetical jobs or being forced to choose between pairs of jobs cannot capture the individual's perception of whether there is even a need for compromise, which is something that can be measured by comparing career aspirations and expectations (Armstrong & Crombie, 2000; Junk & Armstrong, 2010). Additionally, there are a lack of longitudinal studies testing Gottfredson’s theory; cross-sectional research cannot accurately show the developmental process of compromise (Junk & Armstrong, 2010). This study assesses personal career aspirations and expectations and how these factors change over a one-year period at different stages of adolescence, as we have collected longitudinal data from mid- and late-adolescent groups.

6.1.1.4 Predictors of career compromise

Armstrong and Crombie (2000) suggested that by comparing aspirations and expectations, it could be possible to classify participants into ‘discrepancy groups’ (participants reporting the same occupation for both aspirations and expectations would be classed as ‘nondiscrepant adolescents’; whereas those reporting different occupations for both aspirations and expectations are classed as ‘discrepant adolescents’). It would not be expected for nondiscrepant adolescents to compromise their aspirations, as they already see their aspirations as feasible options, whereas discrepant adolescents may show compromise, lowering their aspirations to be more in line with their expectations. In order for any change to be considered a ‘compromise’, Armstrong and Crombie (2000) stated it would need to “be in the direction of their expectations and contribute to reductions in aspiration-expectation discrepancies” (p.84).

Gottfredson (2002a) discusses various principles of compromise, all of which emphasise the importance of protecting our visible social self over our more private psychological self. She writes that “crafting a ‘good enough’ public self is essential” (p.103), presenting the potential argument that being aware of what other people think, and being able to differentiate between one’s own thoughts and the thoughts of others based on the outward, public self one has created, would require a well-developed Theory of Mind. Additionally, Gottfredson (2002a) writes that her core theory particularly focuses on “how young people compare their perceptions of certain aspects of self (such as academic ability) to their perceptions of parallel aspects of the occupational world (jobs' intellectual demands) in order to identify a range of occupational niches that is suitable for themselves (their social space, or zone of acceptable alternatives)." (p.131). It could be argued that this process requires individuals to mentally project themselves into the future, or alternative situations. Buckner and Carroll (2007) suggested envisioning the future (prospection) and Theory of Mind (alongside other abilities) share common functional anatomy, reflecting workings of the same core brain network. Therefore, it was hypothesized that there may be a relationship between ToM ability and anticipatory compromise in adolescence. Armstrong and Crombie (2000) found adolescents in their discrepant group changed their aspirations in the direction of their expectations over time, but did not include other measures (e.g. self-efficacy, academic performance) - meaning they could not evaluate why discrepant adolescents made changes. Even though Gottfredson (2002a) writes that young people's preference gradients shift based on experiences gained, or through considering probable barriers and opportunities, she suggests that at this stage adolescents are forging a more personal sense of self. Gottfredson (2002a) writes that "this… is a period of learning more about one's psychological profiles, especially as it affects one's public self" (p.100). One could suggest those with higher ToM ability at an earlier stage of development are more likely to understand the importance of developing both their own personal sense of self as well as their public self at an earlier stage too. This further suggests that ToM ability correlates with career aspiration stability.

Additionally, meta-analyses exploring vocational interest stability across specific vocational interest traits suggest a possible relationship between vocational choice development and Theory of Mind. Hoff et al. (2018) conducted a meta-analysis of 49 longitudinal studies including a total of 20,639 participants ranging from early adolescence (age 11) through to middle adulthood (age 42). In the college years (ages 18-22) and emerging adulthood (ages 22-30) groups, there was a notable difference: people-related vocational interest categories either increased or remained constant, whereas the things-related vocational interests either decreased or remained constant. Hoff et al (2018) argue that at this stage of 'young adulthood' (although ages 18-22 would be classed as late adolescence in accordance with our study), individuals are becoming more socially mature, as well as becoming increasingly interested in helping, leading and influencing people. The period of late-adolescence has been suggested to be the specific point at which ToM improves – similarly due to this concept of becoming more socially mature and developing a natural tendency to acknowledge others' perspectives (Dumontheil et al., 2010). Low et al (2005) found in their meta-analysis that this period of late-adolescence saw a notably large increase in vocational interest stability, and Hoff et al (2018) saw an increase in people-based vocational interest scores in this same age-group. It is therefore worth investigating whether there is a relationship between the stability of vocational interests, especially people-based vocational interests, and ToM development in the late-adolescent group.

Overall, the aim of this study is to test the stability of vocational interests and career aspirations and expectations in adolescence. We are using Gottfredson's theory of C&C to assess career aspiration stability, as well as experiential compromise in the group of late-adolescents following graduation from university. SES, IQ and self-efficacy will also be explored in relation to career aspiration and expectation choice, testing Gottfredson's theory of circumscription. Additionally, we are testing the theory empirically with a new emphasis on the impact of ToM on the stability of career aspirations, expectations and vocational interests in adolescence. Exploring the stability of career aspirations and expectations at two stages of adolescence will help inform the possible idea of looking at when best to implement timing of providing careers advice and make career-related decisions.

6.2 Research questions

1. Does the stability of expressed career aspirations follow Gottfredson's predictions? (in both mid- and late-adolescent groups)

2. Of those late-adolescents (undergraduate finalists) who appear to be presenting a career compromise between aspirational occupation choice at Wave 1 and their actual current job at Wave 2, does the order of stability follow Gottfredson's predictions?

3. Is there a relationship between SES, cognitive ability and self-efficacy for the future and prestige of occupational expectations and aspirations?

4. Do discrepant and non-discrepant groups differ in ToM and self-efficacy for the future scores?

5. Is stability of vocational interests over one year associated with ToM and self-efficacy?

6. Is there an association between ToM score and the mean level change in the vocational interest of People?

6.3 Methods

Participants

Participants were *N*=164 (62 male and 102 female) adolescents. Of these, *n*=91 (46 male and 45 female) were Year 10 pupils (mid-adolescents) and *n*=73 (17 male and 56 female) were final-year university students (late-adolescents). There were *n*=91 (46 male and 45 female) Year 10 pupils (mid-adolescents) tested during the first wave of data collection, and *n*=72 retested in Year 11. The first wave of final-year university student data collection took place between April 2018 and January 2019 and a follow-up questionnaire was emailed to the final-year university student (late-adolescent) group in August 2019. The follow-up questionnaire was exactly the same as the questionnaire administered in the first-wave of data collection, with the exception of an additional question asking participants to state what current job or discipline (if a postgraduate student) they were in. This questionnaire was designed and emailed out using Qualtrics. Of the *n*=73 final-year university students tested in the first wave, we received *n*=45 responses in the follow-up data collection.

RQ3 and RQ4 used responses from only the first wave of data collection, and therefore the total sample of *N*=164 participants was used. RQ1, RQ2, RQ5 and RQ6 were assessing stability or change, and therefore data from both waves of the longitudinal study were required. Therefore, for these analyses, we used the reduced sample size of *N*=117.

Measures

Theory of Mind (ToM)

The study employed the computer-based cartoon vignette paradigm developed by Sebastian et al (2012), which assesses both cognitive and affective ToM development. A full description of the task can be found in Chapter 3.

FSIQ

The study employed the Wechsler Abbreviated Scale of Intelligence – Second Edition (WASI-II) to control for general intelligence in both the Year 10 and undergraduate sample. A full description of the FSIQ measure can be found in Chapter 3.

Self-efficacy

The study assessed confidence about the future using a sub-scale of the Student Experiences of Non-Shared Environment Scales (SENSES: Yerdelen et al. 2018). Participants were asked how confident they were in their own ability to live up to their parents', teachers' and their own expectations of their future (Scale: 1 = not at all confident, 3 = somewhat confident, 5 = very confident). Self-efficacy scores were calculated by averaging the results of these four questions.

SES

All participants were asked to provide information about the occupations and highest education levels of their parents. Occupations were coded according to the eight NS-SEC Analytic classes as outlined by the ONS (2016) (1 = Higher managerial, administrative and professional occupations to 8 = Never worked and long-term unemployed). Education levels were coded according to the recommended qualifications question response list used in the UK census (ONS, 2013). The highest educational qualification and occupational class of the two parents/carers was used. Where 'SES' is used in the hypotheses, both educational qualification and occupation class were analysed separately. Highest parental qualification and parental occupation were chosen in reference with governmental evaluation of different measures of SES: as both measures are deemed to be accurate measures of socioeconomic background (Cabinet Office, 2018: Annex A). Additionally, considering the effect of highest qualification and occupation separately, and not combining scores to create a composite variable, enables more specific evaluation of the influence each variable may have on career aspirations.

Career aspiration and expectation variables

All participants were asked at both data collection points, “In an ideal world, what job or career would you most like to do?” and “What do you think you will most likely do for a job or career?”. The answers to these questions were coded as career idealistic aspirations and career realistic expectations respectively. In order to test Gottfredson’s theory of circumscription and compromise, we followed the procedure as outlined by Junk and Armstrong (2010) to develop new variables: each realistic and idealistic career choice had a sex-type score, prestige value, and a Data/Ideas and Things/People dimension score.

Occupational interest-based dimensions

Using RIASEC variable scores from the O*NET database online (National Center for O*NET Development, 2020), these interest-based dimension scores were calculated as below:

- Data/Ideas = 1.7(E + C – I – A), with a higher score indicating a relative preference for working with data rather than ideas.

- Things/People = 2(R-S) + I + C -A – E). Higher scores on this score indicate preference for working with things over people.

Prestige

Using methods outlined by Deng et al. (2007), three variables were used to construct a measure of prestige for idealistic aspirations, realistic expectations and actual job titles for both age-groups at both time-points:

1) Vocational preparation

Vocational preparation scores were obtained from the O*NET Job Zone ratings. According to Deng et al. (2007), a Job Zone is a group of occupations that are similar in terms of the experience, education and training needed to do the work. These are on a five-point scale with 1 = little or no preparation to 5 = extensive preparation.

2) Reinforcer (Recognition)

Recognition scores were obtained from the O*NET database (National Center for O*NET Development, 2020). In Deng et al's (2007) procedure, they created a composite need-reinforcer variable of Social Status and Recognition scores - however, Social Status scores are no longer available on the O*NET database. We were advised by an expert that it is appropriate to use the recognition scores by themselves as these scores have social status scores embedded in the score (Rounds, J, 2019, personal communication). This expert suggested correlating the recognition scores, the vocational preparation scores and the mean annual salaries across all aspirational/expected/actual occupations - there should be medium to high positive correlations (Rounds, J, 2019, personal communication).

3) Mean annual salary (MAS)

Mean annual salary (MAS) for each occupation was obtained from the Office for National Statistics (2018): results from the Annual Survey of Hours and Earnings (Table 15.7a Annual pay - Gross (£) - For all employee jobs: United Kingdom, 2018).

The three variables above were used to create a composite variable to represent prestige, using the following formula:

Prestige = 0.37 * z-Job Zone + 0.37 * z-MAS + 0.38 * z-Reinforcer.

Additionally, university graduates were asked what occupation they were currently in, and these occupations were coded in the same way as above, in order to test experiential career compromise in addition to anticipatory compromise.

Sex-type

We used the approach of Einarsdottir and Rounds (2000) to create a variable for sex-type, by coding occupations according to the percentage of female employees in that job. We used the Annual Population Survey – Employment by Occupation by Sex Table (Oct 2018-Sept 2019) (Office for National Statistics, 2019).

Missing data and variable preparation

At the first wave of data collection, there was missing or "un-codable" data for n=5 Year 10 participants and n=2 undergraduate students regarding idealistic career choice, and missing/un-codable data for n=20 Year 10 participants and n=10 undergraduate finalist participants regarding realistic career choice. At the second wave of data collection, there was missing or un-codable data for n=5 Year 11 participants regarding idealistic career choice, and n=14 Year

11 participants regarding realistic career choice. For the undergraduates followed up after graduation, we were able to code all of the idealistic career choices, but there was missing or un-codable data for n=3 of the realistic career choices. Data was deemed un-codable if the participant had left the answer blank, written ‘not sure’, or had written an answer too vague to code as a specific occupation (e.g. a Year 10 student wrote ‘Might go into research’). There was also no information on either the O*NET or the ONS for salary information for military occupations, so any participants that wrote ‘Army’ were left un-coded for prestige and the vocational interest dimensions, but not for sex-type. The occupations listed on the O*NET database are specific, so where participants had written vague responses (e.g. ‘Engineering’ or ‘Scientist’), it was decided to allocate a specific occupation and use this consistently across all participants. All that wrote Engineer were coded as Mechanical Engineer, all that wrote Scientist were coded as the occupation ‘Biochemists and Biophysicists’, and all ‘Teachers’ were coded as Primary School Teachers unless specified otherwise. This was done to ensure consistency across the sample when coding, although it is important to acknowledge the potential problems with this: there are differences in vocational interest data and recognition scores between the subtypes of each occupation, so by selecting the more specific occupation on behalf of the participant could mean the data recorded is not an accurate representation of the occupation they were picturing.

The prestige variable that was used in all of the analyses was calculated with a formula that uses three values: recognition scores, vocational preparation (job zone) scores and mean annual salaries (MAS). Rounds, via email correspondence, suggested correlating these three values across all aspirational/expected/actual occupations, stating that there should be medium to high positive correlations between them. We ran Pearson’s correlations between the three variables across all idealistic and realistic career aspiration data (and included the late-adolescent actual career choice data) in both mid- and late-adolescent groups at both time points. The results can be seen in Table 6.1 below.

TABLE 6.1 PEARSON'S CORRELATIONS BETWEEN MAS, VOCATIONAL PREPARATION AND RECOGNITION SCORES

Outliers included			
Measure	1	2	3
1 MAS	-		
2 Vocational Prep	-.154**	-	
3 Recognition	.395**	.563**	-

Outliers removed			
Measure	1	2	3
1 MAS	-		
2 Vocational Prep	.416**	-	
3 Recognition	.657**	.657**	-

With outliers included, a significant negative correlation was found between MAS (mean annual salary – as defined on p.215) and vocational preparation scores, which is the opposite to what was predicted (based on what Rounds, by email correspondence, had explained). Via visual inspection of scatterplots, it was evident that the occupation 'Athlete' (which included footballer and rugby player) was an outlier. The MAS for this occupation was £307,115 – the highest across all occupations coded, yet the job zone score was 2, which is low on the 1-5 scale used to code vocational preparation score. Across all coded answers, there were n=13 participants who had chosen Athlete as either their idealistic or realistic occupation choice.

When the Pearson's correlations were run again with these n=13 participants excluded, we saw the positive, moderate to high correlations between the three values that were expected. As these are such substantially high outliers, and the prestige variable is calculated using z-scores, we decided that we would exclude the n=13 cases from any analysis that involves the prestige variable.

Deng et al. (2007) used principle components analysis (PCA) to create a composite variable representing prestige. The suitability of using PCA was assessed prior to analysis: inspection of the correlation matrix showed all variables had correlation coefficients greater than 0.3. The overall Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .62, so adequate for PCA to be run (>0.6). Bartlett's Test of Sphericity was statistically significant (p=.000), which indicated that the data was likely factorizable. Similarly to Deng et al. (2007), we found that only the first component had an eigenvalue larger than 1, accounting for 71.98% of the total variance, which Deng et al (2007) said indicated that the three variables are highly related. In their own PCA, Deng et al (2007) found only the first component to have an eigenlevel larger than 1, which accounted for 79.05% of the total variance, so a similar result to our analysis.

Analysis

The analysis was originally pre-registered on the OSF, though was withdrawn (the pre-registration and an explanation for the withdrawal can be found at: https://osf.io/pmqxv/?view_only=df57128bc2cf4fae90771cb43bd12817). The withdrawal reasons and process are explained in more detail in the Chapter 7 (General Discussion). All analysis was conducted using the whole sample, and additionally, males and females were analysed separately for all research questions (with the exception of RQ4 and RQ5). Analysis was conducted with both outliers included and excluded. Cases were determined as outliers if their scores were +/- 3SDs above or below the mean, with outlier detection being conducted for each separate analysis. All analysis in this chapter is presented with outliers included (analyses with outliers removed are available in Appendix (11.6).

Hypothesis 1: *After controlling for confounding between measures of sex type, prestige and vocational interests, sex-type of expressed career aspirations will be more stable over time than prestige, and prestige will be more stable than interests in both the mid-adolescent (Year 10 followed up in Year 11) and late-adolescent (UG/PG finalists followed up after graduation) groups.*

In order to test this hypothesis we ran zero-order correlations and partial correlations (Pearson's) for the Wave 1 and Wave 2 expressed career aspirations of those students who have changed career aspirations over the 1-year period – looking at sex-type, prestige and vocational interests separately.

Hypothesis 2: *In the late-adolescent group, of those who appear to be presenting a career compromise between their aspirational occupation choice at Wave 1, and their actual current job/occupational area stated at Wave 2 following graduation, the order of stability will follow Gottfredson's predictions (sex-type being most stable, then prestige, then vocational interests).*

Zero-order correlations and partial correlations were calculated to test for associations between career aspirations expressed at Wave 1 and actual current job/occupational area at Wave 2 - looking at sex-type, prestige and vocational interests separately.

Junk and Armstrong's (2010) results section suggested they looked at a dimension, for example sex-type, of each participant's career aspiration at Wave 1, and ran correlations with the sex-type of their career aspiration at Wave 2, controlling for the non-independence of the ratings of the other dimensions (Prestige and the two interest dimension scores). This was then repeated for the other variables (Prestige and the two interest dimension scores). To assess stability, they compared the results across the four dimensions – for example they concluded that for their female sample, sex-type was the least stable aspiration dimension (r = .36), and prestige (r=.62), Things/People (r=.61) and Data/Ideas (r=.58) were relatively similar in stability and more stable than sex type. Junk and Armstrong (2010) outlined that they use confidence intervals to assess the statistical significance of the differences between two partial correlations (e.g. between sex-type and prestige). They write that:

"statistical significance at the .05 level is indicated if the 95% confidence interval for the stability measure does not include zero. Differences between two partial correlations are statistically significant (p < .05) if their 95% confidence intervals do not overlap." (Junk and Armstrong, 2010. p.587)

They used a bootstrap procedure to compute 95% confidence intervals which were used to assess the statistical significance of the difference between two partial correlations, a procedure that was also carried out in the current study.

Hypothesis 3: *There will be significant positive associations of SES, cognitive ability and self-efficacy for the future with occupational expectations and aspirations at all ages.*

Pearson's correlations were calculated to assess the associations between:

- SES and prestige of occupational expectation and aspiration.
- FSIQ score and prestige of occupational expectations and aspirations (while controlling for SES)
- Self-efficacy for the future score (calculated by averaging the results of the four self-efficacy questions) and the prestige of occupational expectations and aspirations.

Hypothesis 4: *Discrepant and non-discrepant groups will be significantly different in ToM and self-efficacy for the future (higher for the non-discrepant group).*

A one-way ANOVA was used to determine whether there were any statistically significant differences between ToM score (both cognitive and affective ToM were assessed separately) in the two groups (participants were classed as discrepant if their career aspiration and expectation were different, and non-discrepant if they were the same). The ToM scores controlled for FSIQ and sex (as explained in the previous results chapters) were used.

A One-way ANOVA was used to determine whether there were any statistically significant differences between self-efficacy score in the two groups.

Hypothesis 5: *Vocational interest stability over a year will be positively associated with both ToM and self-efficacy score in both groups (those who have not changed their vocational interests over the 1-year period will have higher ToM and self-efficacy scores in Wave 1).*

A one-way ANOVA was used to determine whether there were any statistically significant differences between ToM score (both cognitive and affective ToM were assessed separately) and self-efficacy score in the two groups (stable and unstable) for each vocational interest (Data, Things, People and Ideas) and the combined vocational interest profiles from career aspiration and expectation data.

The sample was divided into those whose vocational interests have changed and those whose interests have not. We used the data from the questionnaires that asked participants to state on a scale of 1-4 how important they think each of the four vocational interests (Data/Things/People/Ideas) is in their chosen career or field. Participants were asked this at both time points, so if they had rated the vocational interest with the same value at each time point, they were put into the stable group for this vocational interest. We conducted one-way ANOVAs to assess whether there was a statistically significant difference in ToM and self-efficacy scores between the stable and non-stable groups for each vocational interest.

Additionally, there was a value for each vocational interest dimension (one value for position on People/Things dimension and one for Data/Ideas dimension) of career aspiration/expectation in Wave 1, and the same for career aspiration/expectation in Wave 2. If individuals had the same score on these dimensions at both time points, they were allocated to the stable group. As these scales are on a substantially broader range, and are tied closely to specific job title, we additionally classed those individuals whose vocational interest dimension score at the second time point was within a 5% deviation of their score at the first time-point as in the stable category (their specific aspirational/realistic job title may have changed slightly but their vocational interest dimension score was still very close to their score the year previously). Both vocational interest dimension scores (People/Things and Data/Ideas) were taken into account when allocating individuals to stability groups: in cases where the change in one dimension score was only small (less than 5%), but the change in the other dimension score was larger than 5%, they were classified as unstable. We conducted one-way ANOVAs to assess whether there was a statistically significant difference in ToM and self-efficacy scores between the stable and non-stable groups for the vocational interest profiles calculated from both career aspirations and expectations.

Hypothesis 6: *Positive mean level change in the vocational interest of People will be positively associated with ToM score (an increase in the vocational interest of People over one year will be positively associated with higher ToM score in Wave 1).*

Hypothesis 6 was assessed using a multiple regression. There was one value for position on the vocational interest dimension of People/Things of career aspiration/expectation in Wave 1, and the same for career aspiration/expectation in Wave 2. We subtracted the score at Wave 1 from the score at Wave 2 to work out the + or – change for vocational interests. We also used the data from the questionnaires that asked participants to state on a scale of 1-4 how important they think each of the four vocational interests (Data/Things/People/Ideas) is in their chosen career or field. Participants were asked this at both time points, so again we subtracted the score at Wave 1 from the score at Wave 2 to work out the + or – change for vocational interests. We only used the data from the vocational interest of People for this analysis.

We used a multiple regression between vocational interest in People change scores (from both measures) as dependent variables and ToM scores as independent variables. We assessed whether ToM predicted the direction of the change (i.e. whether ToM was associated with an increase or decrease in the vocational interest of People over time).

6.4 Results

Descriptive statistics

Descriptive statistics were calculated for all main study variables for both the mid-adolescent and late-adolescent groups. Tables 6.2 and 6.3 present descriptive statistics for the sex-typing, prestige and vocational interest dimensions of career aspirations and expectations for both groups at Wave 1 and Wave 2 of data collection. Table 6.4 presents the rest of the main study variables, including age, FSIQ, self-efficacy, ToM scores and socioeconomic status (values for parental education and occupation are listed separately). With the exception of age, where both values from Wave 1 and Wave 2 are included, all of the values in Table 6.1c are from the first wave of data collection for both groups.

TABLE 6.2 CAREER ASPIRATIONS AND EXPECTATIONS (WAVE 1)

	All (mid- and late-adolescent groups)						Mid-adolescent (Y10)						Late adolescent (Final-year university students)					
	All		Females		Males		All		Females		Males		All		Females		Males	
Measure	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD
Career Aspiration																		
Sex-type	47.31 (156)	24.55	55.18 (97)	22.43	34.35 (59)	22.46	39.36 (86)	25.10	49.58 (44)	24.65	28.66 (42)	20.96	57.07 (70)	20.08	59.84 (53)	19.43	48.42 (17)	20.19
Prestige	.13 (150)	.85	.13 (95)	.83	.11 (55)	.89	0.03 (81)	0.92	0.06 (42)	0.97	.00 (39)	.87	.23 (69)	.75	.19 (53)	.70	.38 (16)	.92
Things/People	-21.01 (155)	137.35	-48.79 (96)	127.59	24.20 (59)	141.67	22.69 (85)	152.61	0.00 (43)	151.29	45.93 (42)	152.22	-74.07 (70)	92.45	-88.38 (53)	87.68	-29.47 (17)	95.30
Data/Ideas	-34.02 (155)	126.02	-51.89 (96)	120.61	-4.96 (59)	130.20	-23.38 (85)	108.76	-35.50 (43)	111.74	-10.97 (42)	105.50	-46.94 (70)	144.00	-65.18 (53)	126.84	9.90 (17)	180.55
Career Expectation																		
Sex-type	51.08 (134)	26.56	57.85 (84)	22.92	39.73 (50)	28.55	41.72 (71)	28.94	50.69 (38)	26.19	31.40 (33)	28.86	61.63 (63)	18.83	63.76 (46)	18.05	55.88 (17)	20.25
Prestige	-.10 (134)	.90	-.09 (84)	.88	-.12 (50)	.95	-0.08 (71)	0.94	.08 (38)	.96	-.25 (33)	.89	-.13 (63)	.86	-.23 (46)	.78	.12 (17)	1.04
Things/People	-13.97 (134)	152.15	-46.15 (84)	141.49	40.10 (50)	155.45	42.52 (71)	160.69	11.87 (38)	156.60	77.82 (33)	160.41	-77.63 (63)	112.83	-94.09 (46)	107.56	-33.12 (17)	117.96
Data/Ideas	-7.89 (134)	132.33	-11.96 (84)	131.18	-1.05 (50)	135.30	-25.50 (71)	112.02	-38.07 (38)	108.94	-11.02 (33)	115.43	11.95 (63)	150.47	9.61 (46)	144.68	18.30 (17)	169.73

TABLE 6.3 CAREER ASPIRATIONS AND EXPECTATIONS (WAVE 2)

	All (mid- and late-adolescent groups)						Mid-adolescent (Y11)						Late adolescent (Final-year university students)					
	All		Females		Males		All		Females		Males		All		Females		Males	
Measure	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD
Career Aspiration																		
Sex-type	49.37 (112)	24.76	59.34 (73)	19.86	30.71 (39)	22.25	42.24 (67)	23.54	55.93 (32)	17.48	29.72 (35)	21.43	60.00 (45)	22.86	62.01 (41)	21.36	39.38 (4)	30.90
Prestige	.10 (105)	.86	.07 (73)	.86	.16 (32)	.88	.16 (60)	.96	.23 (32)	1.12	.07 (28)	.75	.01 (45)	.71	-.06 (41)	.56	.77 (4)	1.52
Things/People	-27.04 (112)	138.03	-55.48 (73)	127.39	26.21 (39)	142.98	8.94 (67)	145.37	-19.69 (32)	142.70	35.11 (35)	144.84	-80.60 (45)	107.06	-83.41 (41)	107.73	-51.75 (4)	110.19
Data/Ideas	-22.49 (112)	119.56	-44.39 (73)	111.80	18.48 (39)	124.23	-17.58 (67)	124.08	-48.24 (32)	117.92	10.44 (35)	124.57	-29.81 (45)	113.48	-41.38 (41)	108.17	88.83 (4)	110.85
Career Expectation																		
Sex-type	53.47 (101)	25.06	62.90 (70)	19.44	32.15 (31)	23.41	47.17 (59)	25.20	60.26 (32)	16.71	31.65 (27)	24.95	62.31 (42)	22.29	65.13 (38)	21.43	35.51 (4)	8.17
Prestige	.16 (100)	.94	.14 (70)	.92	.22 (30)	1.02	.16 (58)	.99	.22 (32)	1.05	.09 (26)	.93	.17 (42)	.90	.07 (38)	.81	1.07 (4)	1.34
Things/People	-33.17 (100)	148.24	-76.60 (70)	127.51	68.17 (30)	145.46	14.40 (58)	155.75	-42.03 (32)	141.05	83.85 (26)	146.80	-98.86 (42)	108.23	-105.71 (38)	108.38	-33.75 (4)	94.73
Data/Ideas	-29.70 (100)	115.68	-43.13 (70)	109.51	1.64 (30)	125.28	-48.22 (58)	108.41	-72.09 (32)	94.54	-18.83 (26)	118.68	-4.13 (42)	121.73	-18.74 (38)	116.37	134.73 (4)	84.28

Note: any uneven group sizes in career aspiration/expectation dimensions due to missing information for certain occupations (e.g. Military roles have sex-type data but no other data)

TABLE 6.4 MAIN STUDY DESCRIPTIVE STATISTICS (EXCLUDING CAREER ASPIRATION AND EXPECTATION DATA)

	All (mid- and late-adolescent groups)						Mid-adolescent (Y10)						Late adolescent (Final-year university students)					
	All		Females		Males		All		Females		Males		All		Females		Males	
Measure	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD
FSIQ	104.94 (164)	12.33	105.50 (102)	11.58	104.02 (62)	13.53	102.69 (91)	12.64	103.09 (46)	11.83	102.29 (45)	13.53	107.74 (73)	11.42	107.48 (56)	11.08	108.59 (17)	12.80
SES (Occupation)	2.67 (131)	1.86	2.73 (85)	1.97	2.56 (46)	1.65	3.07 (60)	1.77	3.12 (31)	1.83	3.01 (29)	1.74	2.34 (71)	1.88	2.51 (54)	2.03	1.78 (17)	1.17
SES (Education)	6.13 (129)	2.07	6.19 (84)	1.99	6.02 (45)	2.23	5.68 (59)	2.17	5.74 (31)	2.08	5.61 (28)	2.30	6.51 (70)	1.91	6.45 (53)	1.90	6.71 (17)	1.99
Self-efficacy	3.56 (162)	.79	3.54 (101)	.79	3.58 (61)	.78	3.56 (89)	.76	3.57 (45)	.74	3.55 (44)	.79	3.55 (73)	.82	3.52 (56)	.84	3.65 (17)	.77
Aff ToM RT	.00 (163)	1.00	-.23 (101)	.87	.37 (62)	1.08	.32 (90)	1.06	.17 (45)	.90	.48 (45)	1.18	-.40 (73)	.75	-.55 (56)	.71	.09 (17)	.66
Cog ToM RT	.00 (164)	1.00	-.15 (102)	.91	.25 (62)	1.09	.37 (91)	1.02	.29 (46)	.87	.45 (45)	1.16	-.46 (73)	.74	-.52 (56)	.77	-.29 (17)	.62
Aff ToM % ER	.00 (164)	1.00	-.16 (102)	.95	.26 (62)	1.02	.17 (91)	1.17	-.02 (46)	1.22	.37 (45)	1.10	-.22 (73)	.66	-.28 (56)	.64	-.02 (17)	.72
Cog ToM % ER	.00 (164)	1.00	-.11 (102)	.77	.18 (62)	1.27	.07 (91)	1.13	-.13 (46)	.76	.27 (45)	1.39	-.08 (73)	.80	-.09 (56)	.79	-.07 (17)	.86

Career aspiration and expectation descriptives

Sex-type

The sex-type value represents the percentage of women working in particular roles, therefore higher numbers represent more female sex-typed roles. The Year 10 career aspirations were, on average, more male sex-typed (M=39.36%, SD=25.10), whereas the final-year university student career aspirations were more female sex-typed (M=57.06%, SD=20.08), which was likely caused by there being more females than males in the overall final-year university student sample. Broken down by gender, career aspirations were more female sex-typed for the female participants than the male participants in both groups (in Year 10, female M=49.58%, SD=24.65 vs male M=28.66%, SD=20.96; in final-year university student, female M=59.84%, SD=19.43 vs male M=48.42%, SD=20.19). Across all age-groups and both genders, there was an increase in sex-type score for career expectations (across whole sample career aspirations M=47.31%, SD=24.55 vs career expectations M=51.08%, SD=26.56).

Similar patterns emerged in the sex-type scores at Wave 2. In both the mid-adolescent (now Year 11) group, and the late-adolescent (university graduate students), career aspirations were more female sex-typed for females compared to males (in Year 11, female M=55.93, SD=17.48, male M=29.72, SD=21.43; in university graduate group, female M=62.01, SD=21.36, male M=39.38, SD=30.90). Sex-type of career expectation scores were similar, though there was an increase for the females in both the Year 11 (M=60.26, SD=16.71) and in the university graduate group (M=65.13, SD=21.43) compared to their Wave 2 career aspirations, suggesting that there is an expectation to work in more typically female sex-typed roles.

Prestige

Prestige of career aspirations was higher in the final-year university student group compared to the Year 10 group (M=.23, SD=.75 vs M=.03, SD=.92). Female participants in the Year 10 sample had slightly higher levels of prestige scores of career aspirations than males (M=.06, SD=.97 vs M=.00, SD=.87), with the opposite being true for the final-year university student group (male prestige score M=.38, SD=.92 vs female prestige score M=.19, SD=.70). Overall, prestige scores for career expectations were lower than for career aspirations (M=-.10, SD=.90 vs M=.13, SD=.85), a pattern that was seen in both age-groups for males, and the final-year university student females, but not for the Year 10 female participants. The prestige of the Year 10 female career expectations had a slightly increased (M=.08, SD=.96).

Similar patterns emerged in the prestige scores of career aspirations at Wave 2. Again, female participants in Year 11 had higher prestige levels than their male peers (M=.23, SD=1.12 vs M=.07, SD=.75), and again the opposite pattern was seen in the university graduate group (female M=-.06, SD=.56, male M=.77, SD=1.52). Across the whole sample, prestige scores for career expectations were actually higher than career aspirations (M=.16, SD=.94 vs M=.10, SD=.86). This was particularly noticeable in the university graduate group, where prestige levels of career expectations were higher than aspirations for both males (M=1.07, SD=1.34) and females (M=.07, SD=.81).

Things/People Vocational Interest Dimension

Preference for working with People rather than Things was apparent in the career aspirations of the final-year university student group (M=-74.07, SD=92.45), with the opposite being seen for the Year 10 group (M=22.69, SD=152.61), as higher scores on these dimensions indicate a relative preference for working with Things rather than People. The preference for working with People over Things was apparent in both the male and female final-year university students (male M=-29.47, SD=95.30, female M=-88.38, SD=87.68) though the preference was stronger for the female participants. The mean score for the Year 10 female groups on the Things/People dimension was 0.00 (SD=151.29), with the males leaning more towards a preference for working with Things (M=-45.93, SD=152.22). The same patterns were seen when looking at career expectations across both groups, with the Year 10s preferring working with Things (M=42.52, SD=160.69), and the final-year university students working with People (M=-77.63, SD=112.83). Across the whole sample, for both career aspirations and expectations, there was a clear gender difference, with females having a stronger preference for working with People (for aspirations, M=-48.79, SD=127.59, expectations, M=-46.15, SD=141.49), and the males having a stronger preference for working with Things (for aspirations, M=24.20, SD=141.67, for expectations, M=40.10, SD=155.45).

Again, similar patterns emerged in the People/Things dimension scores for career aspirations at Wave 2. There was still a slight preference for working with Things in the career aspirations of the mid-adolescent (Year 11) group (M=8.94, SD=145.37), and a stronger preference for working with People in the late-adolescent (university graduate) group (M=-80.60, SD=107.06). The preference for working with People over Things in career aspirations was evident for female participants in both age groups (Year 11 M=-19.69, SD=142.70, university graduate M=-83.41, SD=107.73), and also for males in the late-adolescent group (M=-51.75, SD=110.19). The male mid-adolescent group were the exception, indicating a preference towards working with Things rather than People (M=35.11, SD=144.84). There was an even stronger preference towards working with People in career expectations for females in both groups (Year 11 M= -42.03, SD=141.05; university graduate M=-105.71, SD=108.38). There was a stronger preference towards working with Things in the career expectations for the males in the Year 11 group (M=83.85, SD=146.80), and although there was also a shift towards working with Things in the university male group, the preference was still towards working with People (-33.75, M=94.73).

Data/Ideas Vocational Interest Dimension

Higher scores on the Data/Ideas dimension indicate a relative preference for working with Data rather than Ideas. Across the whole sample, both age-groups and genders generally indicated a preference for working with Ideas rather than Data in their career aspirations, with the exception of the male final-year university student group (M=9.90, SD=180.55). There was a shift towards a preference to working with Data rather than Ideas in the career expectations for the final-year university students, (career aspirations M=-46.94, SD=144.00 vs career expectations M=11.95, SD=150.47), a shift that occurred for both males and females. There was not a notable difference between career aspirations and expectations in terms of the Data/Ideas dimension for the Year 10 group, with the preference shifting slightly further towards working with Ideas than Data.

Slightly different patterns emerged in the Data/Ideas dimension scores for career aspirations at Wave 2. Across the whole sample, there was a preference towards working with Ideas over Data (M=-22.49, SD=119.56), although this preference was much stronger for females (M=-44.39, SD=11.80) than males, who overall had a preference for working with Data (M=18.48, SD=124.23). This pattern emerged in both age-groups: female career aspirations indicated a relative preference for working with Ideas (Year 11 M=-48.24, SD=117.92; university graduate

M=-41.38, SD=108.17), whereas male career aspirations indicated a relative preference for working with Data (Year 11 M=10.44, SD=124.57; university graduates M=88.83, SD=110.85). The preference for working with Ideas rather than Data was strengthened in the career expectations of the Year 11 group (whole sample M=-48.22, SD=108.41; females M=-72.09, SD=94.54; males M=-18.83, SD=118.68). The opposite was seen in the university graduate group, where the relative preference for working with Ideas rather than Data was reduced (whole sample M=-4.13, SD=121.73; females M=-18.74, SD=116.37), and the males expectations indicating a stronger preference for working with Data (M=134.73, SD=84.28).

RQ1 Does the stability of expressed career aspirations follow Gottfredson's predictions? (in both mid- and late-adolescent groups)

Table 6.5 presents the zero-order and partial correlations for the stability of expressed career aspirations over a 1-year period for the mid-adolescent group (Year 10s followed up in Year 11), and the late-adolescent group (Final-year university students followed up after graduation). We followed Junk and Armstrong's (2010) method of using bootstrapping to compute 95% confidence intervals, and followed their guidelines that statistical significance ($p < .05$) is indicated if the 95% confidence interval does not include a zero, and that differences between two partial correlations are statistically significant ($p < .05$) if there are no overlaps between the 95% confidence intervals. This analysis included all participants: those who wrote different career aspirational choices at Wave 2 to Wave 1, as well as those who kept their aspirational choices the same. Results are analysed and presented split by gender in order to consider gender differences in career aspirations. Higher correlations indicate greater stability.

In the analysis, cases were excluded listwise due to the interrelatedness of the variables. Therefore, due to missing variables in the mid-adolescent sample, the analysis involved N=56 mid-adolescent participants. As there were only *n*=4 males in the undergraduate follow-up group, 95% confidence intervals could not be calculated and therefore no results are presented for this group. The data of N=41 female late-adolescents were used in the analysis.

There were N=2 outliers, detected by visual inspection of scatterplots. Both cases were in the late-adolescent female group: N=1 had a substantially large difference between the Data/Ideas score for their idealistic aspiration at Wave 1 compared to their Data/Ideas score at Wave 2, and N=1 had a substantially large difference between the prestige score for their idealistic aspiration at Wave 1 compared to Wave 2. The tables presented below include these outliers. Tables presenting the analysis conducted excluding the outliers are presented in Appendix 11.6

In accordance with Gottfredson's (2002a) theory of career compromise, we predicted that of the expressed career aspirations, sex-type would be most stable, followed by prestige, then followed by vocational interests.

TABLE 6.5 STABILITY OF EXPRESSED CAREER ASPIRATIONS OVER A 1-YEAR PERIOD

	Zero-order correlation			Partial correlation		
Measure	*r*	*SE*	CI	*r*	*SE*	CI
Mid-adolescent						
Female						
Sex type	.50	.18	.08-.79	.53	.23	.04-.93
Prestige	.66	.13	.38-.86	.60	.21	.18-.95
Things/People	.71	.11	.44-.89	.68	.16	.29-.92
Data/Ideas	.55	.17	.17-.82	.52	.19	.14-.83
Male						
Sex type	.77	.09	.56-.92	.73	.17	.24-.93
Prestige	.31	.19	-.11-.67	.31	.27	-.27-.77
Things/People	.70	.13	.42-.90	.72	.13	.41-.92
Data/Ideas	.18	.19	-.18-.58	.49	.19	.12-.84
Late-adolescent						
Female						
Sex type	.76	.08	.59-.89	.73	.13	.37-.93
Prestige	.50	.13	.27-.77	.55	.14	.31-.88
Things/People	.72	.13	.42-.92	.72	.20	.12-.94
Data/Ideas	.34	.22	-.09-.72	.28	.24	-.12-.79
Male						
Sex type	-	-	-	-	-	-
Prestige	-	-	-	-	-	-
Things/People	-	-	-	-	-	-
Data/Ideas	-	-	-	-	-	-

In the mid-adolescent female group, the correlations for all of the variables were very similar. Sex-type was one of the least stable aspiration dimensions, *r*=.53 (CI=.04-.93), with prestige being more stable, *r*=.60 (CI=18-.95). Data/Ideas was the least stable variable of all, *r*=.52 (CI=.14-.83), and Things/People was most stable, *r*=.68 (CI=.29-.92).

In the mid-adolescent male group, sex type was the most stable variable, *r*=.73 (CI=.24-.93), which is in accordance with Gottfredson's predictions. Prestige, however, was the least stable, *r*=.31 (CI=-.27-.77), with both vocational interest variables being more stable. Data/Ideas was moderately stable, *r*=.49 (CI=.12-.84), and Things/People was highly stable, *r*=.72 (CI=.41-.92).

In the late-adolescent female group, the data shows that sex-type was the most stable variable, *r*=.73 (CI=.37-.93). Prestige was slightly less stable than sex-type, *r*=.55 (CI=.31-.88), and Data/Ideas was less stable than prestige, *r*=.28 (CI=-.12-.79), both results in line with Gottfredson's predictions. However, Things/People was again one of the most stable variables, *r*=.72 (CI=.12-.94), which is the opposite to Gottfredson's theory of compromise. With the N=2 outliers excluded, both the stability of prestige (*r*=.69, CI=.38-.93) and Data/Ideas increased, (*r*=.59, CI=.24-.90), but the order of stability remained the same across the variables.

The confidence intervals for the partial correlations overlapped between all of the dimensions in all groups, therefore the differences seen in stability between the dimensions are not statistically significant.

Like Junk and Armstrong (2010), we also reported the zero-order and partial correlations of the sample using only those individuals who changed their career aspirations over the 1-year period (*N*=65 across whole sample, *n*=43 mid-adolescents and *n*=22 late-adolescents). By excluding the participants that did not change their career aspirations, it means the analysis focuses specifically on those with unstable career aspirations. This means that we can gain a better insight into which of the variables (sex-type, prestige and vocational interests) are perceived to be most important when adolescents are exploring and changing their career aspirations. These results are reported in Table 6.3 below. In the analysis, cases were excluded listwise due to the interrelatedness of the variables. Therefore, due to missing variables in the mid-adolescent sample, the analysis involved *n*=35 mid-adolescent participants. As there was only *n*=1 male late-adolescent participants who changed their career aspirations over the 1-year period, the analysis involved *n*=22 late-adolescent participants.

TABLE 6.6 CHANGES IN EXPRESSED CAREER ASPIRATIONS OVER A 1-YEAR PERIOD

	Zero-order correlation			Partial correlation		
Measure	*r*	*SE*	CI	*r*	*SE*	CI
Mid-adolescent						
Female						
Sex type	-.12	.25	-.60-.36	.02	.47[b]	-1.00-1.00[b]
Prestige	.50	.19	.11-.82	.51	.50[b]	-.96-1.00[b]
Things/People	.44	.21	-.07-.75	.57	.41[b]	-.86-1.00[b]
Data/Ideas	.36	.21	-.08-.71	.32	.48[a]	-.98-1.00[a]
Male						
Sex type	.58	.15	.25-.85	.59	.46[b]	-.91-1.00[b]
Prestige	-.04	.23	-.56-.40	-.27	.48[a]	-1.00-.88[a]
Things/People	.48	.20	.03-.81	.69	.40[b]	-.76-1.00[b]
Data/Ideas	-.01	.23	-.43-.48	.30	.42[a]	-.85-1.00[a]
Late-adolescent						
Female						
Sex type	.46	.16	.10-.71	-.09	.38	-.73-.75
Prestige	.16	.18	-.30-.46	.51	.35[c]	-.49-.91[c]
Things/People	.44	.23	-.14-.79	.41	.47[c]	-.75-.93[c]
Data/Ideas	.13	.26	-.39-.60	.07	.36	-.58-.87
Male						
Sex type	-	-	-	-	-	-
Prestige	-	-	-	-	-	-
Things/People	-	-	-	-	-	-
Data/Ideas	-	-	-	-	-	-

Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples; a: based on 988-992 samples, b: based on 991-996 samples, c: based on 997-998 samples.

Again, in accordance with Gottfredson's theory of career compromise, we predicted that of those who changed their career aspirations between the first and second waves of data collection, sex-type would be most stable, followed by prestige, then followed by vocational interests. The results from the second analyses do not support Gottfredson's predictions. Sex-type was the least stable of all the dimensions for female participants (in both mid- and late-adolescent groups). Prestige was substantially more stable than sex-type for the female adolescents, but least stable for the male mid-adolescent group. Data/Things was more stable than sex-type for the female participants, but less so than sex-type for the male participants.

Things/People was the most stable variable for both male and female mid-adolescent groups, and while still of relatively high stability, Things/People was not as stable as prestige for the female late-adolescent group.

Of those female participants in the mid-adolescent group who changed their career aspirations between the first and second waves of data collection, sex type was the least stable of all of the dimensions, *r*=.02 (CI=-1.00-1.00), with prestige being more stable, *r*=.51 (CI=-.96-1.00). Both vocational interest variables were more stable than sex-type: Data/Ideas, *r*=.32 (CI=-.98-1.00) and Things/People was also more stable than prestige *r*=.57 (CI=-.86-1.00).

For the male participants in the mid-adolescent group who changed their career aspirations between the first and second waves of data collection, sex-type was highly stable, *r*=.59 (CI=-.91-1.00), with prestige being less stable, *r*=-.27 (CI=-1.00-.88), in line with Gottfredson's predictions. However, both vocational interests dimensions were more stable than prestige (Data/Ideas, *r*=.30 (CI=-.85-1.00) and Things/People, *r*=.69 (CI=-.76-1.00). Again, Things/People was the most stable variable of all, which is not in line with Gottfredson's original predictions.

In the late-adolescent female group the sex type dimension was the least stable, *r*=-.09 (CI=-.73-.75), with prestige being most stable *r*=.51 (CI=-.49-.91). In line with Gottfredson's predictions, Data/Ideas was much less stable than prestige, *r*=.07 (CI=-.58-.87), and even though Things/People was too, *r*=.41 (CI=-.75-.93), Things/People and prestige are of relatively similar stability. When the analysis was conducted again with the *n*=2 outliers removed, the stability across the variables changed. Sex-type remained the least stable, *r*=-.03 (CI=-.76-.95), but Data/Ideas, *r*=.40 (CI=-.70-.98), prestige, r=.42 (CI=-.85-.99) and Things/People, *r*=.42(CI=-.91-.98) were seen to be of a similar level of stability.

Again, as there was only *n*=1 male in the undergraduate follow-up group, it was not possible to calculate 95% confidence intervals, and therefore there are no results reported.

The confidence intervals for the partial correlations overlapped between all of the dimensions in both groups, therefore the differences seen in stability between the dimensions are not statistically significant. In this analysis concerning participants that have changed their career aspirations between the first and second waves of data collection, the confidence intervals are very large – even larger than those seen in Table 6.5 with the analysis of the whole sample.

RQ2 – Career compromise between aspirational and actual job

RQ2: Of those late-adolescents (undergraduate finalists) who appear to be presenting a career compromise between aspirational occupation choice at Wave 1 and their actual current job at Wave 2, does the order of stability follow Gottfredson's predictions?

The late-adolescents that participated in Wave 2 of the data collection were categorised as either discrepant (had different aspirational occupation choice at Wave 1 to actual occupation at Wave 2), or non-discrepant (was working in the role that they aspired to be in at Wave 1). Of the N=29 that provided codable career information, N=24 were classed as discrepant, and N=2 were classed as non-discrepant. N=3 participants were working in occupations of higher prestige than their career aspirations stated at Wave 1, so were not included in the analysis, as they could not be classed as making a career 'compromise'. Scatterplots were assessed and no outliers were identified. The results of the correlational analyses can be seen in Table 6.7 below.

TABLE 6.7 CAREER COMPROMISES AFTER A 1-YEAR PERIOD

	Zero-order correlation			Partial correlation		
Measure	*r*	*SE*	CI	*r*	*SE*	CI
Female						
Sex type	.31	.16	-.05-.58	.36	.24	-.20-.73
Prestige	.29	.23	-.28-.63	.37	.37	-.57-.85
Things/People	.48	.21	-.07-.77	.33	.33	-.51-.80
Data/Ideas	.18	.21	-.30-.56	.39	.32	-.38-.86
Male						
Sex type	-	-	-	-	-	-
Prestige	-	-	-	-	-	-
Things/People	-	-	-	-	-	-
Data/Ideas	-	-	-	-	-	-

Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples; a: based on 984-986 samples, b: based on 991-996 samples, c: based on 999 samples.

According to Gottfredson's (1996) revised theory, the level of career compromise participants engage in affects which career dimension they place greatest importance on maintaining. Gottfredson (1996) wrote that when faced with a low degree of compromise, individuals would place most importance on interests, then prestige, then sex-type, and it is only when in a situation where there is a high degree of compromise, where sex-type is suggested to be most important, followed by prestige, and then followed by vocational interests. We did not include an item to measure the degree, or self-perceived degree, of career compromise, therefore predicted that the order of stability for the career dimensions would follow Gottfredson's original theory, with sex-type being most stable, followed by prestige and then interests.

In the late-adolescent female group the dimensions were all of relatively similar stability between the idealistic and actual career choices. Our results therefore do not support Gottfredson's theory of compromise. There were only *n*=2 males that provided codable data for the current occupational choice at the undergraduate follow-up group, so the analysis could not be conducted with such a small group.

RQ3 Is there a relationship between SES, cognitive ability and self-efficacy for the future and prestige of occupational expectations and aspirations?

We ran Pearson's correlations between SES, cognitive ability (FSIQ) and self-efficacy. Results can be seen in Table 6.8a-d.

SES

Across the whole sample, we found a small to moderate, significant positive correlation between SES (as measured by parental highest level of education) and the prestige of job expectation, $r(109)=.23$, $p=.02$. When the sample was spilt by gender, there were no significant correlations between SES and prestige of job expectation for females, $r(69)=.12$, $p=.31$, but a significant and moderately strong positive correlation was found in the male group, r(38)=.40, $p=.01$. As this result includes both the mid- and late-adolescent male participants, all participants will have progressed through the process of circumscription and so should have incorporated considerations of social class into their self-concepts. Both the small, significant positive correlation between SES and prestige of job expectation across the whole sample, and the stronger, moderately strong positive correlation in the male group support Gottfredson's theory that states that individuals at this stage would have rejected occupations that are inconsistent with these elements of their self-concept.

When we tested both age-groups separately, we found a statistically significant and moderately strong positive correlation between SES (as measured by highest parental level of education) and prestige of career expectation in the mid-adolescent group at Wave 1, *r*(46)=.43, *p*=.002, and at Wave 2, *r*(39)=.46, *p*=.002, but not in the late-adolescent group, r(61)=.07, *p*=.57. Additionally, a statistically significant and moderately strong positive correlation was found between SES (as measured by highest parental level of education) and prestige of career aspiration at Wave 2, *r(*41)=.43, *p*=.004. When each age-group was further separated by gender, a strong significant positive correlation was found between SES (as measured by highest parental level of education) and prestige of career expectation in the mid-adolescent male group at Wave 2, *r*(16)=.67, *p*=.002. Possible explanations for the differences seen between age-groups will be explored in the discussion section of this results chapter.

Cognitive ability (FSIQ)

We ran partial correlations between FSIQ and career aspiration and expectations, controlling for SES (both parental highest occupation and education level were controlled for separately). When controlling for the effects of SES (based on occupation level), there was a significant, small to moderate positive correlation between both FSIQ and prestige of career expectation, *r*(102)=.28, *p*=.003, and FSIQ and career aspiration, *r*(102)=.28, *p*=.003. When the whole sample was split by gender, there were no significant correlations found regarding prestige of career expectations and FSIQ in the female group, but there were in the male group. In the male group, there was a significant moderate to strong positive correlation between FSIQ and prestige of career expectation, both when controlling for parental occupation, *r*(32)=.59, *p*=.000, and parental highest level of education *r*(32)=.47, *p*=.004. Additionally, when controlling for parental occupation, there was a significant positive correlation between FSIQ and prestige of career aspiration, *r*(32)=.37, *p*=.025.

When we tested both age-groups separately, we found a statistically significant positive correlation between FSIQ (controlled for parental occupation) and prestige of career expectation in the mid-adolescent group, $r(40)=.44$, $p=.003$, but not in the late-adolescent group, $r(57)=.14$, $p=.271$. When each age-group was further separated by gender, strong, positive significant correlations were found for the male mid-adolescent group: there was a significant positive correlation between FSIQ and prestige of career expectation when controlling for parental occupation, $r(16)=.612$ $p=.004$.

These results again support Gottfredson's theory that states that by mid-adolescence, individuals will have taken their own ability into account when rejecting and selecting jobs deemed appropriate. We will discuss possible explanations for the differences seen between males and females in these results later on in the overall discussion for this results chapter.

Self-efficacy

There were no statistically significant correlations between self-efficacy for future goals and career expectations or aspirations in the whole sample, nor in either the mid- or late-adolescent groups when separated by age. When the groups were separated by gender, small positive significant correlations between self-efficacy for future goals and prestige of career expectations were found in the male group, both in the whole sample, $r(48)=.285$, $p=.045$, and in the mid-adolescent group, $r(31)=.353$, $p=.044$. However, the significance of these correlations were lost when correcting for multiple comparisons using Benjamini-Hochberg FDR.

When the analysis was run with outliers excluded, a weak to moderate, negative correlation was noted between self-efficacy and prestige of career aspirations in the late-adolescent group, $r(65)=.38$, $p=001$. When the whole group was split by gender, a strong, negative correlation was noted between self-efficacy and prestige of career aspirations in the male group, $r(13)=-.61$, $p=015$. Although initially a significant result, when controlling for multiple comparisons, the significance of the correlation was lost.

TABLE 6.8A CORRELATIONS BETWEEN SES, FSIQ, SELF-EFFICACY AND PRESTIGE OF CAREER EXPECTATIONS AND ASPIRATIONS

Measure	1	2	3	4	5	6	7
Whole sample							
1 Prestige (job expectation) (*n*=134)	-						
2 Prestige (job aspiration) (*n*=150)	.58**	-					
3 SES (occupation) (n=131)	-.13	-.16	-				
4 SES (education) (*n*=129)	.23*	.19	-.47**	-			
5 FSIQ (controlled for SES occ) (*n*=107)	.28** [a]	.28** [a]	-.19	.26**	-		
6 FSIQ (controlled for SES edu) (*n*=106)	.20 [a]	.21 [a]	-.19	.26**	-	-	
7 Self-efficacy (*n*=162)	.15	.04	.04	.04	-.06 [a]	-.07 [a]	-
Females							
1 Prestige (job expectation) (*n*=84)	-						
2 Prestige (job aspiration) (*n*=95)	.56**	-					
3 SES (occupation) (*n*=85)	-.15	-.19	-				
4 SES (education) (*n*=84)	.12	.16	-.54**	-			
5 FSIQ (controlled for SES occ) (*n*=70)	.08 [a]	.23 [a]	-.19	.25	-		
6 FSIQ (controlled for SES edu) (*n*=69)	.08 [a]	.21 [a]	-.19	.25	-	-	
7 Self-efficacy (*n*=101)	.07	-.04	.02	.11	-.13 [a]	-.19 [a]	-
Males							
1 Prestige (job expectation) (*n*=50)	-						
2 Prestige (job aspiration) (*n*=55)	.60**	-					
3 SES (occupation) (*n*=46)	-.08	-.08	-				
4 SES (education) (*n*=45)	.40*	.24	-.37	-			
5 FSIQ (controlled for SES occ) (*n*=37)	.59** [a]	.37* [a]	-.19	.30	-		
6 FSIQ (controlled for SES edu) (*n*=37)	.47** [a]	.18 [a]	-.19	.30	-	-	
7 Self-efficacy (*n*=61)	.29	.18	.09	-.08	.07 [a]	.13 [a]	-

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR. a= result from partial correlation, controlling for SES (both occupation and education controlled for separately). Correlation between SES measure (3 and 4) and FSIQ (5 and 6) conducted without controlling for SES variables.

Table 6.8B Correlations between SES, FSIQ, Self-efficacy and prestige of career expectations and aspirations (Y10 – Wave 1)

Measure	1	2	3	4	5	6	7
Whole group							
1 Prestige (job expectation) (*n*=71)	-						
2 Prestige (job aspiration) (*n*=81)	.77**	-					
3 SES (occupation) (*n*=60)	-.21	-.12	-				
4 SES (education) (*n*=59)	.43**	.33*	-.42**	-			
5 FSIQ (controlled for SES occ) (*n*=45)	.44** [a]	.34 [a]	-.24	.34**	-		
6 FSIQ (controlled for SES edu) (*n*=44)	.30 [a]	.15 [a]	-.24	.34**	-	-	
7 Self-efficacy (*n*=89)	.19	.24	.23	-.08	-.08 [a]	-.07 [a]	-
Females							
1 Prestige (job expectation) (*n*=38)	-						
2 Prestige (job aspiration) (*n*=42)	.89**	-					
3 SES (occupation)(*n*=31)	-.39	-.24	-				
4 SES (education) (*n*=31)	.47	.39	-.45**	-			
5 FSIQ (controlled for SES occ) (*n*=24)	.32	.37	-.27	.36	-		
6 FSIQ (controlled for SES edu) (*n*=23)	.28	.25	-.27	.36	-	-	
7 Self-efficacy (*n*=45)	.06	.18	.23	-.15	-.24 [a]	-.30 [a]	-
Males							
1 Prestige (job expectation) (*n*=33)	-						
2 Prestige (job aspiration) (*n*=39)	.61**	-					
3 SES (occupation) (*n*=29)	.04	.08	-				
4 SES (education) (*n*=28)	.39	.26	-.40	-			
5 FSIQ (controlled for SES occ) (*n*=21)	.62** [a]	.33 [a]	-.21	.36	-		
6 FSIQ (controlled for SES edu) (*n*=21)	.36 [a]	-.05 [a]	-.21	.36	-	-	
7 Self-efficacy (*n*=44)	.35	.30	.23	-.01	.13 [a]	.19 [a]	-

note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR. a= result from partial correlation, controlling for SES (both occupation and education controlled for separately). Correlation between SES measure (3 and 4) and FSIQ (5 and 6) conducted without controlling for SES variables.

Table 6.8C -Correlations between SES, FSIQ, Self-efficacy and prestige of career expectations and aspirations in mid-adolescent group (Y11 – Wave 2)

Measure	1	2	3	4	5	6	7
Whole group							
1 Prestige (job expectation) (*n*=58)	-						
2 Prestige (job aspiration) (*n*=60)	.85**	-					
3 SES (occupation) (*n*=60)	-.33	-.35*	-				
4 SES (education) (*n*=59)	.46**	.43**	-.42**	-			
5 FSIQ (controlled for SES occ) (*n*=40)	.39* [a]	.19 [a]	-.24	.34**	-		
6 FSIQ (controlled for SES edu) (*n*=38)	.31 [a]	.17 [a]	-.24	.34**	-	-	
7 Self-efficacy (*n*=89)	.14	.18	.17	.18	.37* [a]	.17 [a]	-
Females							
1 Prestige (job expectation) (*n*=32)	-						
2 Prestige (job aspiration) (*n*=32)	.92**	-					
3 SES (occupation) (*n*=31)	-.40	-.48	-				
4 SES (education) (*n*=31)	.36	.49	-.45	-			
5 FSIQ (controlled for SES occ) (*n*=23)	.30 [a]	.31 [a]	-.27	.36	-		
6 FSIQ (controlled for SES edu) (*n*=22)	.35 [a]	.36 [a]	-.27	.36	-	-	
7 Self-efficacy (*n*=45)	.09	.14	.22	.17	.45 [a]	.18 [a]	-
Males							
1 Prestige (job expectation) (*n*=26)	-						
2 Prestige (job aspiration) (*n*=28)	.70**	-					
3 SES (occupation) (*n*=29)	-.15	-.16	-				
4 SES (education) (*n*=28)	.67**	.39	-.40	-			
5 FSIQ (controlled for SES occ) (*n*=17)	.60 [a]	.14 [a]	-.21	.36	-		
6 FSIQ (controlled for SES edu) (*n*=16)	.21 [a]	-.16 [a]	-.21	.36	-	-	
7 Self-efficacy (*n*=44)	.20	.25	.15	.19	.35 [a]	.16 [a]	-

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR. a= result from partial correlation, controlling for SES (both occupation and education controlled for separately). Correlation between SES measure (3 and 4) and FSIQ (5 and 6) conducted without controlling for SES variables.

Table 6.8D - Correlations between SES, FSIQ, Self-efficacy and prestige of career expectations and aspirations in late-adolescent group (Undergrad Wave 1)

Measure	1	2	3	4	5	6	7
Whole group							
1 Prestige (job expectation) (*n*=63)	-						
2 Prestige (job aspiration) (*n*=69)	.32	-					
3 SES (occupation) (*n*=71)	-.09	-.16	-				
4 SES (education) (*n*=70)	.07	.02	-.49**	-			
5 FSIQ (controlled for SES occ) (*n*=62)	.14 [a]	.23 [a]	-.09	.28	-		
6 FSIQ (controlled for SES edu) (*n*=62)	.14 [a]	.24 [a]	-.09	.28	-	-	
7 Self-efficacy (*n*=73)	.11	-.21	-.11	.18	-.03 [a]	-.04 [a]	-
Females							
1 Prestige (job expectation) (*n*=46)	-						
2 Prestige (job aspiration) (*n*=53)	.16	-					
3 SES (occupation) (*n*=54)	-.02	-.17	-				
4 SES (education) (*n*=53)	-.12	-.03	-.58**	-			
5 FSIQ (controlled for SES occ) (*n*=46)	-.10 [a]	.10 [a]	-.11	.12	-		
6 FSIQ (controlled for SES edu) (*n*=46)	-.07 [a]	.14 [a]	-.11	.12	-	-	
7 Self-efficacy (*n*=56)	.08	-.25	-.10	.28	-.05 [a]	-.09 [a]	-
Males							
1 Prestige (job expectation) (*n*=17)	-						
2 Prestige (job aspiration) (*n*=16)	.54	-					
3 SES (occupation) (*n*=17)	-.17	-.06	-				
4 SES (education)(*n*=17)	.41	.14	-.06	-			
5 FSIQ (controlled for SES occ) (*n*=16)	.58 [a]	.46 [a]	.01	.16	-		
6 FSIQ (controlled for SES edu) (*n*=16)	.57 [a]	.45 [a]	.01	.16	-	-	
7 Self-efficacy (*n*=17)	.16	-.15	-.09	-.25	.02 [a]	.07 [a]	-

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR. a= result from partial correlation, controlling for SES (both occupation and education controlled for separately). Correlation between SES measure (3 and 4) and FSIQ (5 and 6) conducted without controlling for SES variables.

RQ4 Do discrepant and non-discrepant groups differ in ToM and self-efficacy for the future scores?

Participants were classified into discrepancy groups: non-discrepant (those adolescents who reported the same occupation for their career aspiration and expectation at Wave 1), and discrepant (adolescents who reported different occupations for their aspirations and expectations at Wave 1). Across both mid- and late-adolescent groups, there were *n*=76 participants classified as discrepant, *n*=56 classified as non-discrepant, and *n*=32 unclassified. Participants were unclassified if they had missing data for their idealistic aspiration and/or their realistic expectation at Wave 1.

We predicted that both ToM and self-efficacy for the future scores would be higher for the non-discrepant group. Results for the whole sample, as well as for the mid- and late-adolescent groups separately, are reported in Table 6.9 below.

Across the whole sample, ToM RTs were normally distributed as determined by visual inspection of Q-Q plots. The Q-Q plots for the ToM % error rates, however, were all skewed to the right. We continued the analysis as ANOVAs are generally robust to non-normality (Maxwell et al., 2017).

TABLE 6.9 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY DISCREPANCY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Discrepant		Non-discrepant		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Cog ToM RT (s)	-.08 (132)	.90	-.18 (76)	.94	.07 (56)	.85	.118	.019
2 Aff ToM RT (s)	-.07 (132)	.95	-.10 (76)	1.01	.04 (56)	.88	.752	.001
3 Phys Caus RT (s)	-.07 (132)	.92	-.08 (76)	.94	-.05 (56)	.90	.820	.000
4 Cog ToM % ER	.00 (132)	.99	.11 (76)	1.20	-.14 (56)	.57	.106 ^{w}	.001 (ω^2)
5 Aff ToM % ER	-.07 (132)	.86	-.05 (76)	.90	-.09 (56)	.82	.754	.001
6 Phys Caus % ER	.00 (132)	.99	.02 (76)	.99	-.02 (56)	1.00	.838	.000
7 Self-efficacy	3.60 (132)	.78	3.52 (76)	.78	3.71 (56)	.78	.171	.014
Mid-adolescent (Year 10)								
1 Cog ToM RT (s)	-.08 (68)	.90	-.32 (34)	.92	.16 (34)	.83	.028	.071
2 Aff ToM RT (s)	-.09 (68)	.95	-.23 (34)	1.04	.05 (34)	.84	.229	.022
3 Phys Caus RT (s)	-.08 (68)	.94	-.20 (34)	.91	.03 (34)	.98	.336	.014
4 Cog ToM % ER	.03 (68)	.98	.25 (34)	1.26	-.19 (34)	.52	.068 ^{w}	.036 (ω^2)
5 Aff ToM % ER	-.06 (68)	.85	.00 (34)	.89	-.13 (34)	.80	.534	.006
6 Phys Caus % ER	.06 (68)	1.07	.08 (34)	1.03	.04 (34)	1.13	.872	.000
7 Self-efficacy	3.59 (68)	.77	3.55 (34)	.80	3.63 (34)	.76	.670	.003
Late-adolescent (Final-year university student)								
1 Cog ToM RT (s)	-.08 (64)	.91	-.07 (42)	.94	-.08 (22)	.87	.980	.000
2 Aff ToM RT (s)	-.05 (64)	.96	.01 (42)	.97	-.18 (22)	.94	.445	.009
3 Phys Caus RT (s)	-.05 (64)	.90	.00 (42)	.96	-.16 (22)	.77	.485	.008
4 Cog ToM % ER	-.02 (64)	1.00	.00 (42)	1.15	-.07 (22)	.65	.774	.001
5 Aff ToM % ER	-.07 (64)	.89	-.08 (42)	.91	-.04 (22)	.87	.863	.000
6 Phys Caus % ER	-.06 (64)	.90	-.04 (42)	.96	-.11 (22)	.78	.756	.002
7 Self-efficacy	3.60 (64)	.80	3.49 (42)	.77	3.82 (22)	.82	.115	.039

Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch’s test was used instead

Across the whole sample, and both the mid-adolescent and late-adolescent groups, there were no significant differences between the discrepant and non-discrepant groups in relation to self-efficacy score.

In the mid-adolescent group, the discrepant group performed faster on the cognitive ToM task than the non-discrepant group (M=-.32, SD=.92 vs M=.16, SD=.83), which was not in line with our prediction that those participants in the non-discrepant group would demonstrate better ToM skills than those in the discrepant group. There was a medium effect size (η_p^2=.071), initially seen to be significant, F(1,66)=5.051, p=.028, although once corrected for multiple comparisons using Benjamini-Hochberg FDR, it was no longer a statistically significant result. With outliers excluded, the effect size increased (η_p^2=.088), and the significance of this difference increased (p=.016), however again once corrected for multiple comparisons, statistical significance no longer remained.

RQ5 Is stability of vocational interests over one year associated with ToM and self-efficacy?

Participants were classified into stability groups: stable (those adolescents who reported the same vocational interests at Wave 2 as they did in Wave 1), and non-stable (adolescents who reported different vocational interests at Wave 1 and Wave 2. Participants were unclassified if they had missing data for their idealistic aspiration and/or their realistic expectation at Wave 1 and/or Wave 2. In the previous chapters, we noted a sex effect on the vocational interest dimensions of People and Things, however this analysis involves the difference in scores of the vocational interests, and not the scores themselves. We checked to see if there was an effect of sex on the difference scores and none was noted, so the scores not corrected for sex were used in this analysis. Table 6.10 below shows the descriptive statistics of the difference scores for the vocational interests across the whole sample, and the mid-adolescent and late-adolescent groups separately.

TABLE 6.10 DESCRIPTIVE STATISTICS OF VOCATIONAL INTERESTS AT WAVE 1 AND 2

	Mid-adolescent (Y10)						Paired t-test		Late adolescent (Final-year university students)						Paired t-test	
	Wave 1		Wave 2		Difference score		*p*	Cohen's *d*	Wave 1		Wave 2		Difference score		*p*	Cohen's *d*
Measure	M (n)	SD	M (n)	SD	M (n)	SD			M (n)	SD	M (n)	SD	M (n)	SD		
1 Career Aspiration																
Things/People	3.14 (65)	145.17	2.71 (65)	142.91	-.43 (65)	117.53	.977	.00	-89.29 (45)	88.82	-80.60 (45)	107.06	8.69 (45)	74.02	.435	.09
Data/Ideas	-24.11 (65)	105.29	-14.07 (65)	124.23	10.04 (65)	124.60	.518	.09	-48.58 (45)	127.33	-29.81 (45)	113.48	18.78 (45)	126.79	.326	.16
2 Career Expectation																
Things/People	30.06 (48)	156.45	11.33 (48)	152.47	-18.73 (48)	131.21	.328	.12	-86.54 (39)	107.71	-97.90 (39)	108.30	-11.36 (39)	96.30	.466	.11
Data/Ideas	-39.21 (48)	112.30	-53.90 (48)	103.94	-14.70 (48)	118.62	.395	.14	20.79 (39)	146.50	-5.84 (39)	119.77	-26.63 (39)	135.58	.227	.20
3 Voc Interest (Short)																
Data	2.51 (71)	.92	2.58 (71)	.95	.07 (71)	1.02	.562	.07	2.83 (46)	.95	3.00 (46)	.89	.17 (46)	1.14	.307	.18
Things	2.70 (70)	1.08	2.60 (70)	1.06	-.10 (70)	1.32	.528	.09	1.72 (46)	.81	1.83 (46)	.88	.11 (46)	1.06	.490	.13
People	2.89 (71)	.98	3.21 (71)	.88	.33 (71)	1.09	.015	.34	3.61 (46)	.65	3.61 (46)	.58	.00 (46)	.76	1.00	.00
Ideas	2.82 (71)	.93	3.03 (71)	.81	.21 (71)	.89	.050	.24	3.26 (46)	.80	3.02 (46)	.86	-.24 (46)	1.06	.132	.29

Measures 1 and 2 are specific career aspirations and expectations coded and allocated position on Things/People and Data/Ideas dimensions. Measure 3 is a short item asking participants to state on a scale of 1-4 how important they think each of the four vocational interests (Data/Things/People/Ideas) is in their chosen career or field.

We used the data from the questionnaires that asked participants to state on a scale of 1-4 how important they think each of the four vocational interests (Data/Things/People/Ideas) is in their chosen career or field. Participants were asked this at both time points, so if they had rated the vocational interest with the same value at each time point, they were put into the stable group for this vocational interest. We conducted one-way ANOVAs to assess whether there was a statistically significant difference in ToM and self-efficacy scores between the stable and non-stable groups for each vocational interest. Results of these analyses can be seen in Table 6.11-6.14 below.

Additionally, there was a value for each vocational interest dimension (one value for position on People/Things dimension and one for Data/Ideas dimension) of career aspiration/expectation in Wave 1, and the same for career aspiration/expectation in Wave 2. If individuals had the same score on these dimensions at both time points, they were allocated to the stable group. As these scales are on a substantially broader range, and are tied closely to specific job title, we additionally classed those individuals whose vocational interest dimension score at the second time point was within a 5% deviation of their score at the first time-point as in the stable category (their specific aspirational/realistic job title may have changed slightly but their vocational interest dimension score was still very close to their score the year previously). Both vocational interest dimension scores (People/Things and Data/Ideas) were taken into account when allocating individuals to stability groups: in cases where the change in one dimension score was only small (less than 5%), but the change in the other dimension score was larger than 5%, they were classified as unstable. We conducted one-way ANOVAs to assess whether there was a statistically significant difference in ToM and self-efficacy scores between the stable and non-stable groups for the vocational interest profiles calculated from both career aspirations and expectations. The results of these analyses can be seen in Table

6.15 and Table 6.6 f below. The results of the analysis with outliers excluded are in Appendices 11.6.

Data was normally distributed for both stability groups across all ToM reaction times, as assessed by Shapiro-Wilk test (p >.05) and visual inspection of Q-Q plots. Data was non-normally distributed for both stability groups across the ToM error rates, as assessed by Shapiro-Wilk test (p <.05), with visual inspection of Q-Q plots showing they were skewed to the right. We decided to continue with the one-way ANOVA as it is generally considered robust to non-normality (e.g. Maxwell et al., 2017). Homogeneity of variances was assessed using Levene's test for equality of variances, and in cases where this was violated (p <.05), the result of the Welch's ANOVA are presented instead.

Theory of Mind

Some of the results support our hypothesis that vocational interest stability over a year will be positively associated with ToM score. With regards to the stability of the vocational interest in Data, there were no significant differences in ToM scores between the stable and non-stable group. However, when outliers were excluded from the analysis, a difference in cognitive ToM % error rate between the stable and non-stable group was found in the late-adolescent group. In line with our hypothesis, the stable group performed significantly better, making fewer mistakes on the cognitive ToM task, in comparison to the non-stable group (M=-.44, SD=.12 vs M=.15, SD=1.16). There was a medium effect size (ω^2 = .064), initially seen to be significant, Welch's F(1, 25.993)=6.536, p=.017), although once corrected for multiple comparisons using Benjamini-Hochberg FDR, it was no longer a statistically significant result. Additionally, when outliers were removed from the analysis on the stability of the vocational interest Things, there was again a significant difference in cognitive ToM % error rate between the stable and non-stable group in the late-adolescent group, Welch's $F(1, 28.517)=11.457$, $p=.002$. Again, this was in line with our hypothesis, with the stable group performing significantly better than the non-stable group (M=-.46, SD=.12 vs M=.17, SD=.96), with a large effect size ($\omega^2 = .113$).

Similarly, with outliers included, those whose vocational interest in Ideas was stable performed significantly faster than the non-stable group on the Affective ToM task across the whole sample (M=-.27, SD=.96 vs M=.13, SD=.95) and in the mid-adolescent group specifically (M=-.30, SD=.93 vs M=.24, SD=.94). There was a medium effect size (η_p^2=.078) in the mid-adolescent group and a smaller effect size (η_p^2=.041) in the whole sample, both of which were initially seen to be significant: $F(1, 69) = 5.825$, p=.018 (in the mid-adolescent group) and $F(1, 115) = 4.968$, p=.028 in the overall sample, however once corrected for multiple comparisons these were no longer statistically significant results. The overall results remained the same when outliers were excluded from the analysis on the stability of the vocational interest in Ideas, although the effect sizes were larger (η_p^2= .050 in whole sample; η_p^2= .086 in the mid-adolescent group).

However, some of the results counter the hypothesis that vocational interest stability over a year will be positively associated with ToM score. While there were no significant differences between the stable and non-stable group for the vocational interest in People and ToM scores in the whole sample, when outliers were removed from the analysis, there was a significant difference in cognitive ToM % error rate between the two stability groups in the late-adolescent group. The non-stable group performed significantly better on the cognitive ToM task than the stable group (M=-.49, SD=.15 vs M=.15, SD=1.11), with a medium effect size ($\omega^2 = .064$) which is the opposite to what was hypothesised, Welch's $F(1, 31.637)=9.426$, p=.004).

Similarly, when outliers were excluded from the analysis of the vocational interest profile stability of career expectations, there was again a significant difference in cognitive ToM % error rate between the two stability groups in the late-adolescent group. Again, the non-stable group performed significantly better on the cognitive ToM task than the stable group (M=-.44, SD=.15 vs M=.30, SD=1.20), with a large effect size (ω^2=.135). This result was initially significant, Welch's $F(1, 18.553) = 7.143$, p=.015, although this significance was lost once corrected for multiple comparisons using Benjamini-Hochberg FDR. The non-stable group also performed statistically significantly better on the affective ToM task in the mid-adolescent group when outliers were excluded, making fewer mistakes than the stable group (M=-.27, SD=.62 vs M=.22, SD=.86), with a large effect size (η_p^2 =.103). This result was also initially significant, $F(1, 44)$=5.071, p=.029, although this significance was lost once corrected for multiple comparisons using Benjamini-Hochberg FDR.

TABLE 6.11 ToM AND SELF-EFFICACY MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST DATA

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Aff ToM RT (s)	-.04 (117)	.97	-.07 (49)	1.04	-.01 (68)	.92	.724	.001
2 Cog ToM RT (s)	-.08 (117)	.90	-.11 (49)	.95	-.07 (68)	.88	.795	.001
3 Phys Caus RT (s)	-.01 (117)	.92	-.06 (49)	.92	.04 (68)	.92	.565	.003
4 Aff ToM % ER	-.07 (117)	.86	-.06 (49)	.83	-.07 (68)	.89	.971	.000
5 Cog ToM % ER	-.05 (117)	.97	-.02 (49)	1.13	-.07 (68)	.84	.784	.001
6 Phys Caus % ER	-.08 (117)	.97	-.06 (49)	.99	-.10 (68)	.96	.793	.001
7 Self-efficacy	3.53 (116)	.79	3.61 (49)	.77	3.47 (67)	.80	.369	.007
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.01 (71)	.97	.08 (30)	1.09	-.04 (41)	.87	.625	.003
2 Cog ToM RT (s)	-.03 (71)	.94	.03 (30)	1.07	-.06 (41)	.85	.701	.002
3 Phys Caus RT (s)	.00 (71)	.99	.06 (30)	1.08	-.05 (41)	.93	.648	.003
4 Aff ToM % ER	-.09 (71)	.80	.01 (30)	.89	-.17 (41)	.73	.371	.012
5 Cog ToM % ER	-.12 (71)	.92	-.02 (30)	1.28	-.20 (41)	.55	.481 w	-.005 (ω^2)
6 Phys Caus % ER	-.02 (71)	.98	-.08 (30)	1.00	.02 (41)	.98	.682	.002
7 Self-efficacy	3.56 (70)	.77	3.63 (30)	.77	3.52 (40)	.78	.572	.005
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.11 (46)	.97	-.31 (19)	.92	.04 (27)	1.01	.241	.031
2 Cog ToM RT (s)	-.17 (46)	.84	-.32 (19)	.69	-.07 (27)	.93	.321	.022
3 Phys Caus RT (s)	-.01 (46)	.79	-.26 (19)	.52	.16 (27)	.91	.052 w	.049 (ω^2)
4 Aff ToM % ER	-.03 (46)	.95	-.17 (19)	.74	.08 (27)	1.08	.381	.018
5 Cog ToM % ER	.06 (46)	1.04	-.03 (19)	.88	.12 (27)	1.15	.652	.005
6 Phys Caus % ER	-.18 (46)	.95	-.02 (19)	1.01	-.29 (27)	.91	.348	.020
7 Self-efficacy	3.48 (46)	.81	3.58 (19)	.79	3.41 (27)	.84	.487	.011

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch's test was used instead

TABLE 6.12 TOM AND SELF-EFFICACY MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST THINGS

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Aff ToM RT (s)	-.03 (116)	.97	-.12 (43)	.99	.02 (73)	.96	.429	.006
2 Cog ToM RT (s)	-.08 (116)	.90	-.01 (43)	.97	-.12 (73)	.87	.555	.003
3 Phys Caus RT (s)	-.01 (116)	.91	-.05 (43)	1.00	.01 (73)	.87	.748	.001
4 Aff ToM % ER	-.06 (116)	.86	-.01 (43)	.88	-.09 (73)	.85	.664	.002
5 Cog ToM % ER	-.05 (116)	.97	-.03 (43)	1.22	-.05 (73)	.80	.902	.000
6 Phys Caus % ER	-.08 (116)	.97	-.09 (43)	.93	-.08 (73)	1.00	.975	.000
7 Self-efficacy	3.53 (115)	.79	3.30 (43)	.88	3.67 (72)	.70	.014	.052
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.02 (70)	.97	-.11 (25)	.83	.09 (45)	1.04	.422	.010
2 Cog ToM RT (s)	-.01 (70)	.94	.10 (25)	1.01	-.08 (45)	.91	.462	.008
3 Phys Caus RT (s)	-.01 (70)	.99	-.08 (25)	1.03	.02 (45)	.98	.674	.003
4 Aff ToM % ER	-.08 (70)	.80	.02 (25)	.96	-.14 (45)	.71	.429	.009
5 Cog ToM % ER	-.11 (70)	.93	.03 (25)	1.28	-.19 (45)	.66	.343	.013
6 Phys Caus % ER	-.02 (70)	.99	-.03 (25)	1.05	-.02 (45)	.97	.978	.000
7 Self-efficacy	3.56 (69)	.78	3.35 (25)	.84	3.68 (44)	.72	.088	.043
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.11 (46)	.97	-.15 (18)	1.21	-.08 (28)	.81	.821	.001
2 Cog ToM RT (s)	-.17 (46)	.84	-.17 (18)	.91	-.18 (28)	.81	.960	.000
3 Phys Caus RT (s)	-.01 (46)	.79	-.01 (18)	.99	-.02 (28)	.66	.959 ^{w}	-.022 (ω^2)
4 Aff ToM % ER	-.03 (46)	.95	-.06 (18)	.79	-.00 (28)	1.06	.838	.001
5 Cog ToM % ER	.06 (46)	1.04	-.11 (18)	1.15	.17 (28)	.96	.373	.018
6 Phys Caus % ER	-.18 (46)	.95	-.17 (18)	.76	-.18 (28)	1.07	.975	.000
7 Self-efficacy	3.48 (46)	.81	3.22 (18)	.94	3.64 (28)	.69	.113 ^{w}	.043 (ω^2)

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch's test was used instead

TABLE 6.13 ToM AND SELF-EFFICACY MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST PEOPLE

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Aff ToM RT (s)	-.04 (117)	.97	.05 (58)	1.04	-.12 (59)	.89	.324	.008
2 Cog ToM RT (s)	-.08 (117)	.90	-.07 (58)	.91	-.09 (59)	.90	.900	.000
3 Phys Caus RT (s)	-.01 (117)	.92	.02 (58)	.88	-.03 (59)	.95	.763	.001
4 Aff ToM % ER	-.07 (117)	.86	-.15 (58)	.70	.01 (59)	.99	.323 w	-.000 (ω^2)
5 Cog ToM % ER	-.05 (117)	.97	.00 (58)	.98	-.10 (59)	.97	.568	.003
6 Phys Caus % ER	-.08 (117)	.97	-.19 (58)	.90	.02 (59)	1.03	.241	.012
7 Self-efficacy	3.53 (116)	.79	3.54 (57)	.70	3.53 (59)	.87	.947 w	-.009 (ω^2)
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.01 (71)	.97	.14 (26)	1.05	-.07 (45)	.92	.381	.011
2 Cog ToM RT (s)	-.03 (71)	.94	.16 (26)	1.01	-.13 (45)	.89	.217	.022
3 Phys Caus RT (s)	.00 (71)	.99	.13 (26)	1.03	-.08 (45)	.97	.397	.010
4 Aff ToM % ER	-.09 (71)	.80	-.12 (26)	.58	-.08 (45)	.91	.804 w	-.014 (ω^2)
5 Cog ToM % ER	-.12 (71)	.92	-.23 (26)	.67	-.06 (45)	1.05	.466	.008
6 Phys Caus % ER	-.02 (71)	.98	-.16 (26)	.66	.06 (45)	1.12	.379	.011
7 Self-efficacy	3.56 (70)	.77	3.46 (25)	.70	3.62 (45)	.81	.403	.010
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.11 (46)	.97	-.02 (32)	1.03	-.31 (14)	.82	.364	.019
2 Cog ToM RT (s)	-.17 (46)	.84	-.26 (32)	.78	.02 (14)	.96	.300	.024
3 Phys Caus RT (s)	-.01 (46)	.79	-.07 (32)	.74	.11 (14)	.91	.474	.012
4 Aff ToM % ER	-.03 (46)	.95	-.17 (32)	.79	.30 (14)	1.21	.132	.051
5 Cog ToM % ER	.06 (46)	1.04	.19 (32)	1.15	-.24 (14)	.67	.125 w	.014 (ω^2)
6 Phys Caus % ER	-.18 (46)	.95	-.21 (32)	1.06	-.09 (14)	.64	.689	.004
7 Self-efficacy	3.48 (46)	.81	3.59 (32)	.70	3.21 (14)	1.00	.213 w	.025 (ω^2)

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch's test was used instead

TABLE 6.14 TOM AND SELF-EFFICACY MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST IDEAS

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Aff ToM RT (s)	-.04 (117)	.97	-.27 (48)	.96	.13 (69)	.95	.028	.041
2 Cog ToM RT (s)	-.08 (117)	.90	-.16 (48)	.92	-.03 (69)	.89	.448	.005
3 Phys Caus RT (s)	-.01 (117)	.92	-.05 (48)	.94	.02 (69)	.90	.686	.001
4 Aff ToM % ER	-.07 (117)	.86	-.14 (48)	.57	-.01 (69)	1.02	.399	.005
5 Cog ToM % ER	-.05 (117)	.97	-.07 (48)	.91	-.04 (69)	1.01	.863	.000
6 Phys Caus % ER	-.08 (117)	.97	.08 (48)	1.07	-.19 (69)	.88	.137	.019
7 Self-efficacy	3.53 (116)	.79	3.50 (48)	.80	3.55 (68)	.78	.730	.001
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.01 (71)	.97	-.30 (30)	.93	.24 (41)	.94	.018	.078
2 Cog ToM RT (s)	-.03 (71)	.94	-.21 (30)	1.00	.11 (41)	.88	.152	.029
3 Phys Caus RT (s)	.00 (71)	.99	-.19 (30)	.99	.14 (41)	.98	.168	.027
4 Aff ToM % ER	-.09 (71)	.80	-.23 (30)	.50	.01 (41)	.96	.189 w	.007 (ω^2)
5 Cog ToM % ER	-.12 (71)	.92	-.24 (30)	.54	-.03 (41)	1.12	.353	.013
6 Phys Caus % ER	-.02 (71)	.98	-.01 (30)	.91	-.03 (41)	1.04	.911	.000
7 Self-efficacy	3.56 (70)	.77	3.58 (30)	.77	3.55 (40)	.78	.859	.000
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.11 (46)	.97	-.22 (18)	1.03	-.04 (28)	.95	.543	.008
2 Cog ToM RT (s)	-.17 (46)	.84	-.07 (18)	.79	-.24 (28)	.88	.516	.010
3 Phys Caus RT (s)	-.01 (46)	.79	.19 (18)	.83	-.15 (28)	.76	.160	.044
4 Aff ToM % ER	-.03 (46)	.95	.01 (18)	.67	-.04 (28)	1.11	.864	.001
5 Cog ToM % ER	.06 (46)	1.04	.22 (18)	1.29	-.04 (28)	.84	.410	.015
6 Phys Caus % ER	-.18 (46)	.95	.22 (18)	1.31	-.43 (28)	.50	.059 w	.091 (ω^2)
7 Self-efficacy	3.48 (46)	.81	3.36 (18)	.85	3.55 (28)	.79	.439	.014

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch's test was used instead

TABLE 6.15 TOM AND SELF-EFFICACY MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – CAREER ASPIRATIONS

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Aff ToM RT (s)	-.03 (110)	.95	-.12 (49)	1.13	.03 (61)	.78	.436 ʷ	-.003 (ω^2)
2 Cog ToM RT (s)	-.07 (110)	.90	-.10 (49)	1.00	-.05 (61)	.82	.738	.001
3 Phys Caus RT (s)	.00 (110)	.91	-.10 (49)	.97	.08 (61)	.85	.289	.010
4 Aff ToM % ER	-.08 (110)	.85	-.02 (49)	.90	-.13 (61)	.80	.519	.004
5 Cog ToM % ER	-.07 (110)	.85	-.13 (49)	.83	-.01 (61)	.87	.465	.005
6 Phys Caus % ER	-.07 (110)	.99	-.29 (49)	.97	.10 (61)	.98	.039	.039
7 Self-efficacy	3.55 (110)	.77	3.59 (49)	.81	3.51 (61)	.75	.595	.003
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.03 (65)	.93	.04 (23)	1.14	.02 (42)	.81	.931	.000
2 Cog ToM RT (s)	.00 (65)	.94	.13 (23)	1.07	-.07 (42)	.87	.422	.010
3 Phys Caus RT (s)	.03 (65)	.99	.05 (23)	1.17	.02 (42)	.89	.900	.000
4 Aff ToM % ER	-.09 (65)	.80	.09 (23)	.91	-.19 (42)	.72	.181	.028
5 Cog ToM % ER	-.16 (65)	.68	-.33 (23)	.44	-.07 (42)	.77	.086 ʷ	.019 (ω^2)
6 Phys Caus % ER	-.00 (65)	1.01	-.01 (23)	1.22	.00 (42)	.88	.976	.000
7 Self-efficacy	3.57 (65)	.77	3.52 (23)	.81	3.60 (42)	.75	.694	.002
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.13 (45)	.97	-.26 (26)	1.11	.05 (19)	.73	.267 ʷ	.003 (ω^2)
2 Cog ToM RT (s)	-.18 (45)	.85	-.31 (26)	.91	-.00 (19)	.74	.229	.033
3 Phys Caus RT (s)	-.04 (45)	.79	-.23 (26)	.77	.23 (19)	.75	.047	.088
4 Aff ToM % ER	-.07 (45)	.92	-.12 (26)	.90	.01 (19)	.97	.652	.005
5 Cog ToM % ER	.07 (45)	1.05	.04 (26)	1.05	.11 (19)	1.07	.836	.001
6 Phys Caus % ER	-.18 (45)	.96	-.54 (26)	.58	.31 (19)	1.16	.007 ʷ **	.177 (ω^2)
7 Self-efficacy	3.51 (45)	.79	3.65 (26)	.81	3.32 (19)	.74	.159	.046

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch's test was used instead

TABLE 6.16 TOM AND SELF-EFFICACY MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – CAREER EXPECTATIONS

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
Whole sample								
1 Aff ToM RT (s)	-.05 (87)	.99	-.12 (35)	1.01	-.01 (52)	.98	.612	.003
2 Cog ToM RT (s)	-.12 (87)	.89	-.05 (35)	.99	-.17 (52)	.83	.524	.005
3 Phys Caus RT (s)	-.04 (87)	.92	-.15 (35)	.90	.04 (52)	.93	.356	.010
4 Aff ToM % ER	-.10 (87)	.74	-.03 (35)	.77	-.15 (52)	.73	.475	.006
5 Cog ToM % ER	-.01 (87)	.87	.06 (35)	.98	-.05 (52)	.80	.566	.004
6 Phys Caus % ER	-.04 (87)	1.06	-.19 (35)	.95	.06 (52)	1.13	.290	.013
7 Self-efficacy	3.56 (87)	.78	3.64 (35)	.78	3.51 (52)	.79	.465	.006
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	-.01 (48)	.96	-.12 (16)	1.04	.05 (32)	.94	.559	.007
2 Cog ToM RT (s)	-.07 (48)	.91	-.05 (16)	1.15	-.08 (32)	.79	.913	.000
3 Phys Caus RT (s)	-.08 (48)	1.02	-.18 (16)	1.19	-.02 (32)	.94	.611	.006
4 Aff ToM % ER	-.05 (48)	.78	.22 (16)	.86	-.18 (32)	.72	.089	.062
5 Cog ToM % ER	-.06 (48)	.70	-.23 (16)	.53	.02 (32)	.77	.242	.000
6 Phys Caus % ER	.08 (48)	1.11	.10 (16)	1.16	.07 (32)	1.11	.929	.000
7 Self-efficacy	3.61 (48)	.76	3.52 (16)	.75	3.66 (32)	.78	.532	.009
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.11 (39)	1.03	-.11 (19)	1.02	-.10 (20)	1.06	.972	.000
2 Cog ToM RT (s)	-.19 (39)	.87	-.05 (19)	.86	-.32 (20)	.88	.331	.026
3 Phys Caus RT (s)	.01 (39)	.80	-.12 (19)	.61	.14 (20)	.94	.322	.026
4 Aff ToM % ER	-.16 (39)	.70	-.24 (19)	.63	-.09 (20)	.76	.494	.013
5 Cog ToM % ER	.06 (39)	1.05	.30 (19)	1.20	-.17 (20)	.84	.162	.052
6 Phys Caus % ER	-.18 (39)	1.00	-.43 (19)	.68	.05 (20)	1.20	.138	.059
7 Self-efficacy	3.49 (39)	.81	3.74 (19)	.81	3.26 (20)	.76	.067	.088

Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity was not met so Welch's test was used instead

Self-efficacy

There were no significant differences in self-efficacy scores between the stable and non-stable groups across the vocational interests with the exception of Things. In the whole sample, those in the stable group on the vocational interest of Things had lower self-efficacy scores than the non-stable group (M=3.30, SD=.88 vs M=3.67, SD=.70), which is the opposite to what was hypothesised. The effect size was medium (η_p^2=.052), and the result was initially significant, F(1, 113)=6.207, *p*=.014, although once corrected for multiple comparisons using Benjamini-Hochberg FDR, it was no longer a statistically significant result.

RQ6 Is there an association between the mean level change in the vocational interest of People and ToM score?

We used a multiple regression between vocational interest in People change scores as dependent variables and ToM scores as independent variables. We assessed whether ToM predicted the direction of the change (i.e. whether ToM was associated with an increase or decrease in the vocational interest of People over time). There was one value for position on the vocational interest dimension of People/Things of career aspiration/expectation in Wave 1, and the same for career aspiration/expectation in Wave 2. We subtracted the score at Wave 1 from the score at Wave 2 to work out the + or – change for vocational interests. We also used the data from the questionnaires that asked participants to state on a scale of 1-4 how important they think each of the four vocational interests (Data/Things/People/Ideas) is in their chosen career or field. Participants were asked this at both time points, so again we subtracted the score at Wave 1 from the score at Wave 2 to work out the + or – change for vocational interests. We only used the data from the vocational interest of People for this analysis.

Across all multiple regressions run, there was independence of residuals as assessed by a Durbin-Watson statistic. Additionally, visual inspection of scatterplots of studentised residuals plotted against unstandardized predicted values showed a linear relationship and homoscedasticity in all cases. There were some moderate collinearity problems, with high correlations between affective and cognitive ToM RTs, but all VIF values were 3.6 and under. There were no Cook's distance values above 1, and visual inspection of Q-Q plots showed data was approximately normally distributed. Results of the multiple regressions are presented in Tables 12.17-12.19 below.

Table 6.17 Multiple Regression Analysis to predict Vocational Interests Stability by ToM score (VI People)

VI People	Whole sample			Mid-adolescent group			Late-adolescent group		
Variable	B	SE $_{\beta}$	β	B	SE $_{\beta}$	β	B	SE $_{\beta}$	β
Constant	.17	.09		.31	.13		-.07	.11	
Affective RT	.07	.14	.07	.14	.24	.12	-.03	.14	-.03
Cognitive RT	-.25	.15	-.23	-.28	.24	-.24	-.34*	.17	.38*
Affective ER	-.03	.11	-.03	.04	.20	.03	-.09	.11	-.12
Cognitive ER	-.05	.10	-.05	-.11	.16	-.09	.03	.11	.04

TABLE 6.18 MULTIPLE REGRESSION ANALYSIS TO PREDICT VOCATIONAL INTERESTS STABILITY BY TOM SCORE (PEOPLE/THINGS – CAREER ASPIRATIONS)

People/Things	Whole sample			Mid-adolescent group			Late-adolescent group		
Variable	B	SE $_{\beta}$	β	B	SE $_{\beta}$	β	B	SE $_{\beta}$	β
Constant	2.52	9.91		-2.07	15.33		15.56	11.04	
Affective RT	-10.47	15.60	-.10	-1.34	30.10	-.01	-9.14	14.06	-.12
Cognitive RT	7.97	16.11	.07	-8.76	28.39	-.07	34.66*	16.40	.40*
Affective ER	-6.20	11.99	-.05	-23.43	21.75	-.16	10.21	11.74	.13
Cognitive ER	7.37	11.77	-.06	2.26	24.06	.01	-16.44	10.60	-.23

TABLE 6.19 MULTIPLE REGRESSION ANALYSIS TO PREDICT VOCATIONAL INTERESTS STABILITY BY TOM SCORE (PEOPLE/THINGS – CAREER EXPECTATIONS)

People/Things	Whole sample			Mid-adolescent group			Late-adolescent group		
Variable	B	SE_{β}	β	B	SE_{β}	β	B	SE_{β}	β
Constant	-11.19	12.64		-14.04	19.19		-10.16	15.38	
Affective RT	-.65	18.34	-.01	-21.27	36.89	-.16	2.05	18.15	.02
Cognitive RT	27.05	19.84	.21	33.05	36.77	.23	39.61	21.77	.36
Affective ER	9.13	17.75	.06	48.16	28.28	.29	-36.28	21.53	-.26
Cognitive ER	10.60	14.76	.08	5.23	30.50	.03	8.69	14.48	.10

Outliers excluded

Outliers were detected for each regression analysis by checking the Casewise Diagnostics table and examining the studentized deleted residuals. Any cases that were larger than +/- 3SDs were excluded from the analysis. Results from the analysis with outliers excluded are presented in Tables 6.20-6.22 below.

When outliers were excluded from the analysis, a multiple regression model statistically significantly predicted level of change on the singular People measure in the whole sample, $F(4, 110)=2.671$, $p=.007$, adj R^2 =.036, with one variable adding statistically significantly to the prediction, cognitive ToM RT ($p=.007$). An increase in reaction time on the cognitive ToM task at Wave 1 was associated with a decrease in score on the People vocational interest measure over one year. This result supports Hypothesis 6, that better performance on ToM tasks at Wave 1 is associated with an increase in the vocational interest level of people over one year in the late-adolescent group. However, when controlling for multiple comparisons using Benjamini-Hochberg FDR, the significance of the model was deemed no longer significant.

When outliers were excluded from the analysis, a multiple regression model statistically significantly predicted level of change on the singular People measure in the late-adolescent group, $F(4, 40)=4.116$, $p=.007$, adj R^2 =.221, with two variables adding statistically significantly to the prediction, cognitive ToM RT (p=.019) and affective ToM % ER ($p=.007$). An increase in both error rate on the affective ToM task and reaction time on the cognitive ToM task at Wave 1 was associated with a decrease in score on the People vocational interest measure over one year. This result supports Hypothesis 6, that better performance on ToM tasks at Wave 1 is associated with an increase in the vocational interest level of people over one year in the late-adolescent group. However, when controlling for multiple comparisons using Benjamini-Hochberg FDR, the significance of the model was deemed no longer significant.

When outliers were excluded from the analysis, a multiple regression model statistically significantly predicted level of change on the People/Things dimension for career expectations in the late-adolescent sample, $F(4, 33)=3.211$, $p=.025$, adj $R^2=.193$, with one variable adding statistically significantly to the prediction, cognitive ToM RT ($p=.005$). An increase in reaction time on the cognitive ToM task at Wave 1 was associated with an increase in score on the People/Things vocational interest dimension over one year (higher scores on this dimension indicate preference for working with things over people). This result supports Hypothesis 6, that better performance on ToM tasks at Wave 1 is associated with an increase in the vocational interest level of people over one year in the late-adolescent group. However, when controlling for multiple comparisons using Benjamini-Hochberg FDR, the significance of the model was deemed no longer significant.

TABLE 6.20 MULTIPLE REGRESSION ANALYSIS TO PREDICT VOCATIONAL INTERESTS STABILITY BY TOM SCORE (VI PEOPLE) (OUTLIERS EXCLUDED)

VI People	Whole sample			Mid-adolescent group			Late-adolescent group		
Variable	B	SE $_\beta$	β	B	SE $_\beta$	β	B	SE $_\beta$	β
Constant	.11	.08		.26*	.13		-.13	.10	
Affective RT	.13	.13	.13	.25	.23	.23	.04	.12	.05
Cognitive RT	-.38**	.14	-.37**	-.42	.23	-.38	-.35*	.14	-.42*
Affective ER	.04	.10	.03	.14	.19	.10	-.32**	.11	-.38**
Cognitive ER	-.06	.09	-.06	-.17	.15	-.15	.06	.09	.09

Table 6.21 Multiple Regression Analysis to predict Vocational Interests Stability by ToM score (People/Things – Career Aspirations) (Outliers excluded)

People/Things	Whole sample			Mid-adolescent group			Late-adolescent group		
Variable	B	SE $_\beta$	β	B	SE $_\beta$	β	B	SE $_\beta$	β
Constant	-.14	9.40		-5.96	14.37		-1.03	8.09	
Affective RT	-11.34	14.75	-.11	-6.68	28.15	-.06	-2.13	10.10	-.04
Cognitive RT	10.79	15.24	.10	-.85	26.62	-.01	8.04	12.41	.14
Affective ER	-2.46	11.38	-.02	-16.74	20.42	-.12	3.77	8.49	.07
Cognitive ER	-4.95	11.14	-.04	7.89	22.53	.05	-6.11	7.56	-.14

TABLE 6.22 MULTIPLE REGRESSION ANALYSIS TO PREDICT VOCATIONAL INTERESTS STABILITY BY TOM SCORE (PEOPLE/THINGS – CAREER EXPECTATIONS) (OUTLIERS EXCLUDED)

People/Things	Whole sample			Mid-adolescent group			Late-adolescent group		
Variable	B	SE_{β}	β	B	SE_{β}	β	B	SE_{β}	β
Constant	-13.13	10.75		-15.16	14.29		-15.79	13.61	
Affective RT	-7.76	15.53	-.08	-49.16	28.08	-.47	-28.17	18.35	-.31
Cognitive RT	27.87	16.68	.25	49.85	27.53	.46	61.49**	20.23	.61**
Affective ER	5.46	14.97	.04	41.29	20.86	.32	-25.81	19.17	-.20
Cognitive ER	18.04	12.56	.16	33.89	23.58	.24	11.88	12.76	.14

6.5 Discussion

This study is the first to test the stability of career aspirations in relation to Gottfredson's theory of compromise in a contemporary, UK-based sample. Although the size of our sample reduced the statistical power of our analysis, at a descriptive level our results did not support Gottfredson's theory regarding the order of the importance of sex-type, prestige and vocational interest dimensions. By following the methods of coding and statistical analysis published by Junk and Armstrong (2010), our study is one of only a few to assess stability of career aspirations while controlling for confounding between these three components. Additionally, we assessed and found partial support for Gottfredson's theory of circumscription, particularly with regard to SES and ability being contributing factors to the development of career expectations. Finally, this is the first study to assess the relationship between the cognitive ability of ToM and both career aspiration and vocational interest stability. Although we did not find many statistically significant results, our exploration of vocational interests and career aspirations in relation to previously untested psychological constructs present an original contribution to the field.

6.5.1 Career aspiration stability in relation to Gottfredson's theory of compromise

In accordance with Gottfredson's theory of career compromise, we expected that of the expressed career aspirations, sex-type would be most stable, followed by prestige, followed by vocational interests – a pattern that we did not find in our study. Across the whole sample, including those who did not change their career aspirations, partial support for Gottfredson's theory was found: mainly that sex-type was moderately-highly stable, and more so than prestige (with the exception of the female mid-adolescent group). However, the Things/People dimension was consistently either the highest or equivalently stable to sex-type. As Junk and

Armstrong (2010) highlighted in their own study, much of the overall stability in the whole sample may be due to the inclusion of the students who did not change their career choice. Gottfredson's theory only focuses on individuals making career aspiration changes, and therefore analyses should focus specifically on those students that made career aspiration changes over the 1-year period (Junk and Armstrong, 2010).

Focusing specifically on those students that did change their career aspirations, we did not find any evidence to support Gottfredson's original theory of career compromise. While sex-type remained moderately stable for the mid-adolescent male group, it was one of the least stable elements for female career aspirations in both age-groups, the opposite to Gottfredson's predictions. Prestige was most stable for the late-adolescent group, but of varying stability in the mid-adolescent group, with the Things/People dimension being of moderate stability across both age-groups, and the most stable element for both the male and female mid-adolescent students. As Gottfredson predicted vocational interests to be the least stable variable, finding the Things/People vocational interest dimension to consistently be moderate-highly stable suggests our results do not support her theory of compromise.

6.5.1.1 Sex-type and Prestige

While we did not find evidence to support Gottfredson's theory of career compromise, some of our findings support those found in previous studies testing Gottfredson's theory of compromise. In both mid- and late-adolescent female subgroups, prestige was found to be more stable than sex-type, a finding that is supported in a number of other studies that tested Gottfredson's theory of compromise (e.g. Leung & Plake, 1990; Hesketh, Durant & Pryor, 1990; Hesketh, Elmslie & Kaldor, 1990). Additionally, some of the levels and patterns of stability found in our study support those found by Junk and Armstrong (2010). When including only those participants with changed career aspirations, Junk and Armstrong (2010) found prestige to be the most stable component, with the Things/People interest dimension being slightly less but still moderately stable. Sex-type and the Data/Ideas interest dimension both had very low stability, with sex-type being the least stable component in their study. Our late-adolescent female sample displayed the same pattern: prestige and Things/People interest were of moderate and highest stability, with sex-type and Data/Ideas being of lowest stability. The participants in Junk and Armstrong's (2010) study were college students, and although ranged in age from 16 to 47 years old, circumstantially they were at a similar stage of education as the participants in our late-adolescent group. Although none of our results were significant due to our sample size, it is interesting to see that our late-adolescent group follows a similar pattern to the one noted in Junk and Armstrong's (2010) study, especially as their study was conducted using data from a longitudinal study conducted in 1981-1982.

While Junk and Armstrong's (2010) data was contemporary to the time Gottfredson first published her theory of circumscription and compromise (1981), observing that our late-adolescent university student sample follows a similar pattern almost four decades later requires exploration, especially with regard to the sex-type component. Despite a large number of governmental and non-governmental initiatives, alongside general changing attitudes in society regarding the role of women during this time, sex-type was seen to be of the lowest stability, and thus assumed least important component, both in the 1980s and in our current late-adolescent sample. This could possibly be reflective of both samples being composed of students attending university, and thus not representative of the general population. All of the women in Junk and Armstrong's (2010) study were attending prestigious liberal arts colleges in the US, and the universities our participants attended were also all high-ranking, Russell group universities in the UK. Junk and Armstrong (2010) suggested that the “beliefs and missions of the schools attended by the study’s participants along with the education level of their parents may have affected the women’s beliefs regarding gender traditional occupations and the importance of prestige” (p.595). Our late-adolescent sample also had parents with notably high education levels, with 74.3% of the sample having at least one parent with either a first (BA/BSc) or Higher (MA, MSc, PhD) degree. The female participants in Junk and Armstrong’s (2010) study attended colleges focused on providing equal educational opportunities for women, eradicating stereotypes about what women can do. It could be argued that this supportive environment where women were encouraged to aspire beyond gender-stereotyped roles reflects current widespread positive attitudes towards gender equality, and raising and challenging stereotypical aspirations for girls across the UK, which could explain why we are seeing the same pattern in two datasets collected nearly 40 years apart. Due to our limited sample size, we could only examine the late-adolescent female participants, so future investigation as to whether these patterns are replicated or differ in a late-adolescent male sample would be valuable.

While prestige has been seen to be the ‘preferred’ or more stable component compared to sex-type for both male and female participants in a number studies testing Gottfredson’s theory of compromise (e.g. Junk & Armstrong, 2010), our results found sex-type was actually moderately stable, and more so than prestige, in our male mid-adolescent group. Gottfredson (1996) wrote that during Stage Two of circumscription, children erect their ‘tolerable-sextype boundary’, ruling out occupations due to them being the wrong sex-type. This process of circumscription results in adolescents that “have developed firm conceptions of their place in the social order and narrowed their vocational options accordingly” (Gottfredson, 1996. P.194), so we would expect to see a high level of stability on the sex-type dimension for both boys and girls. Our results suggest boys more closely fit Gottfredson's theory, particularly in relation to sex-type.

Similar gender differences have been seen in previous studies: Blanchard and Lichtenberg (2003) found that when placed in a simulated high compromise situation, male participants rated sex-type significantly higher than both prestige and vocational interest ratings. For the female participants in an equivalently high compromise situation, the mean for sex-type ratings was lower than the mean for prestige ratings (Blanchard & Lichtenberg, 2003), highlighting that this high level of importance for sex-type in compromise situations is more apparent for male participants. Leung and Plake (1990) also found one exception to their overall finding that prestige, not sex-type, was more likely to be the preferred factor: if a male participant was faced with choosing between a masculine occupation of lower prestige and a feminine occupation of higher prestige, they would more likely sacrifice prestige for sex-type (with women in the equivalent situation more likely to sacrifice sex-type). Both of these findings suggest it is not uncommon to see males prioritising sex-type over prestige, as we did in our own analysis.

A number of studies have found evidence to suggest the preferences of male participants are more rigidly sex-typed than for female participants, who typically express aspirations with more neutral sex compositions (Helwig, 1998; Berger et al., 2019; Henderson et al., 1988). Even at the earliest stages of circumscription, Care et al. (2007) found in their study of 4-5-year olds that boys' aspirations were consistently male sex-typed, whereas the girls preferred either neutral or male sex-typed jobs to female sex-typed jobs. It was suggested that the girls in this sample being both "attracted to and aware of jobs across the gender spectrum" (p.163), could be explained by the occupations of their mothers: Gottfredson (2002a) proposed children are attracted to the activities of their same sex parent, and the highly educated mothers in this sample had access to higher status roles, which tend to be either male or neutrally sex-typed (Care et al., 2007). The large proportion of mothers in these roles “may develop a family culture that encourages girls to be open to all occupations, including those that are traditionally male” (Care et al., 2007. P.164). This ‘culture’ encouraging girls to be open to all occupations could extend further than just within the family, as it has been highlighted that generally girls tend to be more flexible in ‘cross-gender’ career choices, a tendency that appears to continue and increase with age (Eccles, 2011; Fabes et al., 2014).

One explanation as to why sex-typing of occupations is more apparent for men could be due to the spread of traditionally ‘feminine’ and ‘masculine’ jobs across the dimension of prestige. Gottfredson (1996) wrote that ““Masculine” work spans the full range of prestige, but “feminine” work is mostly moderate in prestige” (p.196). In response to a number of studies reporting mens’ strong avoidance of cross-sex work, and women’s selection of it at both college (Betz et al., 1990) and high school stages (Hannah & Kahn., 1989), Gottfredson (1996) suggested that “Given the absence of high-level “feminine” work in the occupational world…women with high aspirations may be forced in effect to turn to less feminine work” (p.209). Gottfredson (1996) argued that the correlations between the sex-type, prestige and vocational interest dimensions mean many people will not find work that is compatible in all three dimensions, including women seeking high-prestige feminine work, which she stated does not exist.

While the idea that there is no such thing as high-prestige feminine work seems a stereotyped, outdated concept, it is important to remember that at the very core of Gottfredson’s (1981) theory is stereotyped perceptions. The cognitive map of occupations is the organisation of one's occupational images, or occupational stereotype, which Gottfredson (1981) defined as "a generalization a person makes about a particular occupation" (p.547). Gottfredson (1981) wrote that these stereotypes of occupations are shared across society, both across men and women, young and old, with individual differences in these perceptions constituting "only minor variations on a major theme" (p.554). According to her theory, investigative work (such as science and medicine) has the highest average prestige, tending to be more masculine on average. Enterprising work (such as sales and management) are more masculine and social jobs (such as education) are more feminine. As prestige decreases, jobs become more sex-typed: realistic (manual) work is said to be masculine and conventional (clerical) work is more feminine (Gottfredson, 1981). It is important to note that at the core of Gottfredson's original map of how sex-type, prestige and fields of work are related were the sex-type ratings collected for 129 occupations: ratings which were based on the opinions of 60 male and 60 female college students collected in the 1970s (Shinar, 1975). This is both a very small, and now very outdated sample. While it could be true that people do match themselves to occupations based on the stereotypical sex-type and prestige of various different fields of work, it could be argued that these stereotypes have been challenged, especially for girls, and this is reflected in the reduced sex-typing of occupations seen for females in more recent studies, including ours.

There is evidence to suggest Gottfredson's cognitive map of occupations generally reflects the actual world of work, although tests to assess this have noted some differences in the distribution of certain occupations. Figure 6.3 presents Gottfredson's common cognitive map of occupations, outlining the means and standard deviations for the prestige and sex-type ratings of Holland's (1973, 1997) RIASEC fields of work. Figure 6.4 maps the same dimensions but uses the measured sex composition and socioeconomic status ratings of actual occupations collected from the 2001 Australian Census, to assess whether Gottfredson's (1981) theoretical cognitive map of occupations is reflected in the real world of work (Beavis, 2007). Figure 6.4 uses slightly different measures to the means and standard deviations used by Gottfredson (1981) in Figure 6.3, instead using the median with lines extending to the 25th and 75th percentiles, which Beavis (2007) states provides a more accurate portrayal, as it "better depicts the broad shape of the distributions" (p.41). While the two figures show considerable similarity in how occupations are distributed, there is an important difference with regard to social occupations, which are notably more feminine in Figure 6.4 than Gottfredson's original cognitive map of occupations (Figure 6.3) suggests. Social occupations have both a higher mean and median score than conventional occupations, so is seen to be the most highly female field of work (Beavis, 2007). Gottfredson (1981) initially wrote that conventional work has poor prospects for obtaining high prestige level work, suggesting "if one wants high-level feminine work, the artistic and social fields offer the best prospects" (p.554). It could be argued that Gottfredson's (1981) cognitive map of occupations was reflective of the real world of work in the 1980s, but Beavis' (2007) map of measured sex composition and prestige of occupations demonstrates the shift towards women aiming higher and increasingly pursuing roles in the social fields. This idea will be explored in further detail in relation to our findings regarding the stability of the Things/People vocational interest dimension in the next section.

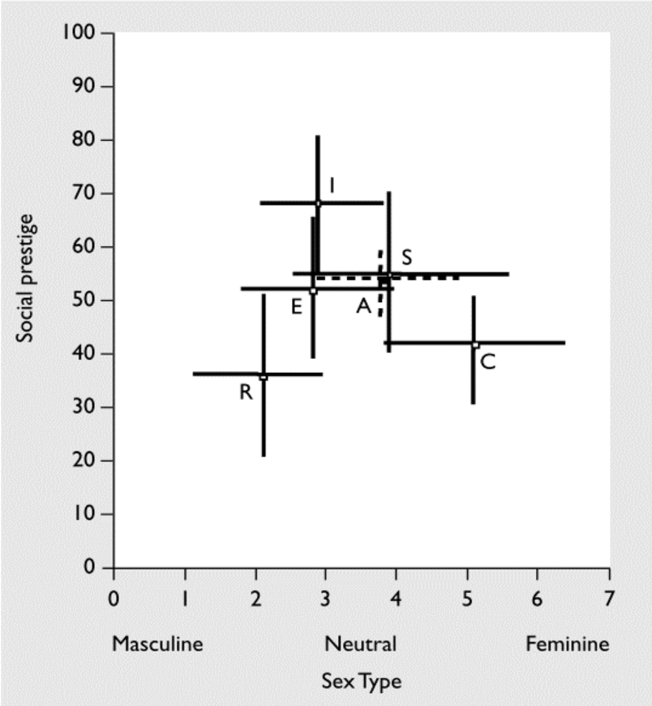

FIGURE 6.3 THE COMMON COGNITIVE MAP OF OCCUPATIONS. GOTTFREDSON (1981) REPRINTED BY BEAVIS (2007) COPYRIGHT © 2007 SAGE PUBLICATIONS

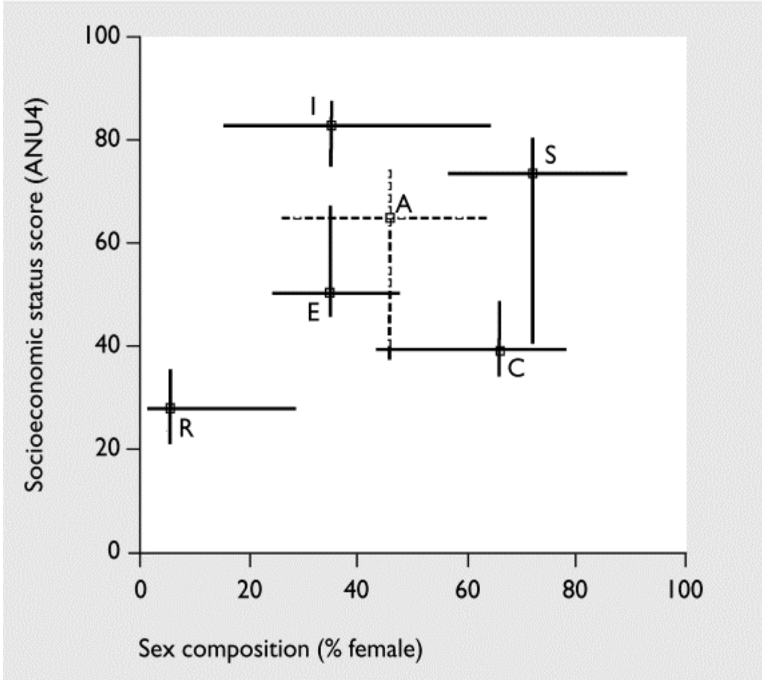

FIGURE 6.4 THE MAP OF AUSTRALIAN OCCUPATIONS (2001) BEAVIS (2007) COPYRIGHT © 2007 SAGE PUBLICATIONS

6.5.1.2 Vocational interest dimensions

The vocational interest, or field of work, dimensions were predicted to be the least stable of all, but we found that the Things/People dimension was consistently moderately to highly stable across age-groups and genders. The Data/Ideas dimension, however, was found to be of low to moderate stability across the whole sample, seemingly of less importance than the Things/People dimension. Junk and Armstrong (2010) similarly found the Things/People dimension was more stable than both sex-type and the Data/Ideas vocational interest dimension.

The Things/People vocational interest dimension is likely a consistently more stable dimension than the Data/Ideas dimension because of its gendered nature. In our overall sample, there was a clear gender difference, with females having a stronger preference for working with People over Things and the reverse being seen for the male participants. This gender difference on the Things-People dimension has been consistently reported in the literature (see Su et al., 2009 for a large meta-analysis). Lippa (2010a) conducted analysis of over 200,000 participants, finding large and consistent gender differences on the Things/People dimension across 53 nations of varying levels of gender equality, suggesting there is a possible biological element behind the male preference for working with Things and female preference for working with People (Lippa, 2010b). Junk and Armstrong (2010) hypothesised that a gendered dimension of interests would be more stable than the non-gendered Data/Ideas vocational interest dimension, a notion both the findings of our study and their study support.

The gendered nature of the Things/People vocational interest dimension has also been suggested to explain why it appears to have a higher level of stability than sex-type in developing and altering career aspirations. Gottfredson (1981) predicted sex-type to be the core component when developing and compromising career aspirations, but as stated previously, sex-type has been repeatedly found to be one of the least stable and least important components, in both our study and previous studies testing the theory. Junk and Armstrong (2010) noted similar results, and suggested sex-type actually becomes embedded in the Things/People vocational interest dimension. Sex-type of an occupation is typically measured using the proportion of women in that role, however Junk and Armstrong (2010) argue this information "may be less salient to individuals making career aspirations than are their gender-based preferences for work along the Things/People dimension" (p.593). Gottfredson was possibly correct in emphasising the importance of sex-typing occupations, but instead of basing these perceptions on the numbers of women and men we see in particular roles, perhaps the perception of where an occupation lies on the Things/People dimension is both more important when developing career aspirations, and could arguably be the core component maintained when making career compromises (Junk & Armstrong, 2010).

Interestingly in our late-adolescent group our male participants actually had slight preferences towards working with People over Things in both aspirations and expectations at both waves of data collection. Due to the small sample number of responses received in the second wave of data collection, we could not evaluate the level of stability of any of the components. Being able to assess the stability of this dimension could have provided some insight as to whether our finding, which is inconsistent with the widely accepted notion that Things/People is a gendered dimension, is due to our sample being non-representative of the general male population, or supportive of Hoff et al's (2018) finding that people-related vocational interests are often seen to increase during and shortly following the college years. It is more likely that our small sample size resulted in our male group being non-representative of the general male population. Future research testing the stability of the Things/People dimension, amongst the other career components, in a much larger, contemporary sample could provide a deeper understanding of the relevance and usefulness of Gottfredson's theory today, particularly in light of the increasingly documented and supported notion that the Things/People dimension is gendered.

6.5.2 Testing Gottfredson's Theory of Experiential Compromise

We additionally tested Gottfredson's theory of experiential compromise by assessing the stability of sex-type, prestige and vocational interest dimensions by comparing career aspirations with current occupation of the recently graduated final-year university students. We did not include an item to measure the self-perceived degree of career compromise, so again predicted the order of stability for the career components would follow Gottfredson's original theory. Our results did not support the theory, with all four dimensions being low-moderately stable.

One possible explanation for the lack of correlation across all dimensions could be due to the short gap between the two waves of data collection. The follow-up questionnaires were sent to all final-year university student participants in the summer of 2019. For some participants, this was only four months on from graduation. A large proportion of respondents were either about to start master's degrees, were unemployed, or had taken part-time roles in retail or hospitality as an interim step. Where possible, these occupations were coded in the same way as the career aspirations. It is therefore unsurprising that a large number of the respondents were not immediately in occupations even close to their ultimate career aspirations, and why we did not find significant or high levels of stability on any of the career components. Future research testing experiential compromise would benefit from the inclusion of an item asking participants to rate the degree of compromise they feel they are making, as well as follow-up data collection being conducted at least one-year post-graduation.

6.5.3 Testing Gottfredson's Theory of Circumscription

6.5.3.1 Socioeconomic Status

In our whole sample, we found a weak statistically significant positive correlation between SES (as measured by parental education) and career expectation. When analysed separately, there was no correlation found in the female group, but a moderate positive correlation was noted in the male group. When comparing between the different age-groups, in the mid-adolescent group, moderate positive correlations between SES (as measured by parental education) and career expectations and aspirations were found. The significance of these correlations did not remain when the mid-adolescent group was broken down further to compare across genders. There were no notable, significant correlations found between SES and career expectation/aspirations in the late-adolescent group, although a moderate, non-significant correlation was noted between SES (as measured by parental education) and career expectation in the male, late-adolescent group.

Our data therefore provides partial support for Gottfredson's (2002a) hypothesis that adolescents take into account their social status when forming career aspirations and expectations. In her theory, Gottfredson (2002a) wrote that "youngsters from higher social class (wealthier, better educated) families are subject to higher occupational expectations…" (p.98). Although Gottfredson (2002a) highlights both wealth and education as contributing factors, our results suggest parental education is particularly important in shaping career expectations. Despite there being correlations between SES as measured by occupation and career aspirations/expectations, these were non-significant and smaller than the correlations with SES as measured by parental education.

Our findings suggest parents' level of education is more important than level of income in developing career aspirations. Level of parental education has been deemed a 'robust predictor' of adolescent college-related aspirations, with higher parental education being associated with higher career aspirations (e.g. Cochran et al., 2011). Gao and Eccles (2020) noted adolescents whose parents have higher educational attainment were more likely to maintain than decrease college-associated career aspirations, regardless of gender, GPA or academic motivation. There is evidence to suggest parents with higher education levels are more likely to provide more encouragement for their adolescent children (Catsambis, 2001), and it seems to specifically be a valuable predictor of 'college-related' aspirations. The prestige of career aspirations in our analysis was calculated using three variables, one of which was the level of education required. It is therefore not unreasonable to suggest those students with parents with higher levels of education are being encouraged and supported to aim for occupations that require university degrees.

There are various explanations for why we found significant correlations between SES and career expectations only in the mid-adolescent group, and not in the late-adolescent group. Both groups had parental education levels ranging from no educational qualifications to having achieved a PhD. A key difference between the groups is that the late-adolescent group is composed of students who all went to university, whereas the mid-adolescent group has a wider range of abilities and backgrounds. In relation to Gottfredson's theory, the late-adolescent group participants will all have a tolerable-level boundary threshold that will be relatively high, and a self-defined social space where idealistic and realistic career choices likely require a university degree. This is not the case for the mid-adolescent sample, which is arguably more representative of the general population, and would therefore more likely reflect a wider range of self-defined social spaces across the prestige axis, and therefore potentially explains Additionally, Rojewski and Yang (1997) found that the effects of SES on occupational aspirations decrease as adolescents mature, which could also be a contributing factor as to why we are seeing this difference between the mid and late-adolescent groups. In order to fully test the influence of SES on career aspirations in late adolescence, data needs to be collected from both university students and individuals who did not attend university.

The associations between SES and expectations, rather than aspirations, were strongest and most significant – a finding that has been noted previously in the literature. One of the key reasons for this is likely to be related to the cost of education: although the likelihood to *aspire* to attend university has been seen to be the same for adolescents in both low-SES and high-SES families, if adolescents are in high-SES families that have set money aside for attending university, they are more likely to expect to actually do so (Davey and Stoppard, 1993; Gao and Eccles, 2020). Although this is likely more of an issue in the US and related to tuition fees, research in the UK has shown that students from lower-SES backgrounds considering applying to university were more concerned about the financial aspects of doing a degree compared to higher-SES students (Fagence & Hansom, 2018). This could explain why we found higher correlations between SES and career expectations. It could also explain why we saw this correlation to be particularly marked and significant in the mid-adolescent group and not the late-adolescent group, as again, the late-adolescent group were all attending university, therefore would not be considering whether they could afford it. It is important to note that these other studies were conducted in Canada and the US, where tuition fees and student loans for attending university operate differently than in the UK.

6.5.3.2 Cognitive Ability (IQ)

We found a weak but significant positive correlation between FSIQ and career aspirations and expectations across the whole sample, particularly marked in the male group (with moderate correlations in both mid- and late-adolescent groups), providing some support for Gottfredson's theory of circumscription. The strongest and most significant correlation was between FSIQ and prestige of career expectation, when controlling for SES (parental occupation).

Our data therefore partially supports Gottfredson's (2002a) hypothesis that there is a relationship between cognitive ability and career aspirations. In her theory, Gottfredson

(2002a) discusses how adolescents incorporate their cognitive ability into their self-concepts, developing a floor and ceiling for their career aspirations based on these perceptions of their abilities. This occurs as part of the circumscription process, where Gottfredson (2002a, 2005) writes that career options are eliminated as they are deemed to either be too ‘low level’ or too difficult. It is important to note that Gottfredson’s career theory did not explicitly state there is a direct relationship between cognitive ability and career aspirations, but instead that career aspirations and the zone of acceptable alternatives can be shaped by self-perceived cognitive abilities. Gottfredson set out to provide suggestions to prevent unnecessary circumscription of vocational occupations from occurring. She wrote “children may set their tolerable-level boundaries too high or their tolerable-effort boundaries too low relative to their actual abilities…some will overestimate their intelligence, and others, especially girls, will underestimate it.” (Gottfredson, 2005. P.93).

There is evidence to support Gottfredson’s (2005) theory that girls especially underestimate their intelligence, and it is important to consider this when discussing our results. Across various studies conducted cross-culturally, women’s mean self-estimated IQ has been consistently seen to be significantly lower than men’s (e.g. von Stumm et al., 2009; Furnham, 2009). This could possibly explain the difference we are seeing between the male and females in our sample: across the whole sample for this analysis, the IQ scores are very similar across the genders (males mean IQ=107.30, SD=13.23, females mean IQ=106.41, SD=11.76). Although females have similar IQ scores to males, they on average have less prestigious career expectations (males mean=-.03, SD=.99, females mean=-.12, SD=.92). This could suggest that in the overall sample, female participants are setting their tolerable-effort boundaries too low relative to their cognitive abilities, supporting Gottfredson’s theory.

However, more in-depth analysis of the mid-adolescent group suggests it is not a straightforward case of all females setting their tolerable-effort boundaries too low in relation to their cognitive abilities: the mean level of prestige for career expectations was actually higher for the females (M=.10, SD=1.12) than the males (M=-.16,SD=.93). This correlational analysis required parental SES data which reduced the sample size, but even when comparing prestige of career expectations/aspirations by gender across the *whole* mid-adolescent sample, the average, minimum and maximum prestige scores for the males were all lower than for the females. The correlation between IQ and prestige of realistic job expectations in the male mid-adolescent group was significant and markedly stronger than the non-significant correlation in the female group, suggesting that the male mid-adolescents follow Gottfredson's predictions where cognitive ability is taken into account when deciding on realistic career options. There is still a correlation between these variables for the female participants, but visual inspection of the scatterplots shows the points are more widely dispersed, with a number of girls aiming for more prestigious jobs than even the most ambitious male participants. These findings actually mirror a consistently reported gender difference: female adolescents are more likely to aspire to either high or low prestige occupations, whereas males are more likely to aspire to occupations of moderate prestige (e.g. Davey & Stoppard, 1993; Rojewski & Yang, 1997).

It could be argued that one of the possible reasons we are seeing this difference between the male and female mid-adolescent participants is due to girls being encouraged to aim higher, especially with governmental incentives encouraging more girls to enter higher education, and more recently STEM careers. Recent research by the Korn Ferry Hay Group (Wilson, 2016) has found STEM graduate jobs are among the highest paid in the UK, therefore an increase in female interest in more scientific roles could explain the higher than expected level of prestige scores in the career expectations for the female participants. Our vocational interest data shows that, on average, the female mid-adolescent group expectations lean slightly more towards working with Things rather than People, which supports this idea there may have been a shift towards working in STEM fields. The literature shows females consistently score higher than males in their people-orientation, and males score higher in things-orientation (Woodcock et al., 2013), and while this pattern is also reflected in our data (the male participants still scored much higher than the females on the things-orientation), it is surprising to see the shift towards working with things rather than people in the female group too. Of course, this could reflect an increasingly digital world: the recent ‘Disconnected’ report found that more young people in the UK are aspiring to jobs in scientific and technical sectors than the number of jobs that actually exist (Chambers et al., 2020).

Another explanation for the weaker correlation between career expectations and IQ in the female group could be due to the girls in our sample either being less aware of their actual ability, or not taking into account their ability when thinking about their career expectations as much as the boys. By this stage of school in the UK, students will have been frequently subjected to testing, and it is therefore reasonable to expect individuals to have an understanding of their academic ability relative to their classmates, as Gottfredson (2005) suggests occurs in her theory. The alternative argument could be that the girls in our sample do not necessarily take into account their ability when thinking about their career expectations. Visual inspection of the scatterplots showed there were a number of cases where female students with below average Iqs were expecting to work in jobs of higher prestige than the most ambitious boys. The reverse was also seen; female students with notably high Iqs expected to work in much less prestigious jobs. Our results are partially in line with Gao and Eccles’ (2020) study, where they did not find any relationship between academic expectancy and college-associated career aspirations. In their sample, the adolescents’ confidence in their academic ability did not have any effect on their decisions as whether to lower or increase career aspirations. They suggested that this reflects the nature of career aspirations: “the occupations adolescents desire to have in an ideal situation” (Gao & Eccles, 2020. P.9). There is no need to consider barriers, which can include perceived low ability, when thinking about their ‘dream’ occupation (Gao & Eccles, 2020). This could explain why we are found a particularly strong relationship between IQ and career expectation, not aspiration, in the overall sample, but does not fully explain why this correlation is stronger for the males, and not found in the female mid-adolescent group.

6.5.3.3 Self-efficacy

In line with Gottfredson’s (2002a) theory, we predicted self-efficacy for the future to be positively correlated with career aspirations and expectations. In accordance with her theory, anticipatory compromises are based on perceived ideas of inaccessibility, so we hypothesised that those adolescents with low self-efficacy for the future would be more likely to make anticipatory compromises, and therefore have lower career aspirations and expectations. In the overall sample, we did not find any significant correlations in any of the age-groups across either gender. The strongest correlation was noted in the male Year 10 group – where moderate, but non-significant correlations were found between self-efficacy and both career expectations and aspirations. When outliers were excluded, a weak to moderate significant negative correlation was found between self-efficacy and career aspirations in the late-adolescent group.

One reason as to why we did not find stronger correlations between self-efficacy for the future and prestige of career aspirations could be due to our sample having, on average, relatively high levels of self-confidence for the future. The scales asked students to indicate on a scale of 1 to 5 how confident they feel in living up to their parents’, teachers’ and their own expectations, and in how clear their plans are for what they hope to do next (Yerdelen et al., 2018). These were averaged to create a composite score for self-confidence for the future. These average self-efficacy scores across all subgroups, both age and gender, were all very similar, with the average score being at approximately 3.5 (between 'somewhat true' and 'very true' on the overall confidence for the future scale). This suggests that, on average, the adolescents in our sample felt relatively confident about their futures, which would not necessarily correlate with the wide range of prestige levels of career aspirations. The recent 'Disconnected' report similarly found that when it came to career aspirations, young people were highly confident about their futures: 76% of the 14-18 year olds in their study were either fairly or completely certain on the career they wish to pursue, and 58% were fairly or very confident that they will be able to achieve it (Chambers et al., 2020). Concerningly, the qualitative review suggested that despite this confidence, "few young people have, or are willing to describe, a detailed knowledge of the pathway(s) necessary to get to the job they want" (Chambers et al., 2020. P.7). We did not include a measure to ask participants to outline the steps they should take to reach their ideal job, although future studies exploring career aspirations in the UK, and how careers guidance in schools could be improved, could benefit from this information.

Alternatively, self-efficacy for the future may not correlate as predicted with prestige of career aspirations due to various other external factors affecting both variables. Visual inspection of the scatterplots of the correlation between self-efficacy for the future and prestige of career aspirations showed a mixed picture: some students had high self-efficacy scores, but their career aspirations were of low prestige. It could be argued that a student could have a clear plan to work in a low-prestige job, and if their parents had relatively low expectations, the student would feel they will easily live up to what their parents expect, resulting in a high self-efficacy score. Gottfredson (2005) wrote of this problem of under-aspiration, typically occurring for children from lower class families, arguing that these individuals tend to be brighter than their parents, but do not aspire to proportionately more prestigious jobs. This results in these young people setting low tolerable-effort boundaries, as “jobs below their ability level are sufficient to be successful in their social circles” (Gottfredson, 2005. P.95). Gottfredson (2005) wrote that the opposite issue can also be seen for children from high achieving parents, which she termed ‘the effort-ability squeeze’. She argued that these young people frequently have high aspirations but tend not to be as intelligent as their parents, resulting in a need to “seek careers that are near or beyond the limits of their capabilities” (Gottfredson, 2004. P.95). This could result in lower self-efficacy for the future scores alongside aspirations to work in jobs of high prestige, a possible explanation for the negative correlation we found between self-efficacy and career aspirations in the late-adolescent group when outliers were excluded. It is important to consider the relationship between self-efficacy and prestige level of career aspirations is likely a bi-directional one, with other factors coming in to play. To fully investigate this, more qualitative research should be conducted to understand the reasons behind why certain career aspirations are selected.

Additionally, the self-efficacy measure we used in this study is a relatively new measure in need of further validation. There were only four items combined to create the composite value, and while one study testing the measure suggest good levels of internal reliability (Cronbach Alpha = .81) the findings are preliminary (Yerdelen et al., 2018). Additionally, in this study measuring the validity of the scale (Yerdelen et al., 2018), the self-efficacy for the future factor was found to moderately correlate with self-reported life satisfaction. Considering our findings in light of this, the negative correlation found between career aspirations and self-efficacy in the late-adolescent group (when outliers were excluded) could reflect that individuals with higher career aspirations may have lower levels of life satisfaction. Those aspiring for the jobs of highest prestige levels will likely have further qualifications to gain, and further to go to reach these aspirations. They could therefore feel broadly unsatisfied with their lives until they reach these goals. Of course, the correlation found between the variables does not necessarily mean this is the case, and there are likely many other factors at play. As stated previously, incorporating qualitative methods into the research would enable researchers to more fully understand the reasons behind why career aspirations are chosen.

6.5.4 Stability of career aspirations and vocational interests

At ages fourteen and above, Gottfredson (2002a) argued young people reach Stage 4 of the circumscription process: orientation to the unique, internal self. While now understanding where their place is in society broadly (in relation to gender, ability, and social status), adolescents begin to develop a more personalised sense of self (Gottfredson, 2002a). This is a complex process, and young people vary in their approach, with Gottfredson (2002a) stating that “adolescents struggle, often confused and insecure, to ascertain just what their interests, abilities, personality traits, and values really are” (p.99). As stated by Gottfredson (2002a), adolescents are considerably different in terms of mental and career maturity. We therefore hypothesised that those students who have higher self-confidence for the future would be more career mature, demonstrating greater career aspiration certainty and vocational interest stability. Additionally, with its links with prospection, we hypothesised that students with higher ToM scores would be able to more accurately ‘put themselves into the shoes’ of various occupational titles, and be more aware of developing their ‘public’ self (“the public presentation of who we can and want to be” (Gottfredson, 2002a. p.100)). We therefore hypothesised that higher scores for both self-confidence for the future and ToM would be associated with greater certainty of career aspirations, and greater stability of vocational interests. The results of the associations of both variables are explored below.

6.5.4.1 Self-efficacy

We hypothesised that non-discrepant adolescents (those reporting the same aspirations and expectations) would have higher confidence for the future scores than discrepant adolescents. Armstrong and Crombie (2000) predicted that non-discrepant adolescents would not be expected to make any compromises to their aspirations, since "presumably their aspirations are perceived as being viable expectations" (p.84), whereas discrepant adolescents may compromise their career aspirations more towards the direction of their expectations. We predicted seeing certainty in one's career choice to be reflected in higher self-confidence for the future scores, and those who were less certain in their career choice (the discrepant group), and thus more likely to compromise, would have lower self-confidence for the future.

Across the whole sample, and separately in both the mid-adolescent and late-adolescent groups, there were no significant differences between the discrepant and non-discrepant groups in relation to self-efficacy score. However, at a descriptive level, our findings reflect our predictions: the non-discrepant group had higher self-confidence for the future scores, and this was seen in both mid-adolescent and late-adolescent groups. These descriptive findings support previous studies that have looked at the relationship between similar concepts: Kirk et al. (2012) found discrepant students reported lower academic self-perception (scoring lower on measures such as 'I am capable of getting straight A's at school') than non-discrepant students. They argued that how students see themselves in the academic realm is important in their exploration and assessment of possible future options, concluding "it appears that students may have more positive outcomes if their realistic expectations are congruent with their idealised aspirations" (Kirk et al., p.509). This argument is supported by a large study (N=761) that found discrepant students are more likely to have poorer academic performance, have increased emotional difficulties, and have higher levels of test anxiety (Boxer et al., 2010). An important distinction to note is that this latter study was focused on the discrepancy between *academic* expectations and aspirations, and not specifically career aspirations and expectations, although it does outline relevant associations: those students with contrasting aspirations and expectations are less likely to have positive outcomes. The size of our sample could explain why our results were not significant, and further research should explore this association in a larger sample.

In addition to higher self-confidence for the future scores being associated with more certainty regarding career aspirations, we predicted they would also be associated with greater vocational interest stability. By Stage 4 of Gottfredson's (2002a) theory of circumscription, adolescents now know their place in society, but "the unsettled and unsettling question for many relates instead to who they are as individuals" (p.99). At this stage adolescents are exploring and orienting to their internal concepts of self, before beginning the compromise process where they consider barriers and accessibility to various occupations (Gottfredson, 2002a). We predicted that the more career mature students would go through this process earlier, thus having higher self-confidence about plans for the future, correlating with more stable career goals and more established vocational interests. As Low et al (2005) stated, "Despite their dispositional qualities, interests do continue to develop…People change their interests in response to the positive and negative environmental reinforcements they receive" (p.715). We therefore predicted that self-confidence for the future scores at Wave 1 would be associated with vocational interest stability over a 1-year period. If individuals feel confident that they can live up the expectations of their teachers, parents and themselves, and that they have a clear plan for what they will be doing next, it is reasonable to hypothesise that these individuals will have explored and refined their desired field of work, meaning their vocational interests would likely remain stable.

There were no significant differences in self-confidence for the future scores between the stable and non-stable groups across the vocational interests (both in terms of the career aspiration and expectation vocational interest profiles, and each vocational interest measured separately), with the exception of Things. In the whole sample the stable group on the vocational interest of Things had lower self-efficacy scores than the non-stable group, with a medium effect size (η_p^2=.052), which was the opposite to what was hypothesised. Although initially significant, once corrected for multiple comparisons the result was no longer statistically significant.

While a number of studies have found evidence to support the associations between vocational interests and self-efficacy, these self-efficacy measures are focused specifically on confidence in particular occupational areas, and not self-confidence about plans for the future more broadly. These studies are largely testing the Social Cognitive Career Theory (SCCT) that argues “it is likely that people form enduring interests in activities in which they view themselves to be efficacious” (Lent et al., 1994, p.89). For example, Bandura et al. (2001) evaluated young people’s occupational self-efficacy, such as ‘Science-Technology Efficacy’ and ‘Literature-Art Efficacy’, and found children’s perceived occupational self-efficacy shaped their occupational pursuits. Patrick et al. (2011) similarly asked respondents to rate their competency for performing activities across each of the six RIASEC vocational interest dimensions. They found some vocational interests, and ultimately educational pathway choice, were more heavily influenced by perceived competency in that respective vocational interest realm – such as for the Realistic and Investigative themes (Patrick et al., 2011). One's belief in their abilities to succeed in particular vocational interest-based tasks is clearly associated with the respective vocational interest, but our study investigated individuals' self-confidence about plans for the future more broadly.

One possible explanation as to why we found no positive associations between self-confidence about plans for the future and the stability of vocational interests could be due to the stage both our mid-adolescent and late-adolescent groups were at during Wave 2 of data collection. We chose to test these age-groups as both were at stages of their lives where they are thinking about their futures: at Wave 2, the mid-adolescent group were in their final GCSE year, and the final-year university student group were either about to enter or had recently entered the world of work post-graduation. In relation to Gottfredson's (2002a) theory, we postulated that those with high levels of self-confidence about their future plans would likely have already explored within their zone of acceptable alternatives, seeking out and gaining experiences that would strengthen existing vocational interests. As Betz and Luzzo (1996) outlined, "low self-efficacy expectations regarding a behaviour or behavioural domain lead to avoidance of those behaviours" (p.414). Therefore, those students with low self-confidence about their plans for the future would be less likely to explore career options, resulting in less stable career aspirations, and ultimately less stable vocational interests. However, it is plausible that because all of the students are in the process of making important future-related decisions, it would be impossible for them to entirely avoid planning their futures. Gottfredson (2002a) highlighted that the consolidation of vocational interests "seems to depend somewhat on exposure to specific kinds of environments and experiences" (p.136). For the majority of students, the time between the two waves of data collection is typically spent exploring options for the next step, gaining real-life work experiences and being confronted with making career-related decisions.

Therefore, self-confidence about future plans at Wave 1 could only be playing a small part in how vocational interests are solidified or developed. Evaluating this association in a much larger sample is necessary to fully investigate whether there is a relationship.

6.5.4.2 Theory of Mind

We hypothesised that non-discrepant adolescents (those reporting the same aspirations and expectations) would have higher ToM scores than discrepant adolescents. None of the results discussed in this paragraph were significant. Overall, we found only very partial support for our hypothesis: in the mid-adolescent group, the discrepant group made more mistakes on the cognitive ToM task, thus demonstrating a worse performance than the non-discrepant adolescents. Across the whole sample, however, we found that the non-discrepant group also performed more slowly on the cognitive ToM task, which is not in line with our hypothesis. Neither of these results were significant, and we cannot claim that our results indicate a relationship between ToM ability and certainty of career aspirations.

It could be argued that a more developed ToM does not necessarily mean anticipatory compromises will have already been made. We hypothesised that those with higher ToM ability would have already made anticipatory compromises, as envisioning the future (prospection) and ToM share common functional anatomy (Buckner & Carroll, 2007). We postulated that, in accordance with Gottfredson's (2002a) theory, more developed ToM ability would enable adolescents to be better at projecting themselves into the world of work, imagining themselves in various roles. Their more developed ToM ability would then help them to evaluate various roles, consider which ones are realistic, and thus form non-discrepant career aspirations and expectations. However, those with more developed ToM ability could still be thinking about various careers – if they have a better ability at projecting themselves into the future or can more easily picture themselves in a variety of different jobs, it does not necessarily mean they are more decisive about their career.

In order to fully investigate the possible role ToM ability plays in the development and stability of career aspirations, we also assessed the relationship between ToM ability and vocational interest stability. Similarly to the previous research question, we partly based this hypothesis on Gottfredson's (2002a) theory of circumscription and compromise: those with higher ToM ability at an earlier stage of development could better understand the importance of establishing their 'public selves' in relation to career choice, thus would arguably have invested more time in developing these personal and public selves, resulting in more stable vocational interests. Additionally, we were particularly interested in assessing the stability and change of the People-related vocational interest dimension, as interest in working with People was seen to increase or remain constant during the college years of ages 18-22 (Hoff et al., 2018). We hypothesised that as this period of late-adolescence is also the time at which ToM ability improves (Dumontheil et al., 2010), there could possibly be a relationship between the stability or increase in people-based vocational interests and ToM development in the late-adolescent group. Discussion of the multiple regression analysis conducted to assess whether ToM predicted the direction of the change in vocational interest of People over time is found in Section 6.4.5 below.

We found some evidence to support our hypothesis that vocational interest stability over a year will be positively associated with ToM score (though again, once corrected for multiuple comparisons the significance of the results was lost, therefore the results discussed in this paragraph were not significant). Participants were categorised into stable or non-stable groups for each vocational interest, as well as for the vocational interest dimension score for both aspirational and realistic occupation. When outliers were excluded from the analysis, a difference in cognitive ToM % error rate between the stable and non-stable groups in the late-adolescent group was found for both the vocational interest of Data and Things. In both cases, the findings were in line with our hypothesis, with the stable group performing significantly better than the non-stable group (although the significance was lost in the analysis on Data after correcting for multiple comparisons). Similarly, across the whole sample, and in the mid-adolescent group separately, those whose vocational interest in Ideas was stable over the year were seen to perform significantly faster than the non-stable group on the Affective ToM task. Again, once corrected for multiple comparisons these were no longer statistically significant, but these results do provide some preliminary support for our hypothesis that poorer performance on ToM task may be associated with greater instability in vocational interests over a one-year period.

However, some of our results countered our hypothesis: when outliers were excluded from the sample, a significant difference in cognitive ToM % error rate was found between the stable and non-stable groups on the vocational interest of People, with the non-stable group performing significantly better on the ToM task than the stable group in the late-adolescent group. The same difference was seen when assessing the association between cognitive ToM performance and stability of career expectation vocational interest profile: in the late-adolescent group, there was again a significant difference in cognitive ToM % error rate between the two groups, with the non-stable group performing significantly better on the cognitive ToM task than the stable group, and also in the mid-adolescent group, where the non-stable group performed significantly better on the affective ToM task (though both results lost their significance once corrected for multiple comparisons). It is important to note that when looking at the mean scores of the stable and non-stable groups across the vocational interest dimensions, of the results that are significantly (or initially significantly) different, the group that performed best on ToM tasks were always the smaller group (with the exception of the vocational interest profile from career expectation, where the non-stable group performed better and were larger). The small and uneven sample sizes when the groups were split on stability criteria were a limitation that could have influenced our findings. This is more noticeable in some conditions than others, for example, with outliers excluded in the late-adolescent group, the group that were stable on the vocational interest of People included n=30 individuals, whereas the non-stable group had n=12. Findings from this analysis showed the non-stable group to perform better on the cognitive ToM task than the stable group, however, this could have been influenced by these small, uneven sample sizes.

While it was expected that the better ToM performance would be associated with vocational interest stability, it is possible that the method used to assess this relationship may have affected the results. Individuals were allocated into stable or non-stable groups based on whether their vocational interest score had changed, but direction of the change was not considered. Therefore, participants were classed as unstable in cases where their vocational interest scores had increased. While the method used accurately classifies them as unstable, it does not necessarily allow for exploring whether those who have solidified their vocational interests, and thus have increased their score, demonstrated better ToM ability. A larger sample size in future analysis could additionally split the data into three groups: 'stable/increasing' 'stable (no change)' and 'unstable/decreasing', to assess whether ToM performance across these groups varies. It is possible the allocation of individuals into binary groups may have concealed slightly more complex patterns, as individuals classed as 'unstable' on the vocational interest in People may have better ToM ability, and therefore an increasing interest in People over one year. However, as a simple and preliminary step to assess whether there is any association between ToM and vocational interest stability in adolescence, comparing the two stability groups was a straightforward and important initial strategy when exploring a previously untested association. Additionally, we did conduct multiple regressions, to assess whether ToM performance predicted change in the vocational interest in People, which allowed us to see the effect of change (and the results of which will be discussed in Section 6.4.5 below).

Another important limitation to acknowledge is that the ToM measure used in this study was possibly too easy for the age of our sample, which could have influenced our ToM results, especially the % error rates. Again, as outlined in the Discussion of both Study 1 and 2, although the measure was used in an adolescent and adult sample (Sebastian et al., 2012), and a longitudinal study involving participants from late childhood to early adolescence (Holl et al., 2018), the distributions of the error rates show there were ceiling effects of the measure. This did not seem to be an issue with the reaction times of the ToM task, as these were all normally distributed and through which we observed significant differences between the mid-adolescent and late-adolescent group, as well as between Year 10 and Year 11 longitudinally. Therefore, although there were some initially significantly significant results found between ToM performance and vocational interest stability in relation to ToM reaction time, a number of the findings were in relation to cognitive ToM % error rate. It is therefore possible that only a small minority of participants influenced our findings, and the results should be interpreted with caution. Additionally, a measure that does not have this ceiling effect would enable identification of particularly high-performing participants, meaning it would possibly uncover associations between ToM and vocational interest stability that this study could not find.

While theoretically the association between ToM and career aspiration decisiveness and stability is plausible, perhaps an alternative method could more accurately measure it. We situated the first ToM research question (RQ4) in relation to Gottfredson's (2002a) theory of compromise, but that may be too confined – particularly when relating the association back to the timing of careers guidance in schools. Comparing levels of ToM ability between groups of 'decisive' non-discrepant adolescents with the 'less decisive' discrepant adolescents is only the first step in evaluating the role ToM might play in career decision-making. In order to fully assess career decisiveness of adolescents by comparing discrepant and non-discrepant groups both a larger sample size and additional measures would be required. The Career Decision Self-Efficacy Scale, originally developed by Taylor and Betz (1983) could be an additional or replacement measure to use to consider the relationship between confidence in making career decisions and ToM ability. Testing whether there is an association at this level, rather than applying it to anticipatory compromise of actual expressed career aspirations, could arguably provide more support for the influence of ToM on career decision making in adolescence. Further research investigating this association would benefit from substantially larger sample sizes.

6.4.5 Development of vocational interest in People

Vocational interest in working with People has been seen to increase or remain constant during the college years of ages 18-22 (Hoff et al., 2018). We hypothesised that ToM may have an effect on this vocational interest development: although we did not find any significant findings that stability of the vocational interest in People was associated with better performance of ToM, we additionally tested whether ToM ability would be associated with change in the vocational interest of People. Specifically, we hypothesised that better ToM performance at Wave 1 would predict an increase in people-based vocational interests at Wave 2. Our analysis found some results that support our hypothesis – though once corrected for multiple corrections, the significance of the models were deemed no longer significant. The results discussed in the paragraph below are therefore not significant.

With outliers excluded, the multiple regression model found that a decrease of reaction time on the cognitive ToM task at Wave 1 was associated with an increase in People vocational interest score over the year across the whole sample. In the late-adolescent group, the multiple regression model similarly predicted level of change on the singular People measure, with two variables (cognitive ToM reaction time and affective ToM error rate) adding significantly to the prediction – with decreases in the error rate of affective ToM and reaction time of cognitive ToM being associated with an increase in score on the People vocational interest measure. Finally, when considering the data from the People/Things dimension for career expectations, again the model predicted change on this dimension in the late adolescent sample. Again, a decrease in cognitive ToM predicted a decrease in score on the People/Things dimension (lower scores on the dimension indicate preference for working with people over things). All of these results support our hypothesis that better performance on ToM tasks at Wave 1 would be associated with an increase in vocational interest level of people over one year, especially in the late-adolescent group. However, once corrected for multiple comparisons, the significance of the models were deemed no longer significant.

Hoff and colleagues (2018) argued that this stage of ‘young adulthood’ (ages 18-22) is characterised by becoming socially mature, in addition to developing interests in helping and influencing people for some people. Their finding that people-based interests increase during this period opens up new lines of research, arguing “it is likely that mean-level changes in interest traits co-occur with changes in personality traits, abilities, and other individual differences” (Hoff et al., 2018. p.444). Our investigation as to whether ToM ability contributes to this level of change during late-adolescence has explored one of these new lines of research, and has provided some evidence to suggest ToM may be one of the abilities that co-occurs with changes in vocational interests. Hoff and colleagues (2018) suggest the increase in people-oriented interests could be motivated by “the same normative transitions that occur during young adulthood or general social pushes toward psychological maturity” (p.444), which a number of ToM studies have also suggested to be the reason why ToM ability increases at this same stage of development (e.g. Dumontheil et al., 2010). Our results suggesting some preliminary support for the hypothesis that there is an association between ToM ability and people-based vocational interest is an original contribution to the field.

Whilst we did find some evidence to support the idea that ToM ability has an effect on the stability of vocational interests, and additionally an increase in mean-level change of people-based vocational interests, we should be cautious when discussing the results. Our sample size limited the power of our analysis, and while all assumptions were checked before analysis was conducted, there were a large number of cases with leverage points with values higher than 0.2 (N=20 in the late-adolescent group). These were all included in the analysis, to avoid reducing the size and power of our sample even further, but this could have affected the results. Additionally, the regression model was conducted with four separate ToM variables (reaction times and percentage error rates were included separately for cognitive and affective ToM). We had moderate collinearity across all the regression models assessing the effect of ToM on stability of vocational interests, which again could have resulted in skewed findings. Combining the error rates and reaction times to create a composite variable for both cognitive and affective ToM to reduce the collinearity of these variables could have possibly strengthened our results.

6.4.6. Limitations

There were both theoretical and practical limitations for our study. Theoretically, a large amount of Gottfredson's (1981, 1997, 2002a) theory regards perceptions - particularly in relation to testing whether anticipatory or experiential compromise has taken place. We did not include a measure of self-reported career compromise, so it is important that we do not assume compromise has taken place. Our analysis focuses on the stability of expressed career aspirations, and while it could be assumed that the change between career aspirations over a 1-year period could be due to adolescents compromising their idealistic aspirations in anticipation, we did not include a measure to confirm this. There are also issues regarding the generalisability of our sample. A large number of the late-adolescent (final-year university student) sample were from an Education department (students of Psychology in Education) and we had an uneven spread of male and female participants, resulting in skewed interests towards people and social-typed roles. Our sample size was also small, and only 61.64% of the late-adolescent group completed the follow-up questionnaire, resulting in a male late-adolescent group too small for analyses to be conducted. Our sample size was limited by the need to conduct ToM and IQ testing, which required in person-testing that took up to 40 minutes per participant, with no financial incentive offered. Testing a larger number of participants to consider the role of ToM in relation to career aspiration and vocational interest stability would require a larger research team, as reaching a larger sample size was beyond the scope of this study.

7 General Discussion

7.1 Introduction

Despite recent initiatives by the Government, careers guidance and support in the UK still requires improvement and any investment in improvements should be evidence informed. At a time when the world of work is changing in terms of digitalisation and globalisation (Organisation for Economic Co-operation & Development (OECD), 2019), shaping, encouraging and, in some cases, challenging career aspirations has never been more important. Developing specific career aspirations is a complex task, influenced by individual differences and structural factors. Despite acknowledgment of the importance of these factors in careers guidance, there is a need for further integration of relevant research in careers education. Findings from this study suggest that the development of cognitive abilities, such as Theory of Mind (ToM), may play an influential role in how specific vocational interests develop. Additionally, other factors previously noted in the literature, such as socioeconomic status and gender, were also found to influence career aspirations in our research. Finally, there was some evidence from this study to suggest ToM may play a role in vocational interest stability, particularly in late-adolescence, which has both theoretical and practical implications.

The aim of this research was to gain further insight into how vocational interests develop in order to offer suggestions for the development of more personalised careers tools for students. Additionally, the role of ToM, which has been seen to continue to develop throughout adolescence, was examined to assess the best time to implement careers guidance. Information regarding ToM ability, IQ, vocational interests, self-efficacy for the future, career aspiration and expectation and demographic data was collected from mid-adolescent (Year 10 students) and late-adolescent (final-year university students) groups. This chapter discusses the main findings from the three results chapters, and the possible implications for students, schools and universities.

7.2 Research Questions

Numerous research questions were posed in this thesis. The discussion sections in Chapters 4-6 have discussed findings in relation to these specific research questions so the current chapter will discuss the key research themes of the whole thesis, largely in relation to vocational interests and career aspirations. The following research areas will frame this discussion chapter:

- The influence of birth order in adolescence: relationships with vocational interests.
- The role of ToM in vocational interest development: relationships with specific vocational interests and the stability of vocational interests.
- The influence of gender, IQ and SES on career aspirations and expectations.

This chapter will also include a brief discussion of the recent emphasis on Open Science in psychological research, and our experience of pre-registering the studies reported in this thesis. Additionally, general limitations and areas for future research will be discussed.

7.3 Birth order and vocational interests

Vocational interests have been acknowledged to represent “manifestations of more basic personality characteristics” (Hogan & Sherman, 2019. p.192), and as large, representative meta-analyses have found evidence of essentially no birth-order effects on personality (e.g. Rohrer et al., 2015), the likelihood of finding any notable associations between birth order and vocational interests in our smaller-scale study was small. However, Barclay et al (2017) found birth-order position did influence college major choice: with first-borns more likely to apply to law, life sciences and engineering, and later-born siblings found to be more likely to apply for art, journalism and business programmes. As these findings were observed in Sweden, where tertiary education is free, we hypothesised that these birth-order effects could possibly be the result of individual differences in vocational interests, and not driven by other factors, such as financial reasons.

No clear relationships were found between birth order position and vocational interests in our study, and there are a number of possible reasons for this, one being the vocational interest measure we used. In relation to Barclay et al's (2017) findings, we hypothesised first-born children would have more interest in Data and Things, and later-born children to be more interested in People-based roles. The vocational interest measure we used may have been too basic to gauge an accurate reflection of each individuals' vocational interests. Adapting the four-item measure developed by Svedholm-Häkkinen and Lindeman (2016), we asked participants to evaluate and rate the extent to which their ideal chosen field focuses on Data, People, Ideas or Things, on a scale of 1-4. The measure asked participants to allocate the highest score to only one of the vocational interest areas, although many participants did not do this. The measure was chosen for its succinctness, but the broad nature of the items likely reduced the specific variation between the individual vocational interests themselves, as well as the variation between participants' scores. For example, one student may have nursing in mind as their desired field of work, thus rating the importance of the vocational interest in People with a score of 4, Data as 3, Things as 3 and Ideas as 2. Although different constructs, Data and Things would have equivalent scores. Additionally, this same vocational interest profile could be presented for a student with career aspirations in an entirely different field. These hypothetical examples suggest a vocational interest measure with a higher number of items would enable more distinction between participants' overall vocational interest profiles, and within each participants' vocational interest profile themselves. Additionally, whether the adapted measure actually assesses vocational interests is debatable – asking participants to rate how much their desired field of work focuses on each vocational interest area is more a measure of the *perceptions* participants have of what these roles entail. Of course, if participants have their ideal career choice in mind when filling in their ratings, this would likely represent their vocational interest preferences – although again, a measure with more items would likely collect data that more accurately reflects vocational interests.

The most probable explanation as to why no relationship was found between birth order and vocational interests in our study was due to our use of a between-family design. Studies comparing siblings across different families have been largely criticized: due to numerous confounding factors that differ between families, which are unlikely or very difficult to take into account, the reported associations found between different birth-order positions are deemed 'spurious' (Barclay et al., 2017; Rodgers, 2001). In order to fully investigate whether first-borns are more likely to be interested in Data and Things, and last-borns more interested in People-based vocations, research needs to be conducted using a within-family design.

Even using this methodological 'gold standard' of birth-order research of within-family sibling comparison (Barclay et al., 2017), there is also the possibility that the reason no relationship was found between vocational interests and birth order is because no relationship exists. Vocational interests are acknowledged to reflect personality traits (Hogan & Sherman, 2019), and large-scale meta-analyses have largely discounted any sizeable associations between birth-order position and personality (e.g. Damian & Roberts, 2015b; Rohrer et al., 2015). While Barclay et al (2017) provided evidence to suggest birth-order position may influence college major choice, this might not necessarily be due to vocational interests, with there being no specific mention of vocational interests at any point in relation to their findings. Barclay et al (2017) discuss that they did not have the data to assess whether personality mediates the relationship between birth-order and college-major choice, instead suggesting that the differences seen between siblings could be due to first-borns being more ambitious than later-born siblings (as found by Bu, 2016). With the significant differences seen between first-born and later-born children on college major choice in their study, the hypothesised association between birth-order position and vocational interests is logical, and simply because we found no associations in our comparably small sample does not discount the hypothesis completely. Further research with much larger sample sizes in a within-family research design should be conducted to assess the influence of birth-order position on vocational interests, with ambition as a possible moderating factor.

7.4 The influence of ToM on vocational interest development

ToM was considered in relation to vocational interests for two reasons: firstly, in relation to the development of People-based or ‘Social’ jobs. We hypothesised that better ToM ability would predict more interest in working with People. Additionally, as ToM had been seen to relate to cognitive abilities such as prospection and self-concept, we hypothesised that ToM may be useful in predicting vocational interest stability, which could possibly enable us to explore whether there are specific times at which careers guidance would most usefully be implemented.

ToM was not found to be directly positively associated with People-based jobs in either the cross-sectional or longitudinal studies (Chapters 4 and 5). In fact, as discussed in Chapter 4, significant moderate positive correlations were found between the vocational interest in Things and performance on both cognitive and affective ToM tasks. We argued that these findings, while in the opposite direction to our hypothesis, could support Svedhölm-Hakkinen and Lindeman's (2016) study, that suggested individuals could possess both high levels of systemising and empathising – individuals could demonstrate good ToM ability but ultimately have stronger vocational interests in Things. Simply demonstrating better perspective-taking abilities does not mean an individual is automatically interested in People-based roles. In fact, social influences have a large impact on how interests develop during adolescence: causing interest in certain areas to be maintained, or to decline, often through peer disapproval or competition (Hoff et al., 2018). Therefore, good ToM ability may mean adolescents are better at considering the perspectives of others, and therefore possibly susceptible to influence from friends and family, which could influence change in vocational interests across all areas, and not specifically people-based ones.

While there appears to be no direct relationship between ToM ability and vocational interest in People in the mid-adolescent group, in Chapter 6 we found some evidence to suggest better performance on the ToM task at Wave 1 was associated with an increase in the vocational interest level of People in the late-adolescent group over a 1-year period. While better ToM may not correlate with interest in People-based roles at the same time-point, these findings suggest there may be a 'lag', with better ToM ability laying a cognitive foundation that could result in more interest in People. In relation to work conducted by Ackerman and Heggestad (1997) and Dennissen et al (2007), Su et al (2019) stated "Individuals tend to be interested in areas where they are knowledgeable, do well, and have high perceived abilities" (p.23). If an individual is aware that they are good at understanding the perspectives and emotions of other people, they may then subsequently develop interest in roles where they can use these skills.

The relationship between ToM development and the shift towards being interested in working with People may not be unidirectional: instead, the two variables could mutually reinforce each other, or be developing entirely independently. The likelihood of there being no relationship between the two variables seems slim, both in light of our findings and in relation to Hoff et al (2018) who suggested people-oriented interests likely "co-occur with changes in personality traits, abilities, and other individual differences" (p.444). This period of late-adolescence is characterised by an important transition into the world of work, where social maturity is valued and encouraged (Hoff et al., 2018). The late-adolescent group in our research had recently graduated and were newly employed in, or contemplating starting, graduate jobs. It may be that this emphasis on the importance of social maturity, and working well with other people, is an important aspect in most roles, which could be the reason for this shift towards people-oriented roles (Hoff et al., 2018). However, the evidence that better ToM ability predicted even greater levels of interest in People suggests it is likely that development in both variables are "motivated by the same normative transitions that occur during young adulthood" (Hoff et al., 2018. p.444). Although we found a possible association between ToM development and vocational interest change, there are likely numerous other variables that could also be changing at this stage, and further research should consider researching a combination of traits to investigate the mechanisms responsible for this shift in vocational interests in late-adolescence. Additionally, while our results indicate better ToM performance leads to developing more interest in People, future research would benefit from a longer-term longitudinal design, in order to gauge a more accurate picture of the nature of this relationship.

There was evidence from the longitudinal mid-adolescent study (Chapter 5) to suggest ToM may be able a useful indicator of the development of certain vocational interests during mid-adolescence. In their meta-analysis of vocational interest stability, Hoff et al (2018) found interest intensity increased across all interests from the age of 14 onwards, following a general decline in early adolescence. Our longitudinal study showed an increase in interests in all vocational areas between Year 10 (mean age=14.91 years) and Year 11 (mean age=15.91 years), with the exception of Things, where there was a slight decrease. Our findings therefore are generally in line with this increasing intensity of vocational interests. Hoff et al (2018) argue that "Rather than viewing the disruption of early adolescence as inherently negative, these changes can be viewed as a period of preparation and reorganization" (p.444), essentially stating that this period may be necessary for adolescents to learn to adapt, and their vocational interest deficits of early adolescence are required for fuelling this increased intensity of vocational interests in later adolescence. However, these explanations are theoretical, and there is little empirical research exploring the mechanisms responsible for this increase in vocational interest intensity from the ages of 14 onwards (Hoff et al., 2018).

We explored the influence of ToM on the stability of vocational interest levels in Study 3, and found in the mid-adolescent group that worse affective ToM performance at Wave 1 (according to reaction time) was associated with more instability on the vocational interest of Ideas. While this suggests ToM ability may influence vocational interest development, at this level this is largely theoretical. However, the longitudinal role of ToM ability in vocational interest development reported in Study 2 suggested ToM may be a contributing factor of increased intensity of vocational interests during mid-adolescence. We found making more mistakes on the affective ToM task in Year 10 correlated with reporting higher interests in Ideas in Year 11. A hierarchical multiple regression found the addition of Year 10 affective ToM score to the prediction of Year 11 vocational interest in Ideas led to a small increase in R^2 (although this just missed the level of significance, p=.055). Essentially, our findings suggest worse ToM ability in Year 10 predicted interest in vocations involving Ideas in Year 11. This further supports the possible role ToM ability plays in vocational interest development. Ultimately, these findings could indicate that in Year 10, students with less developed ToM ability had less developed self-concepts, or vocational identities. Over the course of the year, these vocational identities developed, and in the case of our sample, interest in vocations involving Ideas has increased. While plausible, this finding begs the question: why are we seeing this effect in the vocational interest of Ideas?

There are two potential reasons we found poorer ToM performance in Year 10 contributes to an increased interest in Ideas in Year 11. Research has shown that between the ages of 13 and 14, psychological thinking and reflecting about oneself intensifies, which has been suggested to form part of the basis for identity development (Białecka-Pikul et al., 2020). Relevantly, research has also found ToM is positively related to this psychological self-thinking and understanding (Białecka-Pikul et al., 2020), suggesting it is possible that students with weaker ToM ability may be more delayed in their identity formation. Individuals' vocational interests are known to be shaped and affected by changes in their environment (Low et al., 2005), therefore these students' vocational identities could possibly be heavily influenced by the transition between KS3 and KS4 learning and the increased focus on problem-solving and critical thinking that GCSEs, such as science and English, demand (Ofqual, 2015a; Ofqual, 2015b). Problem-solving and critical thinking are skills associated with the Ideas vocational interest theme: consequently, as these students are required to engage with these concepts, their interest in roles that require these elements may increase. For those students with weaker ToM abilities during the first part of their GCSE studies, their identity formation may be heavily influenced by this new emphasis on problem solving and critical thinking, or even more specific subjects that they have chosen to study and are therefore gaining a deeper understanding and interest in that topic. The vocational interest of Ideas covers a broad area (the questionnaire describes this field as including “inventing, insight, interpretations, abstract ideas, science and art”), which could mean participants’ vocational interests could be influenced by a more in-depth understanding of science or art. Alternatively, and as discussed in Study 2, poorer ToM ability may be associated with better systemising, so the shift towards Ideas-oriented vocational interests may be reflective of a shift towards an interest in these more ‘systemising’, or scientific roles, as seen by Svedhölm-Hakkinen and Lindeman (2016).

However, there was additionally a negative correlation between affective ToM reaction time in Year 10 and vocational interest in Things in Year 11, with faster performance on the affective ToM task in Year 10 correlated with reporting higher interest in Things in Year 11. Stepwise multiple regression found the addition of Year 10 affective ToM reaction time contributed to a small, significant improvement to the prediction of vocational interest in Things in Year 11 over and above Year 10 vocational interest in Things score and Year 11 affective ToM reaction time alone. This finding does not necessarily support the discussion above, as in this case, better ToM ability in Year 10 predicted higher interest in Things in Year 11. It still could be argued that vocational identities were developing over this period, and that ToM may play a role in this development. The regression analysis shows that change in ToM ability in Year 10 predicts change in interest in Things one year later, so our findings could suggest that poorer ToM ability in Year 10 predicts lower interest in Things in Year 11. Across the whole sample of mid-adolescents, vocational interest in Things decreased. Similarly to the discussion above, this change could be caused by the newly varied curriculum experienced throughout the GCSE years. For example, the Things vocational interest largely regards using machinery and computers, which GCSE students are likely to gain more experience of throughout the GCSE years – with options to tailor subject choices so more experience is gained in areas such as technology, computer science, and science more broadly. It is possible that those Year 10s with poorer ToM ability also had less developed vocational identities, and with increasing experience with new tools, computers and machinery, these individuals changed their vocational interests accordingly – realising perhaps that they did not want these aspects to be the focus of the jobs. In relation to both results, the explanations are theoretical, and therefore qualitative research, or measures that provide a more accurate reflection of vocational interests, are essential to understand exactly why these changes are occurring in relation to ToM ability.

There are practical implications of our findings regarding the relationship between ToM and vocational interests, discussion of which can be broken down into both the individualisation and timing of careers guidance. Firstly, the finding that late-adolescents shift towards people-oriented vocational interests as they end their degrees is useful to careers advisors in university settings, who can anticipate these changes, and tailor their advice accordingly (Hoff et al., 2018). In the mid-adolescent group, finding evidence to suggest ToM ability at age 14 may be able to predict both the intensity and preference of particular vocational interests one year later is very important for careers guidance in schools. We found poorer ToM ability at the first wave was associated with an increase in Idea-oriented vocational interests, though also evidence to suggest poorer ToM ability at the first wave was associated with decrease in Things-oriented vocational interests. Larger-scale, longitudinal research conducted over multiple years may find evidence of a clearer relationship between ToM ability and vocational interest intensity across various fields of interest. Our research is only one small step in an important movement to integrate adolescent socio-cognitive development into careers policy in schools, but even at this small scale, there is evidence to suggest a relationship exists between

ToM and vocational identity formation. With this in mind, the period from age 14 onwards appears to be crucial for engaging with students individually and discussing specific vocational interests and how these may be increasing or changing.

7.5 Influence of gender, SES and IQ on career aspirations and expectations

The influence of gender, SES, IQ and self-efficacy on career aspirations and expectations were explored in detail in the discussion section of Chapter 6, largely in relation to Gottfredson's (2002a) theory of C&C. This section will therefore consider some key results from our research in relation to the most up-to-date data about careers aspirations in UK schools, and the current UK careers guidance policy.

Recent data from the academic year 2018/2019 shows there has been some improvement in schools achieving the Gatsby benchmarks: 59% of schools are fully achieving Benchmark 8 (Personal Guidance), although only 22% of schools are fully achieving Benchmark 3 (Addressing the needs of each pupil) (The Careers & Enterprise Company, 2019). Nationally, Personal Guidance was the Benchmark achieved by most schools, with 'Addressing the needs of each pupil' achieved least. 'Personal Guidance' involves having a one-to-one interview with a member of staff trained in careers guidance, whereas 'Addressing the needs of each pupil' regards actively challenging stereotypical thinking and ensuring aspirations are raised (The Careers & Enterprise Company, 2018). While these results optimistically suggest more students are having one-one-one interviews and conversations about future careers, it also implies that stereotypical career aspirations are not being challenged.

One of the key stereotypes Benchmark 3 is designed to challenge is gendered occupations. Across our whole sample, in both age-groups at both time-points, the girls were aspiring to occupations that were notably more female sex-typed than boys. The late-adolescent females aspired to roles that were more female sex-typed than the mid-adolescent females, which could suggest attempts to challenge gender stereotypes of certain aspirations are working. However, it is more likely our late-adolescent female group sex-type scores were skewed towards more feminine roles due to the large number of Psychology in Education students who took part. In regard to tackling the gender pay-gap, recent large-scale studies have found the average pay of job choices of 14-year-old girls was substantially lower than boys: girls' occupational aspirations were associated with a deficit of more than 20% of boys income (Platt & Parsons, 2017). Platt and Parsons' (2014) findings were from a nationally representative sample of N=5445 adolescents aged 14 in 2015, who took part in the Millennium Cohort Study, so while a much larger sample size, the age of the participants is directly comparable with our mid-adolescent group. In our study, the prestige of career aspirations was higher for the male late-adolescents than female late-adolescents, however, the opposite pattern was seen for the mid-adolescents, with girls seen to have more prestigious aspirations and expectations than the boys at both Wave 1 and 2.

Our results are not in line with Platt and Parsons' (2017) findings, and a possible explanation for this is due to the measure of prestige we used. Our measure of prestige was a composite variable, constructed using methods outlined by Deng et al. (2007), that incorporated salary, vocational preparation and recognition scores. Vocational preparation scores represented the level of education and training required to do a particular occupation, and recognition scores represented levels of status for each occupation (Deng et al., 2007). Despite the finding that girls aimed for lower salaried jobs, Platt and Parsons (2017) found girls aspired to professional or managerial roles significantly more than boys, and also had higher expectations for attending university than boys. This could possibly explain why we found this notable difference between our results and Platt and Parsons (2017) – through the integration of these separate values to construct the prestige composite variable in our research, girls' overall prestige levels may be elevated due to the higher preparation and recognition scores, even if they also are aspiring to roles with overall salaries that are lower than the boys. The reason we did not see this same pattern in the late-adolescent group may be due to the participants all having been university students – there was likely a 'level playing field' with regard to vocational preparation required for their career aspirations.

The Gatsby Benchmarks have also put specific emphasis on the importance of breaking down barriers and ensuring students do not limit their aspirations based on their SES-background. Our results found a moderate positive correlation between SES-background and career expectations across the whole sample, with a particularly noticeable large positive correlation in the mid-adolescent (Year 11) male group. Despite acknowledging that more needs to be done to challenge assumptions based on social class, our results suggest social background remains a key barrier to overcome, particularly for boys.

7.6 Possible implications for careers guidance

In relation to the recent 'Disconnected' report, that found a strikingly consistent disconnect between the sectors students aspire to work in and the number of jobs available, Chambers et al. (2020) recommend careers guidance needs to be both extended and intensified. Schools need to be engaging with young people's aspirations, constructively challenging them, emphasising projected demand in different industries and ensuring doors to a broad range of occupations are kept open for as long as possible (Chambers et al., 2020). This influence of SES-background on career aspirations has been reported for children as young as 7 (Chambers et al., 2018). While the Gatsby Benchmarks are focusing their efforts on the right areas, actively challenging gendered stereotypical thinking and raising aspirations for those students from lower SES-backgrounds, in light of our results and other recent larger-scale findings, it begs the question: are they 'too little, too late'?

With regards to the aspect of timing, this thesis originally set out to assess the role of ToM in vocational interests and career aspiration development, in order to explore whether careers guidance was being implemented too early, before students are capable of thinking seriously about their futures. Our research suggests ToM development during adolescence may be important to consider in relation to the timing of careers guidance, although this does not mean career-related discussion should be absent until this point. On the basis of findings of recent large-scale reports on career aspirations in the UK (e.g. Platt & Parsons, 2017; Chambers et al., 2020), it is evident that educating students on the wide range of occupations available to them is most useful as early as possible, even at primary school. In relation to the 'Drawing the Future' report, Andreas Schleicher, director of Education and Skills at the OECD, stated "Career counselling in secondary schooling comes far too late…children arrive in school with strong assumptions based on their own day to day experiences, which are shaped by ideas surrounding gender, ethnicity and social class" (Chambers et al., 2018. p.viii). In order to successfully challenge both gendered stereotypes and raise aspirations of those from lower SES-backgrounds, it is clear careers policy needs to stretch across primary and secondary school years.

However, the need for career *policy* to be in place across childhood into adolescence does not suggest individualised careers guidance should be implemented at the age of 7-years-old. As Chambers et al (2020) argue, engaging younger children with a wide variety of jobs “is not about providing ‘careers advice’ in primary schools but breaking down barriers, broadening horizons and raising aspirations…” (p.2). Instead, in relation to our findings on the influence of ToM on vocational interest development, we tentatively suggest career guidance would be most usefully implemented during mid-adolescence, though it is essential that individual differences between students are taken into account when considering whether students are ready to engage in this conversation, and how to ensure the guidance is as individualised as possible. Of course, there are numerous variables that influence career-choice readiness, such as self-esteem, perceived barriers, and self-reported knowledge of occupational occupation (Hirschi, 2011), and our study has only focused on a handful of possible influential factors. The core message stands, though: empirical studies assessing individual differences in career aspiration stability, career decisiveness, vocational interest development among many other related outcomes, are essential to enable students to receive the most useful careers guidance, at the most useful time, possible. The Gatsby Benchmarks are crucial to ensure careers guidance is actually in place and being administered, however, it is vital that they are not being used simply as a ‘box-ticking exercise’ in schools, and that the individualisation of careers guidance is not being lost in the process of trying to ensure the highest number of benchmarks are fulfilled.

7.7 Open Science: a reflexive discussion

As discussed in the Methodology chapter, the three separate results chapters were pre-registered as independent studies using the Open Science Framework (OSF), with the Center for Open Science (2020) at osf.io. With the recent push to increase reproducibility, credibility and transparency of findings in psychological research, pre-registering studies has been encouraged: outlining methodologies, analysis plans and hypotheses before any data is collected (Foster & Deardorff, 2017).

Overall the process of creating a pre-registration document was straightforward, and also found to be beneficial when data preparation and analysis took place. I personally found that the more detail I put into the pre-registration form, the easier I found the process of transitioning from data collection to analysis. Generally, updating the registration with any modifications was found to be a simple process, particularly if these changes are not in relation to the analysis plan, or require removing any information. For example, in our original pre-registration for Chapter 4, we proposed a total sample size of 300 participants (N=150 in each group). However, due to the data collection being labour intensive and conducted solely by myself, alongside the difficulty of getting schools on board, we had to create a new, linked registration to update the pre-registration with our newly proposed, reduced sample size. This was a straightforward modification and demonstrates how pre-registration is malleable to issues that are inevitable in people-based research.

However, following conducting the data analysis of Chapter 6, I noticed there was a detail included in the pre-registration form that needed to be removed. The pre-registration was mistakenly uploaded with a slightly older version of the data procedure section and included a sentence that stated the region in the UK where data was initially collected from schools. For ethical purposes, to maintain the confidentiality of schools as much as possible, I sent a request to the OSF to ask if they could possibly remove this sentence. They responded to say this was not possible, and the best course of action would be to withdraw the preregistration and submit a new one. While I took down the original preregistration, I decided it would not be appropriate to upload a new one. Despite Dehaven (2017) stating preregistration is not a prison sentence, our analysis plan had altered in a number of ways since we pre-registered the study. Extra unplanned analysis had to be conducted before the actual hypotheses were tested, in order to assess the reliability of certain variables (such as the prestige composite variable), and our research questions were changed as the dependent variables we had chosen to analyse were not the ones most relevant to our hypothesis. While we could have uploaded a new registration form with these changes, for transparency purposes, our pre-registration would have required labelling all of the new analyses as exploratory as data analysis and write-up had already been conducted. This process reinforced the importance of thoroughly checking the analysis plan before conducting the data analysis and ensuring any and all changes are recorded.

7.8 Limitations and areas for future research

There are important considerations and limitations to take into account when evaluating the usefulness of our findings to the field. This section explores key limitations of our research, namely sample size, generalisability of the findings, and the measures used.

Firstly, our research was limited by small sample sizes. In relation to ToM, our sample was larger than those used in fMRI studies, however a bigger sample would have given us more statistical power, which would have been particularly beneficial when considering longitudinal development of ToM. Our sample size was limited by the time the overall procedure took to conduct (approximately 40 minutes per pair in schools at the first wave of testing), which contributed to the difficulty we experienced recruiting schools due to the issue of taking students out of lessons, particularly during the important GCSE years. Additionally, our limited sample size was a significant limitation in relation to the birth order analysis. When considering the role of birth order on both ToM and vocational interest development, our research would have benefitted from breaking down the birth-order element further: considering the role of gender and spacing between siblings. However, taking into account these additional distinctions would only further reduce the group sizes, reducing statistical power further. Additionally, although we conducted some analysis with the results split by gender, the number of participants restricted our ability to do this in all research questions: for example, exploring vocational interest stability in the final part of Chapter 6 had both male and female participants grouped together, which could have influenced our results. Much larger group sizes are required to explore these associations in better detail.

Furthermore, due to the small size of the groups and the convenience sampling measure implemented to recruit participants, it cannot be said that the results of our study are generalisable. While the mid-adolescent group were recruited from mixed-ability state schools, the late-adolescent sample were mostly recruited from highly-ranked universities. Final-year university students were chosen due to participants likely making decisions regarding their future careers, however future research would benefit from exploring how vocational interests change throughout this period of late-adolescence and emerging adulthood in the general population. Our results that this period of late-adolescence is characterised by a shift towards working with People are in line with Hoff et al's (2018) findings from large-scale analyses of vocational interest stability. However, in Hoff et al's (2018) 80% of their 18-22 age category was composed of college students, with the remaining 20% being composed of high school students, and 88% of the 22-30 age category having a form of college education. While statistics from the Department for Education (2018b) have shown an increase in the number of young people attending university, with 50.2% of 17-30-year-olds now participating in Higher Education, that means almost half of young people do not. Further research is needed to understand the individual differences responsible for the change in vocational interests. It could be that the process of undertaking a university degree may influence this shift towards People-based vocations, or possibly delay it further. If individuals enter the world of work straight from school, could it be that their vocational interests in People are strengthened earlier, and the process of university delays it? Our research suggests the socio-cognitive development during this period of late-adolescent may influence this increased interest in people-based vocations, however, until these associations are longitudinally explored in samples that extend beyond university students, our understanding of how these variables interact will be limited.

With regards to our measures, the ToM task, vocational interest measure, and self-efficacy scale all had limitations. Our research set out to test a number of important variables, however, we had to do this in the shortest amount of time possible, in order to achieve a large enough sample size for the statistical power required for our analysis. Therefore, our choice of measures was restricted as we did not want the overall procedure to take more than 30-40 minutes.

The ToM task we used may have some limitations: both practically and in relation to how accurately the measure actually assessed ToM. We outlined some specific cartoons that may have caused errors in Study 1, which could have contributed to the differences seen between the late-adolescent and mid-adolescent group. Additionally, and as discussed in the Discussion section of all three studies, the ToM measure was likely too easy for a number of participants, with distributions of the error rates suggesting there was an issue with ceiling effects. While the majority of the statistical tests used are relatively robust to deviations of non-normality (e.g. one-way ANOVAs (Maxwell & Delaney, 2004), independent samples t-test (Rasch & Guiard, 2004; Rasch et al.,2007)), these ceiling effects did effect the distributions of the data, therefore results where the ToM % error rates are discussed should be interpreted with caution. Holl et al (2018), who used the same ToM measure in their longitudinal study testing individuals through late-childhood into early-adolescence, also discussed how ceiling effects of the task were an issue in their research. They discuss how the reduced variance in the measure led to the difficulty to "detect potential effects and to identify children that are very skilled in ToM" (p.264). This is additionally a limitation in our research, and it is very likely these ceiling effects reduced variance in the high-performing end of the sample – which could have prevented us finding valuable results with the ToM error rate data.

However, it is important to note that reaction times across the ToM tasks were normally distributed, and as an output of a ToM measure, reaction time data is certainly valuable. Although their discussion centred on the advances and directions for assessing ToM in autistic adults, Livingston et al (2019) discuss how the sensitivity of reaction time data is arguably a more useful tool in ToM measurement than error or accuracy rate. They argue how accuracy alone, based on the number of correct trials where understanding and inferring mental states of others is demonstrated, can lead to misclassification of what is 'good' ToM – and using response time data is more sensitive. Additionally, they add that for measuring change in ToM ability, the use of reaction time data is more accurate: "RT-based tasks are less susceptible to practice effects from repeated testing" (Livingston et al., 2019 p.1740). Therefore, the ToM measure collecting both reaction time and error rate data was advantageous: despite the ceiling effect of the task in relation to the error rates, the sensitivity of the reaction time data provides a valuable measure of cognitive processing and decision-making speed (Aykan & Nalçacı, 2018).

A further, and possibly more concerning limitation of the ToM task, is in relation to whether the measure used actually assesses ToM ability. Quesque and Rossetti (2020) recently outlined that ToM tasks can only be classified as measures of ToM if the tasks requires respondents to “maintain a distinction between the other’s mental state and their own” (p.386), what they term ‘nonmerging criterion’.

Quesque and Rossetti (2020) argue that success in ToM tasks where participants are required to select a suitable ending to an open-ended story or cartoon-strip, such as Sebastian et al’s (2012) cartoon vignette we used, does not actually provide any evidence that participants are distinguishing their own intentions from those of the character in the story. For example, in the cognitive ToM condition, a participant may demonstrate that they understand the character in the story wants to pick up a ladder in order to reach apples on a tree, but the task cannot arguably provide evidence that participants are distinguishing their own intentions from the character in the story – the participants may be thinking “I would like to use the ladder to reach the apples” not “He would like to use the ladder to reach the apples” (Quesque & Rossetti, 2020). When participants were given instructions for the ToM task, they were told to select the outcome based on what they thought was the most likely thing to happen next. In this regard, while there is obviously no evidence that the participants were distinguishing between their own intentions and ascribing intentions to others, the preceding cartoons tell a story and participants were clearly asked to decide “What is the most likely thing to happen next?” not “What would you do next?”. This does emphasise the third-person perspective, and there were actually several instances after the task where participants said, “Choosing the outcome was sometimes difficult, because what I personally would do next is different to what I think the character in the story would do next”. These occurrences were only in the Year 10 group, and as discussed in Chapter 4, could suggest that the mistakes made on the (particularly affective)

ToM tasks in mid-adolescence are due to participants choosing the ‘anti-social’ response, e.g. while the participant themselves may comfort a friend who was hit in the face by a ball, they may select the outcome that their friend would laugh at them, as they think this is the more likely response from that particular character. Ultimately, the task does not allow for participants to explain their reasoning for their choice, which would enable a clearer understanding of whether the individual is demonstrating perspective-taking.

We selected Sebastian et al’s (2012) cartoon vignette ToM task for numerous practical and theoretical reasons. For time-saving purposes, it took less than 10 minutes to administer and multiple participants could be tested simultaneously, and theoretically, it had been used previously with adolescent and adult participants, and measured both cognitive and affective ToM. Quesque and Rossetti (2020) listed the ToM tasks that passed their criteria (the task both requires participants to actually represent mental states, and distinguishes between one’s own mental state and the mental state of others), and although there are a number of possible options, there are limitations with all of them, particularly in relation to our study. Of the ToM measures that would enable both cognitive and affective ToM to be assessed, the majority of these are tasks are related to verbal ability (e.g. detection of “faux-pas” (Baron-Cohen et al.,1999), or mental state inferences from Strange stories (Happé, 1994)). While verbal ability can be corrected for, any task that requires participants to be probed in their responses requires individual testing, which is more time-consuming, and would have been impractical in a school-setting. Of the computer tasks that could be conducted by multiple participants simultaneously and demand less verbal understanding, such as the director task, where participants are asked to move items based on the instructions of a character who shares a different visual perspective (e.g. Dumonetheil et al., 2010; Wu & Keysar, 2007), there is often no measure of affective ToM. ToM measures that incorporate all aspects, assessing both cognitive and affective ToM and using a computerised design, are largely limited by the length of time they take: the MASC (Movie for the Assessment of Social Cognition) developed by Dziobek et al., (2006), for example, takes approximately 45 minutes of in-person testing. Although the limitations of Sebastian et al's (2012) cartoon vignette task should be considered in relation to our findings, it was arguably an appropriate choice for the purpose of our research. fMRI results indicated the vmPFC was activated during the affective ToM task in adolescence, which is in line with other ToM studies (Sebastian et al., 2012), and behavioural studies using the task cited the main limitation being the ceiling effect in their sample of participants in middle childhood (Holl et al., 2018). However, Holl et al (2018) only used the error rates of the tasks, not taking into account reaction times, which are particularly useful in detecting whether there has been improvement in perspective-taking ability. As discussed above, the ceiling effect of the task on error rates was also a limitation in our research. However, alongside evidence to suggest the tasks are assessing the same abilities as other ToM measures, the task was easy to understand, quick to administer and provided measurements of ToM ability in terms of both accuracy and speed, and therefore was a suitable choice to test ToM in our research.

The self-efficacy measure also had its limitations. Although not a core component of our research, self-efficacy is well-known as an important element of career decision-making (Betz et al., 2005). As our research was largely focusing on the role ToM may play in vocational interest development and career aspiration choice, a novel and unexplored association, we thought it would be important to also include a variable we knew was important and well-researched in the field of career development. It is important to note 'self-efficacy' as a concept is broad: defined as "people's judgements of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986. p. 391). Thus, in relation to career development, there exists research on self-efficacy for various career development related variables, including self-efficacy for specific vocational interests (e.g. Betz, Harmon, et al., 1996) and career decision self-efficacy, which is the belief an individual has in their ability to successfully complete tasks required for making career decisions (Betz et al., 2005; Taylor & Betz, 1983). Arguably the measure we used (developed by Yerdelen et al., 2018) was less a measure of self-efficacy, and instead a measure of self-confidence in ones' ability to achieve goals in the future: while similar, in light of the importance of self-efficacy specifically in careers development research, it should be clarified that this measure did not explicitly assess self-efficacy. Career decision-making self-efficacy is very important and relevant to understanding the process students go through when choosing careers. Although an additional focus on career-related self-efficacy goes beyond the scope of this research, future research considering the role ToM plays alongside this would benefit from using a scale that more accurately measures career-related self-efficacy (for example, the Short Form of the Career Decision-Making Self-Efficacy Scale, Betz, Klein, et al., 1996).

The four-item vocational interest measure we used (adapted from Svedhölm-Hakkinen & Lindeman, 2016) may also not have provided the most accurate reflection of vocational interests. As stated previously in this chapter, the measure was chosen for its succinctness, but some of the distinction both between and within each individuals' vocational interest profiles may be lost due to the small number of items used. Based on the career aspiration and expectations participants provided, we also used O*NET RIASAEC data to construct People/Things and Data/Ideas dimension scores, which enabled us to consider two independent measures of vocational interests.

While using this second measure may have helped to more accurately differentiate between individuals' vocational interests, as they were based on their actual expressed career aspiration, there are also limitations with this method. The dimension scoring of these expressed career aspirations was based on Prediger's (1982) Data-Ideas and People-Things interest circumplex, which has recently been shown through meta-analyses that the four interests should not be conceptualised as bipolar, but instead as independent factors (Tay et al., 2011). If the interests were biopolar, we would expect strong, negative correlations between the opposite interest types, but very low correlations were found in this meta-analysis (Tay et al., 2011). The dimensional measures of vocational interests were only used in relation to stability, therefore any changes in occupational aspiration that are associated more with working with People, for example, would be reflected on these dimension scores. The four-item vocational interest measure we adapted, however, was used in relation to the other variables (such as ToM and birth order), which meant participants who had high levels of interest in both People and Things, for example, would not have been categorised as one or the other.

We ran correlations between the vocational interests as measured by the four-item measure, and the dimension scores calculated using O*NET RIASEC data, to assess the reliability of the measures against each other. The Data and Ideas scores were weakly and inconsistently correlated with the Data-Ideas dimension for most comparisons, with the exception of at Wave 2, where scores on Ideas correlated negatively with the Data-Ideas dimension score calculated from career expectation, $r(98)=-.21$, $p=.04$, which is the direction we would expect – as lower scores on the dimension measure indicate preference for working with Ideas. The People and Things scores, however, were much more strongly, and more significantly, correlated with the People-Things dimension across all comparisons at both time-points, also in the expected direction (higher scores on the People-Things dimensions indicate a preference for working with Things). For example, at Wave 1, vocational interest in Things positively correlated with the Things-People dimension score for both career aspiration (*r*=.46) and expectation (*r*=.56), and vocational interest in People negatively correlated with the Things-People dimension score for both career aspiration (*r*=-.40) and expectation (*r*=-.39). These results suggest that, although a broad measure, the 4-item vocational interest measure does give a reasonably accurate reflection of interest in at least People and Things. While a measure with more items would be likely provide a more accurate and detailed representation of each individuals' vocational interests, it is important to note that the People, Things, Data, Ideas broad areas of vocational interests underly Holland's (1997) RIASEC model, which is one of the most popular and widely supported vocational interests model (Chernyshenko et al., 2019; Tracey & Rounds, 1993). Future research that is less time-restricted would benefit from using longer vocational interest measures to explore the associations assessed in our research in more detail, as our research largely only investigates vocational interest 'themes', the breadth of which may have a substantial effect on our findings.

Ultimately, despite the limitations of our research, this thesis has explored the associations of a number of variables previously untested in relation to career aspiration development. Assessing the role of ToM, which is known to continue developing in adolescence and be associated with self-concept development, on vocational interest and career aspiration stability is novel. Although our sample sizes limited our findings, and our results should be considered cautiously, the findings presented suggest further larger-scale, longitudinal research on vocational interest and career aspiration development in relation to cognitive abilities also developing during adolescence is warranted.

8 Conclusion

Understanding how vocational interests are formed and change is essential to providing individualised careers guidance that is implemented at the most useful time for each student. Despite decades of research on vocational interests, there is very limited research looking at individual differences in vocational interest *change* over time. Wille and De Fruyt (2019) argued that research on individual-level change is essential to consider when "talking about the interest development of individuals and how this may relate to individual career decisions" (p.254). Until we develop an understanding of the reasons why adolescents vary in their career aspiration formation, how can we help either promote this development, or guide their decision making?

This thesis set out to gain a deeper understanding of how vocational interests are shaped by individual differences in factors such as ToM ability, birth order and SES. While our sample size limited our results, our research tentatively suggests ToM development during adolescence may be associated with vocational identity development. Furthermore, we found evidence to support recent large-scale reports of aspirations in the UK, suggesting adolescent career aspirations are influenced by their SES-background, ability and gender.

UK governmental policy shows a clear awareness of the importance of providing tailored careers advice that takes into account the background and barriers each student faces. However, there is a distinct lack of acknowledgement of individual differences in vocational interest change. Currently, the timing of careers guidance is dictated by 'crucial points of decision-making', such as when students are choosing GCSE options, and considering post-18 pathways. However, our findings that suggest ToM ability may influence vocational interest change during mid- and late-adolescence is not only a novel and important theoretical development in the vocational psychology field, but also suggest the development of cognitive abilities during adolescence may be useful tools to understand when careers guidance would be most usefully received.

The purpose of this study was to understand possible ways in which careers guidance could be individualised and, alongside the development of other cognitive abilities, when it is best to implement careers advice. Our findings do not necessarily counter UK governmental career policy, but instead highlight particular areas where emphasis should be placed, namely individualisation of personal guidance. It is important to acknowledge that our research had limitations and more longitudinal research on a larger scale is key to developing our understanding further, but this thesis has hopefully made an important contribution to understanding some of the factors influencing vocational interest development in adolescence.

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10 List of Abbreviations and Definitions

C&C…(Gottfredson's Theory of) Circumscription and Compromise

FSIQ…Full Scale Intelligence Quotient

GPA…grade point average

IQ…intelligence quotient

OSF…Open Science Framework

RIASEC…Realistic, Investigative, Artistic, Social, Enterprising, Conventional (Holland's (1997) vocational interest types

SES…socioeconomic status

ToM… Theory of Mind

VI…vocational interest

WASI…Weschler Abbreviated Scale of Intelligence

11 Appendices

11.1 Information sheets

11.1a Parent/Carer Information Sheet

Dear Parent/Carer,

My name is Rosie Bawn and I am a PhD student in Psychology in Education at the University of York. I would like to invite your son/daughter to take part in a study designed to assess the age at which careers advice would most useful to secondary school pupils.

Below are the answers to some questions you may have about the study.

What is the study about?

The study will explore two factors that may affect how students choose the career paths they do: their Theory of Mind and their birth order, or position in the family. Theory of Mind is the ability to 'put yourself in another person's shoes' or to understand what others are thinking. While most people have a basic level of Theory of Mind by the age of five, there is evidence that this development continues throughout adolescence and this is something our research will explore. We are also interested in whether birth order influences Theory of Mind development and/or vocational interests in adolescents. Overall, measuring the relationship between these factors could enable the development of a more personalised careers guidance tool for young people at school.

How are you collecting the information?

I will assess your child's Theory of Mind using a short, cartoon-based, computer task. I will also ask them to complete a test of verbal and non-verbal intelligence, and to fill out a short questionnaire about their vocational interests and the number of siblings they have. It will take approximately 30 minutes of your child's time to participate in this research, and I will work with the school to find the most appropriate in-school time to conduct the tasks. I will return approximately one year later, when your child is in Year 11, to repeat the tasks in order to explore pupils' development over the course of one year.

What will you do with the information?

Once I have collected the data it will be stored securely at the university and only myself and my research supervisor, Dr Kathryn Asbury, will have access to it before it has been anonymised. All of the information provided will be made anonymous within one month of collecting it, and will be kept confidential. Once I have gathered data from your child for a second time in 2018 I will enter it and anonymise it within one month of collecting it. I will need to keep a key of their names and anonymised codes in order to connect the data we collect from them in Year 10 and again in Year 11. This key will be securely stored at the university and only myself and Dr Asbury will have access to it, and it will be destroyed within one month of the second data collection. I will use the data to write up the study for my PhD qualification and it may also be published in an academic journal. Data will be kept until one year after my PhD submission date, that is, until December 2020. There will not be any identifiable information published or presented at any time.

Does my child have to take part?

No. Participation in this study is not compulsory, and your child can withdraw from taking part at any point during the study without giving a reason. They can also withdraw any information we have already collected from them at any point up to one month after data collection has been completed, either by contacting me by email, or by telling a member of school staff who will pass the message on to me. Withdrawal will not be possible after this point as the data will have been anonymised and it will no longer be possible to identify which responses were provided by your son or daughter.

If you have any further questions or concerns, please email either myself or the University of York Education Ethics Committee (see details below). If you are willing for your child to take part in the study, please complete the attached consent form and submit it at your earliest convenience.

Yours faithfully,

Rosie Bawn
Email: rkjb500@york.ac.uk
University of York Education Ethics Committee email: education-research-administrator@york.ac.uk

11.1b Year 10 Student Information Sheet

Dear Student,

My name is Rosie Bawn and I am a PhD student in Psychology in Education at the University of York. I would like to invite you to take part in a study designed to assess the age at which careers advice would most useful to secondary school pupils. Below are the answers to some questions you may have about the study.

What is the study about?

The study will explore two factors that may affect how students choose the career paths they do: their Theory of Mind and their birth order, or position in the family. Theory of Mind is the ability to ‘put yourself in another person’s shoes’ or to understand what others are thinking. While most people have a basic level of Theory of Mind by the age of five, there is evidence that this development continues throughout adolescence and this is something our research will explore. We are also interested in whether birth order influences Theory of Mind development and/or vocational interests in adolescents. Overall, measuring the relationship between these factors could enable the development of a more personalised careers guidance tool for young people at school.

How are you collecting the information?

I will assess Theory of Mind using a short, cartoon-based, computer task. I will also ask you to complete a test of verbal and non-verbal intelligence, and to fill out a short questionnaire about your vocational interests and the number of siblings you have. It will take approximately 30 minutes of your time to participate in this research. I will return next year, when you are in Year 11, to repeat the tasks in order to explore how pupils develop over the course of one year.

What will you do with the information?

Once I have collected the data it will be stored securely at the university and only myself and my research supervisor, Dr Kathryn Asbury, will have access to it before it has been anonymised. All of the information provided will be made anonymous within one month of collecting it, and will be kept confidential. Once I have gathered data from you for a second time in 2018 I will enter it and anonymise it within one month of collecting it. I will need to keep a key of your names and anonymised codes in order to connect the data we collect from you in Year 10 and again in Year 11. This key will be securely stored at the university and only myself and Dr Asbury will have access to it, and it will be destroyed within one month of the second data collection. I will use the data to write up the study for my PhD qualification and it may also be published in an academic journal. Data will be kept until one year after my PhD submission date, that is, until December 2020. There will not be any identifiable information published or presented at any time.

Do I have to take part?

No! Participation in this study is not compulsory, and you can withdraw from taking part at any point during the study without giving a reason. You can also withdraw any information we have already collected from you at any point up to one month after data collection has been completed by contacting me by email. Withdrawal will not be possible after this point as the data will have been anonymised.

We believe there are no risks associated with participation in this study. However, if you believe that participating has been harmful to you in any way then please do not hesitate to contact us using the details below. If you have any further questions or concerns, please email either myself or the

University of York Education Ethics Committee (see details below). If you are willing to take part in the study, please complete the attached consent form.

Yours faithfully,

Rosie Bawn

Email: rkjb500@york.ac.uk

University of York Education Ethics Committee email: education-research-administrator@york.ac.uk

11.1c University student information sheet

Dear Participant,

My name is Rosie Bawn and I am a PhD student in Psychology in Education at the University of York. I would like to invite you to take part in a study designed to assess the age at which careers advice is most useful to adolescents (I am also gathering data in schools) and young adults. Below are the answers to some questions you may have about the study.

What is the study about?
The study will explore two factors that may affect how students choose the career paths they do: their Theory of Mind and their birth order, or position in the family. Theory of Mind is the ability to 'put yourself in another person's shoes' or to understand what others are thinking. While most people have a basic level of Theory of Mind by the age of five, there is evidence that this development continues throughout adolescence and into early adulthood and this is something our research will explore. We are also interested in whether birth order influences Theory of Mind development and/or vocational interests in adolescents and young adults. Overall, measuring the relationship between these factors could enable the development of a more personalised careers guidance tool for young people at school and university. We are looking to compare Year 10 students with final year undergraduates, in order to note how Theory of Mind develops through adolescence and into adulthood, as well as to whether birth order influences Theory of Mind development and/or vocational interests at an older age.

How are you collecting the information?
I will assess your Theory of Mind using a short, cartoon-based, computer task. I will also ask you to complete a test of verbal and non-verbal intelligence, and to fill out a short questionnaire about your vocational interests and the number of siblings you have. It will take approximately 30 minutes of your time to participate in this research, and once you have agreed to take part, I will create a timetable with a specific appointment for you to carry out the tasks at the university at a time that is convenient to you. One year after the data has been collected I will, with your consent, email you a short questionnaire to complete and return online, which will again be looking at your vocational interests, as well as your current occupation.

What will you do with the information?
Once I have collected the data it will be stored securely at the university and only myself and my research supervisor, Dr Kathryn Asbury, will have access to it before it has been anonymised. All of the information provided will be made anonymous within one month of collecting it, and kept confidential. I will need to keep a key of your names and anonymised codes in order to connect the data we collect from you in your final year and the data collected a year later, should you choose to complete the follow-up email questionnaire. This key will be securely stored at the university and only myself and Dr Asbury will have access to it, and it will be destroyed within one month of the second data collection. Once the second data collection in 2019 has been inputted, I will again anonymise the data within one month of collecting it. I will use the data to write up the study for my PhD qualification and it may also be published in an academic journal. Data will be kept until one year after my PhD submission date, that is, until December 2020. There will not be any identifiable information published or presented at any time.

Do I have to take part?
No. Participation in this study is not compulsory, and you can withdraw from taking part at any point during the study without giving a reason. You can also withdraw any information you have already collected from them at any point up to one month after data collection has been completed by contacting me by email. Withdrawal will not be possible after this point as the data will have been anonymised. In thanks for your time your name will be entered into a prize

draw in which the winner will receive a £50 shopping gift-card and five runners up will each receive a £10 shopping gift-card. If you do not wish your details to be entered into this prize draw please let me know during data collection. The draw will take place once all data has been collected, and no later than the end of January 2019.
If you have any further questions or concerns, please email either myself or the University of York Education Ethics Committee (see details below). If you are willing to take part in the study, please complete the attached consent form.

Yours faithfully,
Rosie Bawn
Email: rkjb500@york.ac.uk
University of York Education Ethics Committee email: education-research-administrator@york.ac.uk

11.2 Consent forms

11.2a Parent/Carer consent form

Dear Parent/Carer,

Please tick the boxes below that you agree with:

I agree that I have been fully informed of the purpose of the research being conducted.	
I agree that I have been fully informed of how my child will be involved in the research study.	
I understand that my child taking part in the research is entirely voluntary.	
I know that my child's data will be made anonymous, will be stored on a password-protected computer, and all information will be treated as confidential.	
I understand that I can withdraw my child from the research at any point.	
I understand that I can withdraw the data my child has provided at any point during the study and up to one month after data collection.	
I have been informed of how I can withdraw my child or their data from the study.	
I agree that as long as my child's data is non-identifiable, it can be used in publications, reports and presentations.	
I agree to the University of York collecting and analysing the information my child provides.	
I understand that any information my child provides will be treated confidentially, unless it leads the researchers to believe that their safety is in danger. In this case there is a moral or legal duty for the researchers to pass it on to the school due to their concerns for my child's welfare.	
FOR MAIN STUDY PARTICIPANTS (i.e. not pilot study participants) I agree to my child participating in the study again in one year's time.	
I agree to my child taking part in this project.	

If you are willing, please fill in the following information. This information will also be anonymised and made confidential, and used in the research. If you would not like this information to be used in the study, please do not fill in answers to the following questions.

What is your current occupation?

____

What is your highest educational qualification e.g. GCSE, BTEC, NVQ, A Level, Undergraduate degree, Post-graduate degree?

____

Name of child:

____

Name of parent/carer: ____________________________________ Date: __________

11.2b Y10 student consent form

Dear Student,

Please tick the boxes below that you agree with:

I agree that I have been fully informed of the purpose of the research being conducted.	
I agree that I have been fully informed of how I will be involved in the research study.	
I understand that taking part in the research is entirely voluntary.	
I know that my data will be made anonymous, will be stored on a password-protected computer, and all information will be treated as confidential.	
I understand that I can withdraw from the research at any point.	
I understand that I can withdraw the data I have provided at any point during the study and up to one month after data collection.	
I have been informed of how I can withdraw myself or my data from the study.	
I agree that as long as my data is non-identifiable, it can be used in publications, reports and presentations.	
I agree to the University of York collecting and analysing the information I provide.	
I understand that any information I provide will be treated confidentially, unless it leads the researchers to believe that my safety is in danger. In this case there is a moral or legal duty for the researchers to pass it on to the school due to their concerns for my welfare.	
FOR MAIN STUDY PARTICIPANTS (i.e. not pilot study participants) I agree to participating in the study again in one year's time.	
I agree to taking part in this project.	

My name: ____

My signature: ____ Date: ___________

11.2c University student consent form

Dear Participant,

Please tick the boxes below that you agree with:

I agree that I have been fully informed of the purpose of the research being conducted.	
I agree that I have been fully informed of how I will be involved in the research study.	
I understand that taking part in the research is entirely voluntary.	
I know that my data will be made anonymous, will be stored on a password-protected computer, and all information will be treated as confidential.	
I understand that I can withdraw from the research at any point.	
I understand that I can withdraw the data I have provided at any point during the study and up to one month after data collection.	
I have been informed of how I can withdraw myself or my data from the study.	
I agree that as long as my data is non-identifiable, it can be used in publications, reports and presentations.	
I agree to the University of York collecting and analysing the information I provide.	
I understand that any information I provide will be treated confidentially, unless it leads the researchers to believe that my safety is in danger. In this case there is a moral or legal duty for the researchers to pass it on to the university due to their concerns for my welfare.	
FOR MAIN STUDY PARTICIPANTS (i.e. not pilot study participants) I agree to participating in the study again in one year's time.	
I agree to taking part in this project.	

If you have agreed to taking part in the study in one year's time, please provide an email address that will still be valid that we can contact you on after you have left university.

Email address: ……………………………………………………………..……………………………………

If you are willing, please fill in the following information. This information will also be anonymised and made confidential, and used in the research. If you would not like this information to be used in the study, please do not fill in answers to the following questions.

What is your mother's current occupation?

……

What is your mother's highest level of qualification?

☐ No educational qualifications
☐ 1 to 4 O levels/CSE's/GCSE's/Standards (any grades)
☐ 5+ O levels/5+ CSE's (grade 1), 5+ GCSE's (grades A to C)
☐ 1 A level or AS Level
☐ 2 or more A levels, 4+ AS levels, or any Higher School Certificates
☐ First Degree (e.g. BA, BSc)
☐ Higher Degree (e.g. MA, PhD, PGCE, post-graduate certificates/diplomas)
☐ Other qualifications (e.g City and Guilds, RSA, BTEC, HNC, HND, Professional qualification)

If 'Other qualifications', please specify: ....

What is your father's current occupation?

....………………………………………………...

What is your father's highest level of qualification?
☐ No educational qualifications
☐ 1 to 4 O levels/CSE's/GCSE's/Standards (any grades)
☐ 5+ O levels/5+ CSE's (grade 1), 5+ GCSE's (grades A to C)
☐ 1 A level or AS Level
☐ 2 or more A levels, 4+ AS levels, or any Higher School Certificates
☐ First Degree (e.g. BA, BSc)
☐ Higher Degree (e.g. MA, PhD, PGCE, post-graduate certificates/diplomas)
☐ Other qualifications (e.g City and Guilds, RSA, BTEC, HNC, HND, Professional qualification)

If 'Other qualifications', please specify: ....

My name: …………...

My signature: .... Date: ....

11.3 Questionnaires

11.3a Y10 questionnaire

1. What is your gender?
   - Male ☐
   - Female ☐
   - Prefer not to say ☐

2. What is your date of birth?

   ____

3. Please state the birth dates and genders of any siblings that currently live or have previously lived with you at home.

Sibling	Gender	Birth date	If this sibling is not your biological brother or sister please can you describe the relationship (e.g. adopted sibling, step sibling, half sibling, foster sibling).
1			
2			
3			
4			
5			
6			
7			
8			

4. Please tick all of the subjects you are currently studying at GCSE level:

GCSE Subject			
Art (Fine Art)	☐	Health and Social Care	☐
Art (Photography)	☐	History	☐
Child Development	☐	ICT (BTEC)	☐
Computing	☐	Music	☐
Design and Technology	☐	PE	☐

Drama	☐	Sports (BTEC)	☐
Food Technology	☐	Spanish	☐
French	☐	Triple Science	☐
Geography	☐		

5. What are your current plans for when you have finished your GCSEs?

		Please specify the subject(s) you plan to study, or area(s) you intend to work in during the next two years
A Levels	☐	
Vocational courses	☐	
An apprenticeship	☐	
I have not decided yet	☐	

6. In an ideal world, what job or career would you most like to do?

____

7. What do you think you will most likely do for a job or career?

____

8. We are interested in how confident you feel about your future. Please indicate how true each of these statements are for you?

	Not at all true 1	2	Somewhat true 3	4	Very true 5
I am confident I can live up to what my parents expect of me					
I am confident I can live up to what my teachers expect of me					
I am confident I can live up to what I expect of myself					

I have a clear plan for what I hope to do next					

9. To what extent does your desired field of work or study focus on each of the following areas? Please give the highest score to only one area (Scale: 1 = not at all, 2 = a little, 3 = moderately, 4 = very much)

	1	2	3	4
Data and facts (organizing and handling registers, files, numbers etc.)				
Thoughts and ideas (inventing, insight, interpretation, abstract ideas, science, art)				
People (meeting people, for example through helping, educating, informing, service, entertainment, sales or motivating)				
Things (machines, materials or tools as the focus of the job, not only as instruments)				

10. How confident are you in your abilities in each of the following areas? Please give the highest score to only one area (Scale: 1 = not at all confident, 2 = a little confident, 3 = moderately confident, 4 = very much confident)

	1	2	3	4
Data and facts (organizing and handling registers, files, numbers etc.)				
Thoughts and ideas (inventing, insight, interpretation, abstract ideas, science, art)				
People (meeting people, for example through helping, educating, informing, service, entertainment, sales or motivating)				
Things (machines, materials or tools as the focus of the job, not only as instruments)				

11.3b Undergraduate questionnaire

1. What is your gender?
   - Male ☐
   - Female ☐
   - Prefer not to say ☐

2. What is your date of birth?

   ____

3. Please state the birth dates and genders of any siblings that currently live or have previously lived with you at home.

Sibling	Gender	Birth date	If this sibling is not your biological brother or sister please can you describe the relationship (e.g. adopted sibling, step sibling, half sibling, foster sibling).
1			
2			
3			
4			
5			
6			
7			
8			

4. What is the name of your degree programme?

   ____

5. In an ideal world, what job or career would you most like to do?

   ____

6. What do you think you will most likely do for a job or career?

   ____

7. We are interested in how confident you feel about your future. Please indicate how true each of these statements are for you?

	Not at all true		Somewhat true		Very true
I am confident I can live up to what my parents expect of me					
I am confident I can live up to what my teachers expect of me					
I am confident I can live up to what I expect of myself					
I have a clear plan for what I hope to do next					

8. To what extent does your desired field of work or study focus on each of the following areas? Please give the highest score to only one area (Scale: 1 = not at all, 2 = a little, 3 = moderately, 4 = very much)

	1	2	3	4
Data and facts (organizing and handling registers, files, numbers etc.)				
Thoughts and ideas (inventing, insight, interpretation, abstract ideas, science, art)				
People (meeting people, for example through helping, educating, informing, service, entertainment, sales or motivating)				
Things (machines, materials or tools as the focus of the job, not only as instruments)				

9. How confident are you in your abilities in each of the following areas? Please give the highest score to only one area (Scale: 1 = not at all confident, 2 = a little confident, 3 = moderately confident, 4 = very much confident)

	1	2	3	4
Data and facts (organizing and handling registers, files, numbers etc.)				
Thoughts and ideas (inventing, insight, interpretation, abstract ideas, science, art)				
People (meeting people, for example through helping, educating, informing, service, entertainment, sales or motivating)				
Things (machines, materials or tools as the focus of the job, not only as instruments)				

11.4 CHAPTER FOUR OUTLIER TABLES AND INFORMATION

Table 11.4.1 Means, standard deviations and t-test results by group: Year 10 (mid-adolescence) and final-year university student (late-adolescence)

	Year 10		Final-year university students		*t*-value	df	*p*	Hedge's *g*
	M (n)	SD	M (n)	SD				
Affective ToM RT	.30 (87)	1.07	-.33 (68)	.71	4.38	149.38	.000**	.68
Cognitive ToM RT	.33 (87)	1.03	-.50 (68)	.69	6.00	149.69	.000**	.93
Phys Caus (control) RT	.22 (87)	1.03	-.42 (68)	.65	4.72	146.92	.000**	.72
Affective ToM % ER	.04 (87)	.93	-.25 (68)	.61	2.39	149.26	.018*	.36
Cognitive ToM % ER	-.07 (87)	.78	-.20 (68)	.57	1.20	152.31	.232	.19
Phys Caus (control) % ER	-.17 (87)	.78	-.08 (68)	.86	-.702	153.00	.484	.11

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.4.2a Pearson's correlations between ToM and Vocational Interests (Year 10: mid-adolescent group) Outliers excluded (N=87 in all cases except VI Things and VI Ideas where N=86)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.79**	-								
3 Phys Caus (RT)	.74**	.69**	-							
4 Cognitive (% ER)	.14	.18	.15	-						
5 Affective (% ER)	.21*	.38**	.27	.33**	-					
6 Phys Caus (% ER)	-.14	-.00	-.06	.16	.33**	-				
7 VI Data	-.20	-.09	-.15	-.07	.03	-.02	-			
8 VI Things	-.33**	-.37**	-.37**	-.08	-.05	.11	.16	-		
9 VI People	.26	.25	.34**	.03	.14	-.10	-.16	-.19	-	
10 VI Ideas	-.14	-.16	-.14	.09	.12	.23	.05	.05	.09	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.4.2b Pearson's correlations between ToM and Vocational Interests (Uni finalist: late adolescent group) Outliers Excluded (N=67)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.63**	-								
3 Phys Caus (RT)	.64**	.52**	-							
4 Cognitive (% ER)	.07	.02	.03	-						
5 Affective (% ER)	.18	.24	.17	.11	-					
6 Phys Caus (% ER)	.36**	.15	.27	-.19	.36**	-				
7 VI Data	-.02	-.10	.02	-.03	-.07	.03	-			
8 VI Things	.04	.03	-.00	.10	.05	.02	.28	-		
9 VI People	-.01	.14	.11	.09	.02	-.10	-.17	-.08	-	
10 VI Ideas	.01	.25	.08	.11	-.01	.11	-.09	-.05	.17	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.4.3a Spearman's correlations between ToM and Vocational Interests (Year 10: mid-adolescent group) Outliers excluded (N=87 in all cases except VI Things and VI Ideas where N=86)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.77**	-								
3 Phys Caus (RT)	.71**	.68**	-							
4 Cognitive (% ER)	.07	.10	.09	-						
5 Affective (% ER)	.20	.37**	.25	.25	-					
6 Phys Caus (% ER)	-.08	.04	.02	.19	.26	-				
7 VI Data	-.20	-.12	-.11	-.08	-.01	.05	-			
8 VI Things	-.32**	-.34**	-.37**	-.15	-.10	.10	.19	-		
9 VI People	.22	.22	.32**	-.06	.18	-.08	-.16	-.16	-	
10 VI Ideas	-.18	-.19	-.16	.08	.13	.24	.02	.08	.09	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.4.3b Spearman's correlations between ToM and Vocational Interests (Uni finalist: late adolescent group) Outliers Excluded (N=67)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.57**	-								
3 Phys Caus (RT)	.66**	.49**	-							
4 Cognitive (% ER)	.01	.01	.04	-						
5 Affective (% ER)	.16	.13	.14	.12	-					
6 Phys Caus (% ER)	.29	-.00	.20	-.09	.31	-				
7 VI Data	-.13	-.16	-.01	.01	-.17	.02	-			
8 VI Things	-.03	-.06	.02	.09	-.07	-.08	.25	-		
9 VI People	-.01	.18	.09	.10	.09	.06	-.16	-.03	-	
10 VI Ideas	.01	.23	.03	.12	.04	.08	-.08	-.10	.18	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.4.4 Means, standard deviations and ANOVA results by birth order position for Year 10 group (mid-adolescence) and final-year university student group (late-adolescence). (Outliers excluded)

Measures	Means and standard deviations										ANOVA-effects of birth order position	
	Year 10 (mid-adolescence) group											
	All		First-born		Middle-born		Last-born		Only-child		Birth order	
	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
1 Cog ToM RT (s)	-.04 (82)	1.01	-.04 (42)	1.02	.38 (14)	1.23	-.28 (26)	.82	-	-	.141	.048
2 Aff ToM RT (s)	-.06 (82)	1.01	-.02 (42)	1.02	.36 (14)	1.07	-.34 (26)	.91	-	-	.105	.055
3 Phys Caus RT (s)	-.09 (82)	.97	-.02 (42)	.96	.34 (14)	1.07	-.42 (26)	.85	-	-	.049	.073
4 Cog ToM % ER	-.14 (82)	.69	-.23 (42)	.69	.09 (14)	.88	-.12 (26)	.57	-	-	.324	.028
5 Aff ToM % ER	-.15 (82)	.74	-.22 (42)	.77	.12 (14)	.80	-.20 (26)	.63	-	-	.318	.029
6 Phys Caus % ER	-.14 (82)	.76	.01 (42)	.87	-.20 (14)	.77	-.36 (26)	.48	-	-	.145	.048
7 Voc Interest - a Data	2.45 (85)	.92	2.53 (43)	.88	2.37 (16)	1.03	2.35 (26)	.94	-	-	.674	.010
b Things	-.03 (84)	.99	-.23 (42)	.94	.18 (16)	1.00	.15 (26)	1.02	-	-	.202	.039
c People	.03 (85)	1.01	-.02 (43)	.95	.23 (16)	1.07	-.01 (26)	1.08	-	-	.698	.009
d Ideas	2.87 (85)	.91	2.86 (43)	.92	2.63 (16)	.81	3.04 (26)	.96	-	-	.362	.024
	Final-year university student (late-adolescence) group											
1 Cog ToM RT (s)	-.05 (68)	.91	-.13 (27)	.71	.08 (10)	1.41	.01 (23)	.86	.05 (8)	1.06	.935	.007
2 Aff ToM RT (s)	-.01 (68)	.98	.07 (27)	.96	.29 (10)	1.24	-.04 (23)	.79	-.54 (8)	1.13	.319	.053
3 Phys Caus RT (s)	-.09 (68)	.80	-.10 (27)	.79	-.13 (10)	.84	-.13 (23)	.77	.07 (8)	.98	.944	.006
4 Cog ToM % ER	-.15 (68)	.69	-.12 (27)	.66	-.05 (10)	.93	-.19 (23)	.70	-.25 (8)	.52	.918	.008
5 Aff ToM % ER	-.06 (68)	.90	.10 (27)	.94	.23 (10)	1.36	-.22 (23)	.68	-.55 (8)	.13	.003** w	.031 (ω^2)
6 Phys Caus % ER	-.08 (68)	.86	-.16 (27)	.89	.12 (10)	1.11	-.03 (23)	.79	-.19 (8)	.72	.808	.015
7 Voc Interest - a Data	2.92 (73)	.95	2.83 (30)	.83	2.58 (12)	1.24	3.17 (23)	.94	3.00 (8)	.93	.335	.048
b Things	.00 (73)	.99	.19 (30)	.99	-.11 (12)	1.29	-.03 (23)	.94	-.48 (8)	.51	.367	.044
c People	.05 (72)	.92	.27 (29)	.74	-.25 (12)	1.31	-.08 (23)	.75	.01 (8)	1.24	.338 w	.007 (ω^2)
d Ideas	3.25 (73)	.81	3.33 (30)	.76	3.58 (12)	.52	2.96 (23)	.93	3.25 (8)	.89	.148	.074

RT = reaction time; ER = error rate; M= mean; SD = standard deviation; n = sample size; *p*= p-value of the effects of birth order on variables; η^2 = eta-squared; w=homogeneity of variances violated, Welch test used instead

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

11.5 CHAPTER FIVE OUTLIER TABLES

Table 11.5.1 Means, standard deviations and paired-samples t-test results by group: Raw Year 10 and Year 11 – Outliers excluded

	Year 10		Year 11		*t*-value	df	*p* (two-tailed)	Cohen's *d*
	M (n)	SD	M (n)	SD				
Affective ToM RT	2.39 (68)	.51	2.18 (68)	.47	4.17	67.00	.000**	.43
Cognitive ToM RT	2.51 (68)	.52	2.26 (68)	.48	5.00	67.00	.000**	.50
Phys Caus (control) RT	2.43 (68)	.53	2.28 (68)	.49	2.47	67.00	.016*	.29
Affective ToM % ER	10.49 (68)	11.35	9.47 (68)	12.07	.59	67.00	.556	.09
Cognitive ToM % ER	3.33 (68)	5.77	4.71 (68)	7.63	-1.39	67.00	.170	.20
Phys Caus (control) % ER	7.71 (68)	10.13	5.07 (68)	8.30	1.91	67.00	.061	.29

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.5.2 Means, standard deviations and paired-samples t-test results by group: Corrected Year 10 and Year 11 – Outliers excluded

	Year 10		Year 11		*t*-value	df	*p* (two-tailed)	Cohen's *d*
	M (n)	SD	M (n)	SD				
Affective ToM RT	.16 (69)	.98	-.25 (69)	.91	4.29	68.00	.000**	.43
Cognitive ToM RT	.18 (69)	.97	-.30 (69)	.89	5.10	68.00	.000**	.52
Phys Caus (control) RT	.08 (69)	.99	-.21 (69)	.88	2.62	68.00	.011*	.31
Affective ToM % ER	-.10 (69)	.73	-.17 (69)	.75	.68	68.00	.497	.09
Cognitive ToM % ER	-.17 (69)	.64	-.09 (69)	.76	-.80	68.00	.430	.11
Phys Caus (control) % ER	.02 (69)	.95	-.20 (69)	.69	2.03	68.00	.046	.26

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 11.5.3 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY BIRTH ORDER POSITION FOR MID-ADOLESCENCE GROUP (IN YEAR 10 AND YEAR 11) – OUTLIERS EXCLUDED

Measures	Means and standard deviations including outliers								ANOVA-effects of birth order position	
	Year 10									
	All		First-born		Middle-born		Last-born		Birth order	
	M (n)	SD	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η_p^2
1 Cog ToM RT (s)	-.03 (66)	1.01	.05 (36)	1.10	.32 (11)	.93	-.39 (19)	.76	.138	.061
2 Aff ToM RT (s)	-.04 (66)	1.00	.03 (36)	1.04	.34 (11)	.89	-.41 (19)	.93	.113	.067
3 Phys Caus RT (s)	-.06 (66)	.98	.01 (36)	1.02	.35 (11)	.87	-.42 (19)	.87	.095	.072
4 Cog ToM % ER	-.13 (66)	.66	-.15 (36)	.72	.04 (11)	.72	-.20 (19)	.50	.633	.014
5 Aff ToM % ER	-.15 (66)	.84	-.16 (36)	.97	.04 (11)	.65	-.24 (19)	.66	.680	.012
6 Phys Caus % ER	-.15 (66)	.74	-.04 (36)	.83	-.15 (11)	.78	-.38 (19)	.46	.267	.041
7 Voc Interest (Y10) - a Data	2.46 (68)	.91	2.49 (37)	.90	2.25 (12)	1.06	2.53 (19)	.84	.684	.012
b Things	-.05 (67)	.99	-.24 (36)	.94	.19 (12)	1.10	.18 (19)	.97	.216	.047
c People	.01 (68)	1.01	.04(37)	.92	.17 (12)	1.12	-.15 (19)	1.14	.673	.012
d Ideas	2.79 (68)	.94	2.76 (37)	.93	2.67 (12)	.89	2.95 (19)	1.03	.362	.024
	Year 11									
1 Cog ToM RT (s)	-.00 (66)	1.00	.15 (36)	1.02	.44 (11)	.92	-.55 (19)	.80	.010	.136
2 Aff ToM RT (s)	.01 (66)	.96	.05 (36)	1.09	.20 (11)	.50	-.20 (19)	.90	.324 ^{w}	-.010 (ω^2)
3 Phys Caus RT (s)	-.04 (66)	.91	.03 (36)	.99	.25 (11)	.66	-.33 (19)	.84	.195	.051
4 Cog ToM % ER	-.09 (66)	.70	-.17 (36)	.72	.10 (11)	.90	-.03 (19)	.53	.480	.023
5 Aff ToM % ER	-.16 (66)	.70	-.19 (36)	.68	.05 (11)	.68	-.23 (19)	.76	.541	.019
6 Phys Caus % ER	-.11 (66)	.77	-.21 (36)	.84	.23 (11)	.82	-.10 (19)	.56	.265	.041
7 Voc Interest (Y11) - a Data	2.57 (68)	.95	2.53 (38)	1.03	2.42 (12)	.90	2.79 (19)	.79	.500	.021
b Things	.02 (67)	.99	.01 (38)	.99	-.27 (12)	1.08	.23 (19)	.95	.388	.028
c People	-.00 (68)	1.00	.12 (38)	.93	-.15 (12)	1.02	-.22 (19)	1.13	.440	.025
d Ideas	3.03 (68)	.81	3.05 (38)	.77	2.83 (12)	1.03	3.16 (19)	.76	.560	.017

Note. ** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR; w=homogeneity of variances violated, Welch test used instead.

Sample size n=66 for ToM data as one student gave no birthdates for siblings at either time point so was not included in the analysis. Y10 vocational interest sample sizes also vary due to missing questionnaire data.

TABLE 11.5.4 MEANS, STANDARD DEVIATIONS AND REPEATED-MEASURES ANOVA RESULTS BY BIRTH ORDER POSITION FOR MID-ADOLESCENCE GROUP (IN YEAR 10 AND YEAR 11) (OUTLIERS EXCLUDED)

Measures	Means and standard deviations including outliers and results of repeated-measures ANOVAs **Year 10**																	
	All (N=66)				First-born (n=36)				Middle-born (n=11)				Last-born (n=19)				2-WayMixed ANOVA-effects	
	Year 10	Year 11			Year 10	Year 11			Year 10	Year 11			Year 10	Year 11				
	M (SD)	M (SD)	*p*	η_p^2	M (SD)	M (SD)	*p*	η_p^2	M (SD)	M (SD)	*p*	η_p^2	M (SD)	M (SD)	*p*	η_p^2	*p*	η_p^2
1 Cog ToM RT	-.03 (1.01)	-.00 (1.00)	.779	.001	.05 (1.10)	.15 (1.02)	.448	.017	.32 (.93)	.44 (.92)	.725	.013	-.39 (.76)	-.55 (.80)	.293	.061	.482	.023
2 Aff ToM RT	-.04 (1.00)	.01 (.96)	.614	.004	.03 (1.04)	.05 (1.09)	.851	.001	.34 (.89)	.20 (.50)	.651	.021	-.41 (.93)	-.20 (.90)	.267	.068	.473	.023
3 Phys Caus RT	-.06 (.98)	-.04 (.91)	.851	.001	.01 (1.02)	.03 (.99)	.855	.001	.35 (.87)	.25 (.66)	.800	.007	-.42 (.87)	-.33 (.84)	.676	.010	.863	.005
4 Cog ToM % ER	-.13 (.66)	-.09 (.70)	.620	.004	-.15 (.72)	-.17 (.72)	.819	.002	.04 (.72)	.10 (.90)	.799	.007	-.20 (.50)	-.03 (.53)	.355	.048	.651	.014
5 Aff ToM % ER	-.15 (.84)	-.16 (.70)	.915	.000	-.16 (.97)	-.19 (.68)	.880	.001	.04 (.65)	.05 (.68)	.973	.000	-.24 (.66)	-.23 (.76)	.996	.000	.992	.000
6 Phys Caus % ER	-.15 (.74)	-.11 (.77)	.648	.003	-.04 (.83)	-.21 (.84)	.211	.044	-.15 (.78)	.23 (.82)	.157	.190	-.38 (.46)	-.10 (.56)	.109	.136	.050	.091
7 Voc Interest (Y10) - a Data	2.46 (.91)	2.57 (.95)	.336	.014	2.49 (.90)	2.51 (1.04)	.868	.001	2.25 (1.06)	2.42 (.90)	.551	.033	2.53 (.84)	2.79 (.79)	.310	.057	.699	.011
b Things	-.05 (.99)	.02 (.99)	.649	.003	-.24 (.94)	.01 (.98)	.106	.073	.19 (1.10)	-.27 (1.08)	.350	.080	.18 (.97)	.23 (.95)	.876	.001	.230	.045
c People	.01 (1.01)	-.00 (1.00)	.910	.000	.04 (.92)	.15 (.92)	.595	.008	.17 (1.12)	-.15 (1.02)	.415	.061	-.15 (1.14)	-.22 (1.13)	.747	.006	.534	.019
d Ideas	2.79 (.94)	3.03 (.81)	.031	.067	2.76 (.93)	3.03 (.76)	.096	.075	2.67 (.89)	2.83 (1.03)	.551	.033	2.95 (1.03)	3.16 (.76)	.215	.084	.932	.002

Note. ** = statistically significant at *p*<.01, * = statistically significant at *p*<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Sample size n=66 for ToM data as one student gave no birthdates for siblings at either time point so was not included in the analysis. Due to missing questionnaire data in Y10, vocational interest sample sizes vary: (N=68 for Data, N=67 for Things, N=68 for People and N=68 for Ideas). As these participants with missing data were first-born children, the vocational interest sample sizes vary in this group (n=37 for Data, n=36 for Things, n=37 for People and n=37 for Ideas).

Pearson's correlation tables – outliers excluded

Table 11.5.5 Pearson's correlations between Year 10 ToM and Year 10 Vocational Interests (outliers excluded)
(N=68 in all conditions except for VI Things with N=67)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.827**	-								
3 Phys Caus (RT)	.763**	.737**	-							
4 Cognitive (% ER)	.013	.162	.073	-						
5 Affective (% ER)	.245	.348**	.290	.316**	-					
6 Phys Caus (% ER)	-.203	-.120	-.085	.242	.331**	-				
7 VI Data	-.134	-.086	-.170	-.041	-.017	.001	-			
8 VI Things	-.328**	-.333**	-.371**	-.086	-.078	.192	.134	-		
9 VI People	.300*	.321**	.419**	-.052	.145	-.082	-.079	-.218	-	
10 VI Ideas	-.128	-.201	-.109	.104	.165	.244	.022	.017	.191	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.5.6 Pearson's correlations between Year 11 ToM and Year 11 Vocational Interests (outliers excluded) *(N=68)*

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.702**	-								
3 Phys Caus (RT)	.800**	.699**	-							
4 Cognitive (% ER)	.021	-.049	.128	-						
5 Affective (% ER)	.090	.079	.047	.225	-					
6 Phys Caus (% ER)	.014	-.040	.089	.360**	.264	-				
7 VI Data	.062	.001	.021	.205	.118	.071	-			
8 VI Things	-.313	-.132	-.336**	.122	.128	.116	.183	-		
9 VI People	.240	.062	.190	-.038	-.140	-.133	-.014	.006	-	
10 VI Ideas	-.188	-.061	-.200	.098	.205	.139	.096	.183	.055	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Spearman's correlation tables – outliers included

TABLE 11.5.7 SPEARMAN'S CORRELATIONS BETWEEN YEAR 10 TOM AND YEAR 10 VOCATIONAL INTERESTS

(N=72 in all ToM conditions except affective RT (N=71). N=71 in all VIs except VI Things (N=70)).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.798**	-								
3 Phys Caus (RT)	.736**	.716**	-							
4 Cognitive (% ER)	.033	.058	.092	-						
5 Affective (% ER)	.313**	.380**	.405**	.344**	-					
6 Phys Caus (% ER)	-.058	-.037	.072	.265	.257	-				
7 VI Data	-.142	-.118	-.127	-.055	.012	.086	-			
8 VI Things	-.307**	-.311**	-.343**	-.074	-.099	.176	.193	-		
9 VI People	.241	.270	.374**	-.141	.130	-.141	-.094	-.197	-	
10 VI Ideas	-.157	-.244	-.076	.106	.203	.263	.042	.051	.166	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 11.5.8 SPEARMAN'S CORRELATIONS BETWEEN YEAR 11 TOM AND YEAR 11 VOCATIONAL INTERESTS

(N=72 in all conditions except affective RT (N=71)).

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.682**	-								
3 Phys Caus (RT)	.765**	.702**	-							
4 Cognitive (% ER)	-.080	-.088	.112	-						
5 Affective (% ER)	.114	.073	.073	.300	-					
6 Phys Caus (% ER)	.048	.007	.174	.491**	.399**	-				
7 VI Data	.035	-.054	.039	.243	.193	.202	-			
8 VI Things	-.342**	-.128	-.353**	.056	.170	.082	.155	-		
9 VI People	.150	.003	.138	-.100	-.167	-.162	-.021	.005	-	
10 VI Ideas	-.218	-.089	-.224	.028	.218	.129	.035	.236	.112	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 11.5.9 SPEARMAN'S CORRELATIONS BETWEEN YEAR 10 TOM AND YEAR 11 VOCATIONAL INTERESTS

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.798**	-								
3 Phys Caus (RT)	.736**	.716**	-							
4 Cognitive (% ER)	.033	.058	.092	-						
5 Affective (% ER)	.313**	.380**	.405**	.344**	-					
6 Phys Caus (% ER)	-.058	-.037	.072	.265	.257	-				
7 VI Data	-.134	-.092	-.112	.144	.073	.120	-			
8 VI Things	-.197	-.285	-.284	.038	.016	.160	.155	-		
9 VI People	.078	.182	.127	-.193	.028	.015	-.021	.005	-	
10 VI Ideas	-.091	.022	-.022	.023	.292	.140	.035	.236	.112	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Spearman's correlations – outliers excluded

Table 11.5.10 Spearman's correlations between Year 10 ToM and Year 10 Vocational Interests
(N=68 in all conditions except for VI Things with N=67)

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.803**	-								
3 Phys Caus (RT)	.740**	.709**	-							
4 Cognitive (% ER)	-.003	.036	.021	-						
5 Affective (% ER)	.289	.352**	.328**	.280	-					
6 Phys Caus (% ER)	-.144	-.109	-.053	.192	.139	-				
7 VI Data	-.132	-.110	-.152	-.088	-.032	.072	-			
8 VI Things	-.307	-.293	-.364**	-.111	-.134	.188	.157	-		
9 VI People	.293	.308	.458**	-.122	.212	-.086	-.087	-.211	-	
10 VI Ideas	-.155	-.255	-.116	.091	.176	.249	-.007	.034	.194	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

Table 11.5.11 Spearman's correlations between Year 11 ToM and Year 11 Vocational Interests *(N=68)*

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.671**	-								
3 Phys Caus (RT)	.767**	.689**	-							
4 Cognitive (% ER)	-.122	-.132	.040	-						
5 Affective (% ER)	.069	.022	.005	.289	-					
6 Phys Caus (% ER)	.003	-.050	.125	.514**	.329**	-				
7 VI Data	.007	-.089	-.013	.233	.142	.158	-			
8 VI Things	-.377**	-.158	-.377**	.079	.149	.045	.177	-		
9 VI People	.191	.056	.168	-.125	-.150	-.126	-.020	.069	-	
10 VI Ideas	-.195	-.047	-.179	.104	.260	.158	.072	.241	.100	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

TABLE 11.5.12 SPEARMAN'S CORRELATIONS BETWEEN YEAR 10 TOM AND YEAR 11 VOCATIONAL INTERESTS (OUTLIERS EXCLUDED) *(N=68)*

Measure	1	2	3	4	5	6	7	8	9	10
1 Cognitive (RT)	-									
2 Affective (RT)	.803**	-								
3 Phys Caus (RT)	.740**	.709**	-							
4 Cognitive (% ER)	-.003	.036	.021	-						
5 Affective (% ER)	.289	.352**	.328**	.280	-					
6 Phys Caus (% ER)	-.144	-.109	-.053	.192	.139	-				
7 VI Data	-.112	-.071	-.120	.122	.045	.125	-			
8 VI Things	-.257	-.328**	-.361**	-.016	-.040	.110	.177	-		
9 VI People	.125	.204	.155	-.157	.061	.057	-.020	.069	-	
10 VI Ideas	-.109	-.026	-.067	.025	.311	.123	.072	.241	.100	-

Note. ** = statistically significant at p<.01, * = statistically significant and p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR

11.6 CHAPTER SIX OUTLIER TABLES

Table 11.6.1 Stability of Expressed Career Aspirations Over a 1-Year Period (Outliers excluded)

	Zero-order correlation			Partial correlation		
Measure	*r*	*SE*	CI	*r*	*SE*	CI
Mid-adolescent						
Female						
Sex type	.50	.18	.08-.79	.53	.23	.04-.93
Prestige	.66	.13	.38-.86	.60	.21	.18-.95
Things/People	.71	.11	.44-.89	.68	.16	.29-.92
Data/Ideas	.55	.17	.17-.82	.52	.19	.14-.83
Male						
Sex type	.77	.09	.56-.92	.73	.17	.24-.93
Prestige	.31	.19	-.11-.67	.31	.27	-.27-.77
Things/People	.70	.13	.42-.90	.72	.13	.41-.92
Data/Ideas	.18	.19	-.18-.58	.49	.19	.12-.84
Late-adolescent						
Female						
Sex type	.76	.08	.59-.89	.76	.13	.46-.94
Prestige	.62	.13	.31-.83	.69	.14	.38-.93
Things/People	.72	.13	.41-.93	.73	.20	.17-.96
Data/Ideas	.58	.16	.18-.83	.59	.16	.24-.90
Male						
Sex type	-	-	-	-	-	-
Prestige	-	-	-	-	-	-
Things/People	-	-	-	-	-	-
Data/Ideas	-	-	-	-	-	-

Table 11.6.2 Changes in Expressed Career Aspirations Over a 1-Year Period (Outliers excluded)

	Zero-order correlation			Partial correlation		
Measure	*r*	*SE*	CI	*r*	*SE*	CI
Mid-adolescent						
Female						
Sex type	-.12	.25	-.60-.36	.02	.47[b]	-1.00-1.00[b]
Prestige	.50	.19	.11-.82	.51	.50[b]	-.96-1.00[b]
Things/People	.44	.21	-.07-.75	.57	.41[b]	-.86-1.00[b]
Data/Ideas	.36	.21	-.08-.71	.32	.48[a]	-.98-1.00[a]
Male						
Sex type	.58	.15	.25-.85	.59	.46[b]	-.91-1.00[b]
Prestige	-.04	.23	-.56-.40	-.27	.48[a]	-1.00-.88[a]
Things/People	.48	.20	.03-.81	.69	.40[b]	-.76-1.00[b]
Data/Ideas	-.01	.23	-.43-.48	.30	.42[a]	-.85-1.00[a]
Late-adolescent						
Female						
Sex type	.37	.16	.03-.63	-.03	.45[c]	-.76-.95[c]
Prestige	.12	.23	-.35-.58	.42	.46[c]	-.85-.99[c]
Things/People	.42	.28	-.35-.80	.42	.52[c]	-.91-.98[c]
Data/Ideas	.41	.25	-.16-.79	.40	.39[c]	-.70-.98[c]
Male						
Sex type	-	-	-	-	-	-
Prestige	-	-	-	-	-	-
Things/People	-	-	-	-	-	-
Data/Ideas	-	-	-	-	-	-

Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples; a: based on 988-992 samples, b: based on 991-996 samples, c: based on 992-997 samples.

Table 11.6.3 Correlations between SES, FSIQ, Self-efficacy and prestige of career expectations and aspirations (outliers excluded)

Measure	1	2	3	4	5	6	7
Whole sample							
1 Prestige (job expectation) (*n*=130)	-						
2 Prestige (job aspiration) (*n*=146)	.53**	-					
3 SES (occupation) (*n*=128)	-.09	-.10	-				
4 SES (education) (*n*=125)	.21	.15	-.47**	-			
5 FSIQ (controlled for SES occ) (*n*=104)	.24 [a]	.28** [a]	-.18	.26**	-		
6 FSIQ (controlled for SES edu) (*n*=102)	.14	.21	-.18	.26**	-	-	
7 Self-efficacy (*n*=158)	.11	-.04	.05	.02	-.09 [a]	-.09 [a]	-
Females							
1 Prestige (job expectation) (*n*=82)	-						
2 Prestige (job aspiration) (*n*=93)	.53**	-					
3 SES (occupation) (*n*=83)	-.12	-.15	-				
4 SES (education) (*n*=82)	.08	.13	-.54**	-			
5 FSIQ (controlled for SES occ) (*n*=68)	.08 [a]	.23 [a]	-.19	.24	-		
6 FSIQ (controlled for SES edu) (*n*=67)	.08 [a]	.21 [a]	-.19	.24	-	-	
7 Self-efficacy (*n*=99)	.05	-.08	.02	.10	-.13 [a]	-.19 [a]	-
Males							
1 Prestige (job expectation) (*n*=48)	-						
2 Prestige (job aspiration) (*n*=53)	.51**	-					
3 SES (occupation) (*n*=45)	-.01	-.01	-				
4 SES (education) (*n*=43)	.43**	.20	-.36	-			
5 FSIQ (controlled for SES occ) (*n*=36)	.54** [a]	.27 [a]	-.16	.31	-		
6 FSIQ (controlled for SES edu) (*n*=35)	.39 [a]	.13 [a]	-.16	.31z	-	-	
7 Self-efficacy (*n*=59)	.22	.05	.12	-.12	.01 [a]	.11 [a]	-

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR. a= result from partial correlation, controlling for SES (both occupation and education controlled for separately). Correlation between SES measure (3 and 4) and FSIQ (5 and 6) conducted without controlling for SES variables.

Table 11.6.4 Correlations between SES, FSIQ, Self-efficacy and prestige of career expectations and aspirations in mid-adolescent group (Y10 – Wave 1) (outliers excluded)

Measure	1	2	3	4	5	6	7
Whole group							
1 Prestige (job expectation) (*n*=69)	-						
2 Prestige (job aspiration) (*n*=79)	.78**	-					
3 SES (occupation) (*n*=59)	-.16	-.05	-				
4 SES (education) (*n*=57)	.41**	.26	-.41**	-			
5 FSIQ (controlled for SES occ) (*n*=44)	.43** [a]	.33 [a]	-.23	.34*	-		
6 FSIQ (controlled for SES edu) (*n*=42)	.28 [a]	.18 [a]	-.23	.34*	-	-	
7 Self-efficacy (*n*=87)	.17	.19	.25	-.11	-.10 [a]	-.07 [a]	-
Females							
1 Prestige (job expectation) (*n*=37)	-						
2 Prestige (job aspiration) (*n*=41)	.86**	-					
3 SES (occupation) (*n*=30)	-.33	-.15	-				
4 SES (education) (*n*=30)	.44	.34	-.43	-			
5 FSIQ (controlled for SES occ) (*n*=23)	.28 [a]	.34 [a]	-.23	.33	-		
6 FSIQ (controlled for SES edu) (*n*=22)	.22 [a]	.19 [a]	-.23	.33	-	-	
7 Self-efficacy (*n*=44)	.01	.15	.26	-.17	-.28 [a]	-.34 [a]	-
Males							
1 Prestige (job expectation) (*n*=32)	-						
2 Prestige (job aspiration) (*n*=38)	.70**	-					
3 SES (occupation) (*n*=29)	.04	.06	-				
4 SES (education) (*n*=27)	.38	.18	-.40	-			
5 FSIQ (controlled for SES occ) (*n*=21)	.62** [a]	.33 [a]	-.21	.38	-		
6 FSIQ (controlled for SES edu) (*n*=20)	.38 [a]	.09 [a]	-.21	.38	-	-	
7 Self-efficacy (*n*=43)	.33	.24	.23	-.06	.13 [a]	.26 [a]	-

Note. ** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR. a= result from partial correlation, controlling for SES (both occupation and education controlled for separately). Correlation between SES measure (3 and 4) and FSIQ (5 and 6) conducted without controlling for SES variables.

Table 11.6.5 Correlations between SES, FSIQ, Self-efficacy and prestige of career expectations and aspirations in late-adolescent group (Undergrad Wave 1) (outliers excluded)

Measure	1	2	3	4	5	6	7
Whole group							
1 Prestige (job expectation) (*n*=61)	-						
2 Prestige (job aspiration) (*n*=67)	.15	-					
3 SES (occupation) (*n*=69)	-.05	-.11	-				
4 SES (education) (*n*=68)	.07	-.01	-.49**	-			
5 FSIQ (controlled for SES occ) (*n*=60)	.04 [a]	.21 [a]	-.08	.13	-		
6 FSIQ (controlled for SES edu) (*n*=60)	.04 [a]	.23 [a]	-.08	.13	-	-	
7 Self-efficacy (*n*=71)	.05	-.38**	-.10	.16	-.06 [a]	-.08 [a]	-
Females							
1 Prestige (job expectation) (*n*=45)	-						
2 Prestige (job aspiration) (*n*=52)	.18	-					
3 SES (occupation) (*n*=53)	-.02	-.14	-				
4 SES (education) (*n*=52)	-.12	-.07	-.58**	-			
5 FSIQ (controlled for SES occ) (*n*=45)	-.09 [a]	.20 [a]	-.12	.12	-		
6 FSIQ (controlled for SES edu) (*n*=45)	-.07 [a]	.24 [a]	-.12	.12	-	-	
7 Self-efficacy (*n*=55)	.08	-.32	-.10	.28	-.04 [a]	-.08 [a]	-
Males							
1 Prestige (job expectation) (*n*=16)	-						
2 Prestige (job aspiration) (*n*=15)	.03	-					
3 SES (occupation) (*n*=16)	-.09	.10	-				
4 SES (education) (*n*=16)	.54	.16	-.06	-			
5 FSIQ (controlled for SES occ) (*n*=15)	.44 [a]	.23 [a]	.08	.16	-		
6 FSIQ (controlled for SES edu) (*n*=15)	.42 [a]	.22 [a]	.08	.16	-	-	
7 Self-efficacy (*n*=16)	-.06	-.61	-.04	-.27	.02 [a]	-.09 [a]	-

Table 11.6.6 Means, standard deviations and ANOVA results by discrepancy group for whole sample, mid-adolescent and late-adolescent groups (Outliers excluded)

Measures	Means and standard deviations including outliers						ANOVA-effects of discrepancy categorisation	
	All		Discrepant		Non-discrepant		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	p	η_p^2
Whole sample								
1 Cog ToM RT (s)	-.12 (124)	.88	-.25 (69)	.89	.05 (55)	.84	.059	.029
2 Aff ToM RT (s)	-.09 (124)	.95	-.11 (69)	1.01	-.07 (55)	.87	.807	.004
3 Phys Caus RT (s)	-.14 (124)	.84	-.19 (69)	.82	-.08 (55)	.88	.477	.004
4 Cog ToM % ER	-.13 (124)	.65	.11 (69)	.71	-.14 (55)	.58	.829	.000
5 Aff ToM % ER	-.16 (124)	.76	-.20 (69)	.70	-.11 (55)	.83	.492	.004
6 Phys Caus % ER	-.13 (124)	.75	-.16 (69)	.66	-.09 (55)	.85	.630 w	-.006 (ω^2)
7 Self-efficacy	3.60 (132)	.78	3.52 (76)	.78	3.71 (56)	.78	.171	.014
Mid-adolescent (Year 10)								
1 Cog ToM RT (s)	-.13 (65)	.89	-.40 (32)	.90	.13 (33)	.82	.016	.088
2 Aff ToM RT (s)	-.13 (65)	.95	-.73 (32)	1.06	.01 (33)	.82	.243	.022
3 Phys Caus RT (s)	-.16 (65)	.90	-.30 (32)	.83	-.02 (33)	.95	.225	.023
4 Cog ToM % ER	-.09 (65)	.65	.02 (32)	.74	-.18 (33)	.53	.215 w	.009 (ω^2)
5 Aff ToM % ER	-.14 (65)	.77	-.12 (32)	.75	-.15 (33)	.81	.906	.000
6 Phys Caus % ER	-.09 (65)	.79	-.11 (32)	.67	-.08 (33)	.90	.862	.000
7 Self-efficacy	3.59 (68)	.77	3.55 (34)	.80	3.63 (34)	.76	.670	.003
Late-adolescent (final year univ. student)								
1 Cog ToM RT (s)	-.11 (59)	.87	-.13 (37)	.88	-.08 (22)	.87	.836	.001
2 Aff ToM RT (s)	-.05 (59)	.95	.03 (37)	.95	-.18 (22)	.94	.413	.012
3 Phys Caus RT (s)	-.12 (59)	.79	-.10 (37)	.81	-.16 (22)	.77	.755	.002
4 Cog ToM % ER	-.17 (59)	.66	-.23 (37)	.67	-.07 (22)	.65	.391	.013
5 Aff ToM % ER	-.18 (59)	.74	-.27 (37)	.65	-.04 (22)	.87	.271	.021
6 Phys Caus % ER	-.16 (59)	.70	-.20 (37)	.66	-.11 (22)	.78	.648	.004
7 Self-efficacy	3.60 (64)	.80	3.49 (42)	.77	3.82 (22)	.82	.115	.039

Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch's test was used instead. Self-efficacy scores had no outliers so whole sample presented in table above.

TABLE 11.6.7 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST DATA – OUTLIERS EXCLUDED

Measures	Means and standard deviations						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η^2
Whole sample								
1 Aff ToM RT (s)	-.04 (110)	.97	-.06 (44)	1.05	-.02 (66)	.92	.828	.000
2 Cog ToM RT (s)	-.10 (110)	.91	-.12 (44)	.97	-.09 (66)	.88	.880	.000
3 Phys Caus RT (s)	-.03 (110)	.91	-.07 (44)	.94	-.00 (66)	.90	.716	.001
4 Aff ToM % ER	-.10 (110)	.83	-.10 (44)	.74	-.10 (66)	.88	.980	.000
5 Cog ToM % ER	-.15 (110)	.76	-.29 (44)	.58	-.06 (66)	.85	.090 [w]	.014 (ω^2)
6 Phys Caus % ER	-.18 (110)	.74	-.14 (44)	.76	-.21 (66)	.73	.637	.002
7 Self-efficacy	3.53 (116)	.79	3.61 (49)	.77	3.47 (67)	.80	.369	.007
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	-.01 (69)	.97	.08 (29)	1.11	-.07 (40)	.86	.538	.006
2 Cog ToM RT (s)	-.06 (69)	.93	-.01 (29)	1.06	-.09 (40)	.84	.739	.002
3 Phys Caus RT (s)	-.04 (69)	.97	.02 (29)	1.08	-.09 (40)	.90	.638	.003
4 Aff ToM % ER	-.14 (69)	.75	-.07 (29)	.79	-.18 (40)	.73	.544	.006
5 Cog ToM % ER	-.20 (69)	.61	-.22 (29)	.70	-.19 (40)	.55	.875	.000
6 Phys Caus % ER	-.12 (69)	.78	-.19 (29)	.82	-.08 (40)	.75	.581	.005
7 Self-efficacy	3.56 (70)	.77	3.63 (30)	.77	3.52 (40)	.78	.572	.005
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.08 (41)	.98	-.33 (15)	.90	.06 (26)	1.02	.231	.037
2 Cog ToM RT (s)	-.17 (41)	.87	-.31 (15)	.74	-.09 (26)	.95	.432	.016
3 Phys Caus RT (s)	-.01 (41)	.82	-.25 (15)	.59	.13 (26)	.91	.158	.050
4 Aff ToM % ER	-.03 (41)	.94	-.16 (15)	.66	.04 (26)	1.08	.529	.010
5 Cog ToM % ER	-.07 (41)	.96	-.44 (15)	.12	.15 (26)	1.16	.017 [w]	.064 (ω^2)
6 Phys Caus % ER	-.28 (41)	.67	-.06 (15)	.65	-.41 (26)	.65	.102	.067
7 Self-efficacy	3.48 (46)	.81	3.58 (19)	.79	3.41 (27)	.84	.487	.011

** = statistically significant at $p<.01$, * = statistically significant at $p<.05$. Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch's test was used instead

TABLE 11.6.8 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST THINGS – OUTLIERS EXCLUDED

Measures	Means and standard deviations						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η^2
Whole sample								
1 Aff ToM RT (s)	-.04 (112)	.97	-.14 (40)	1.01	.01 (72)	.95	.457	.005
2 Cog ToM RT (s)	-.11 (112)	.90	-.06 (40)	.98	-.13 (72)	.86	.683	.002
3 Phys Caus RT (s)	-.05 (112)	.90	-.10 (40)	1.00	-.02 (72)	.85	.635	.002
4 Aff ToM % ER	-.09 (112)	.84	-.08 (40)	.82	-.09 (72)	.86	.917	.000
5 Cog ToM % ER	-.14 (112)	.71	-.31 (40)	.43	-.05 (72)	.81	.030 [w]	.022 (ω^2)
6 Phys Caus % ER	-.13 (112)	.85	-.12 (40)	.80	-.14 (72)	.89	.938	.000
7 Self-efficacy	3.53 (115)	.79	3.30 (43)	.88	3.67 (72)	.70	.014	.052
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.00 (68)	.97	-.11 (24)	.85	.06 (44)	1.04	.479	.008
2 Cog ToM RT (s)	-.05 (68)	.93	.05 (24)	1.01	-.10 (44)	.90	.516	.006
3 Phys Caus RT (s)	-.06 (68)	.97	-.14 (24)	1.01	-.01 (44)	.96	.625	.004
4 Aff ToM % ER	-.12 (68)	.75	-.07 (24)	.85	-.15 (44)	.71	.678	.003
5 Cog ToM % ER	-.20 (68)	.62	-.21 (24)	.53	-.19 (44)	.67	.911	.000
6 Phys Caus % ER	-.12 (68)	.78	-.15 (24)	.85	-.11 (44)	.76	.829	.001
7 Self-efficacy	3.56 (69)	.78	3.35 (25)	.84	3.68 (44)	.72	.088	.043
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.11 (44)	.98	-.17 (16)	1.25	-.08 (28)	.81	.775	.002
2 Cog ToM RT (s)	-.20 (44)	.85	-.23 (16)	.94	-.18 (28)	.81	.859	.001
3 Phys Caus RT (s)	-.03 (44)	.79	-.05 (16)	1.01	-.02 (28)	.66	.918 [w]	-.023 (ω^2)
4 Aff ToM % ER	-.03 (44)	.97	-.08 (16)	.81	-.00 (28)	1.06	.792	.002
5 Cog ToM % ER	-.06 (44)	.83	-.46 (16)	.12	.17 (28)	.96	.002 [w] **	.113 (ω^2)
6 Phys Caus % ER	-.14 (44)	.96	-.08 (16)	.76	-.18 (28)	1.07	.743	.003
7 Self-efficacy	3.48 (46)	.81	3.22 (18)	.94	3.64 (28)	.69	.113 [w]	.043 (ω^2)

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch’s test was used instead

TABLE 11.6.9 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST PEOPLE – OUTLIERS EXCLUDED

Measures	Means and standard deviations						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η^2
Whole sample								
1 Aff ToM RT (s)	-.07 (109)	.94	.03 (54)	.99	-.17 (55)	.89	.272	.011
2 Cog ToM RT (s)	-.14 (109)	.89	-.09 (54)	.92	-.18 (55)	.86	.623	.002
3 Phys Caus RT (s)	-.07 (109)	.90	-.02 (54)	.87	-.11 (55)	.94	.637	.002
4 Aff ToM % ER	-.12 (109)	.83	-.19 (54)	.67	-.05 (55)	.97	.384	.007
5 Cog ToM % ER	-.17 (109)	.75	-.08 (54)	.91	-.25 (55)	.54	.240	.013
6 Phys Caus % ER	-.23 (109)	.73	-.34 (54)	.64	-.12 (55)	.80	.116	.023
7 Self-efficacy	3.53 (116)	.79	3.54 (57)	.70	3.53 (59)	.87	.947 w	-.009 (ω2)
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	-.06 (67)	.92	.01 (24)	.95	-.10 (43)	.92	.658	.003
2 Cog ToM RT (s)	-.08 (67)	.94	.11 (24)	1.03	-.19 (43)	.87	.213	.024
3 Phys Caus RT (s)	-.07 (67)	.97	.06 (24)	1.03	-.15 (43)	.93	.398	.011
4 Aff ToM % ER	-.16 (67)	.74	-.18 (24)	.52	-.15 (43)	.85	.825 w	-.015 (ω^2)
5 Cog ToM % ER	-.25 (67)	.54	-.37 (24)	.44	-.19 (43)	.59	.179	.028
6 Phys Caus % ER	-.15 (67)	.77	-.23 (24)	.63	-.10 (43)	.85	.516	.007
7 Self-efficacy	3.56 (70)	.77	3.46 (25)	.70	3.62 (45)	.81	.403	.010
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.10 (42)	.98	.04 (30)	1.03	-.44 (12)	.77	.154	.050
2 Cog ToM RT (s)	-.22 (42)	.80	-.26 (30)	.79	-.13 (12)	.87	.664	.005
3 Phys Caus RT (s)	-.06 (42)	.80	-.09 (30)	.74	.04 (12)	.97	.636	.006
4 Aff ToM % ER	-.05 (42)	.97	-.19 (30)	.78	.30 (12)	1.31	.240 w	.030 (ω^2)
5 Cog ToM % ER	-.04 (42)	.98	.15 (30)	1.11	-.49 (12)	.15	.004 w **	.064 (ω^2)
6 Phys Caus % ER	-.37 (42)	.64	-.43 (30)	.65	-.20 (12)	.61	.286	.028
7 Self-efficacy	3.48 (46)	.81	3.59 (32)	.70	3.21 (14)	1.00	.213 w	.025 (ω2)

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch's test was used instead

TABLE 11.6.10 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – VOCATIONAL INTEREST IDEAS – OUTLIERS EXCLUDED

Measures	Means and standard deviations						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η^2
Whole sample								
1 Aff ToM RT (s)	-.06 (113)	.97	-.32 (46)	.94	.11 (67)	.95	.017	.050
2 Cog ToM RT (s)	-.12 (113)	.90	-.20 (46)	.92	-.07 (67)	.88	.455	.005
3 Phys Caus RT (s)	-.05 (113)	.89	-.10 (46)	.92	-.02 (67)	.88	.623	.002
4 Aff ToM % ER	-.10 (113)	.84	-.16 (46)	.57	-.06 (67)	.74	.496 [w]	-.005 (ω2)
5 Cog ToM % ER	-.15 (113)	.70	-.20 (46)	.62	-.12 (67)	1.01	.559	.003
6 Phys Caus % ER	-.15 (113)	.84	.08 (46)	1.07	-.31 (67)	.61	.032 [w]	.041 (ω2)
7 Self-efficacy	3.53 (116)	.79	3.50 (48)	.80	3.55 (68)	.78	.730	.001
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	-.02 (68)	.97	-.35 (29)	.91	.22 (39)	.95	.015	.086
2 Cog ToM RT (s)	-.07 (68)	.94	-.24 (29)	1.00	.06 (39)	.87	.194	.025
3 Phys Caus RT (s)	-.06 (68)	.96	-.25 (29)	.95	.07 (39)	.96	.177	.027
4 Aff ToM % ER	-.14 (68)	.76	-.23 (29)	.50	-.07 (39)	.90	.345 [w]	-.003 (ω2)
5 Cog ToM % ER	-.23 (68)	.58	-.30 (29)	.44	-.17 (39)	.67	.343 [w]	-.003 (ω2)
6 Phys Caus % ER	-.14 (68)	.77	-.04 (29)	.90	-.22 (39)	.66	.370	.012
7 Self-efficacy	3.56 (70)	.77	3.58 (30)	.77	3.55 (40)	.78	.859	.000
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.13 (45)	.97	-.28 (17)	1.02	-.04 (28)	.95	.414	.016
2 Cog ToM RT (s)	-.19 (45)	.84	-.12 (17)	.79	-.24 (28)	.88	.640	.005
3 Phys Caus RT (s)	-.04 (45)	.79	.14 (17)	.82	-.15 (28)	.76	.238	.032
4 Aff ToM % ER	-.04 (45)	.96	-.03 (17)	.67	-.04 (28)	1.11	.971	.000
5 Cog ToM % ER	-.03 (45)	.83	-.02 (17)	.84	-.04 (28)	.84	.925	.000
6 Phys Caus % ER	-.16 (45)	.95	.28 (17)	1.31	-.43 (28)	.50	.046 [w]	.112 (ω2)
7 Self-efficacy	3.48 (46)	.81	3.36 (18)	.85	3.55 (28)	.79	.439	.014

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch's test was used instead

Table 11.6.11 Means, standard deviations and ANOVA results by stability group for whole sample, mid-adolescent and late-adolescent groups – career aspirations – outliers excluded

Measures	Means and standard deviations						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η^2
Whole sample								
1 Aff ToM RT (s)	-.06 (106)	.93	-.13 (47)	1.12	-.01 (59)	.74	.563 [w]	-.006 (ω2)
2 Cog ToM RT (s)	-.08 (106)	.91	-.11 (47)	1.00	-.05 (59)	.83	.726	.001
3 Phys Caus RT (s)	-.02 (106)	.89	-.12 (47)	.95	.05 (59)	.84	.341	.009
4 Aff ToM % ER	-.13 (106)	.77	-.10 (47)	.78	-.15 (59)	.78	.766	.001
5 Cog ToM % ER	-.07 (106)	.83	-.12 (47)	.85	-.04 (59)	.83	.648	.002
6 Phys Caus % ER	-.14 (106)	.86	-.38 (47)	.75	.05 (59)	.89	.010	.062
7 Self-efficacy	3.55 (110)	.77	3.59 (49)	.81	3.51 (61)	.75	.595	.003
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	.00 (63)	.93	-.01 (22)	1.14	.01 (41)	.82	.944	.000
2 Cog ToM RT (s)	-.02 (63)	.94	.09 (22)	1.07	-.08 (41)	.87	.496	.008
3 Phys Caus RT (s)	-.02 (63)	.96	-.03 (22)	1.14	-.02 (41)	.87	.992	.000
4 Aff ToM % ER	-.13 (63)	.77	.07 (22)	.93	-.23 (41)	.66	.137	.036
5 Cog ToM % ER	-.19 (63)	.62	-.33 (22)	.45	-.12 (41)	.69	.160 [w]	.009 (ω2)
6 Phys Caus % ER	-.12 (63)	.77	-.19 (22)	.88	-.08 (41)	.71	.604	.004
7 Self-efficacy	3.57 (65)	.77	3.52 (23)	.81	3.60 (42)	.75	.694	.002
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.16 (43)	.92	-.23 (25)	1.13	-.07 (18)	.53	.538 [w]	-.016 (ω2)
2 Cog ToM RT (s)	-.16 (43)	.86	-.29 (25)	.92	.02 (18)	.76	.248	.032
3 Phys Caus RT (s)	-.02 (43)	.78	-.20 (25)	.76	.22 (18)	.77	.088	.069
4 Aff ToM % ER	-.12 (43)	.79	-.25 (25)	.61	.05 (18)	.98	.256 [w]	.013 (ω2)
5 Cog ToM % ER	.10 (43)	1.06	.07 (25)	1.06	.14 (18)	1.09	.824	.001
6 Phys Caus % ER	-.17 (43)	.98	-.54 (25)	.59	.35 (18)	1.18	.007 [w] **	.183 (ω2)
7 Self-efficacy	3.51 (45)	.79	3.65 (26)	.81	3.32 (19)	.74	.159	.046

** = statistically significant at p<.01, * = statistically significant at p<.05. Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch's test was used instead

TABLE 11.6.12 MEANS, STANDARD DEVIATIONS AND ANOVA RESULTS BY STABILITY GROUP FOR WHOLE SAMPLE, MID-ADOLESCENT AND LATE-ADOLESCENT GROUPS – CAREER EXPECTATIONS – OUTLIERS EXCLUDED

Measures	Means and standard deviations						ANOVA-effects of discrepancy categorisation	
	All		Stable		Non-stable		Discrepancy group	
	M (n)	SD	M (n)	SD	M (n)	SD	*p*	η^2
Whole sample								
1 Aff ToM RT (s)	-.06 (83)	.99	-.12 (35)	1.01	-.02 (48)	.98	.656	.002
2 Cog ToM RT (s)	-.14 (83)	.89	-.05 (35)	.99	-.21 (48)	.82	.415	.008
3 Phys Caus RT (s)	-.07 (83)	.90	-.15 (35)	.90	-.02 (48)	.91	.525	.005
4 Aff ToM % ER	-.11 (83)	.72	-.03 (35)	.77	-.18 (48)	.69	.358	.010
5 Cog ToM % ER	-.08 (83)	.78	.06 (35)	.98	-.19 (48)	.57	.189	.025
6 Phys Caus % ER	-.17 (83)	.84	-.19 (35)	.95	-.15 (48)	.75	.845	.000
7 Self-efficacy	3.56 (87)	.78	3.64 (35)	.78	3.51 (52)	.79	.465	.006
Mid-adolescent (Year 10)								
1 Aff ToM RT (s)	-.04 (46)	.96	-.12 (16)	1.04	-.00 (30)	.94	.696	.003
2 Cog ToM RT (s)	-.11 (46)	.91	-.05 (16)	1.15	-.14 (30)	.78	.744	.002
3 Phys Caus RT (s)	-.15 (46)	.97	-.18 (16)	1.19	-.13 (30)	.86	.869	.001
4 Aff ToM % ER	-.10 (46)	.74	.22 (16)	.86	-.27 (30)	.62	.029	.103
5 Cog ToM % ER	-.10 (46)	.63	-.23 (16)	.53	-.04 (30)	.68	.326	.022
6 Phys Caus % ER	-.08 (46)	.82	.10 (16)	1.16	-.18 (30)	.57	.384 [w]	.004 (ω2)
7 Self-efficacy	3.61 (48)	.76	3.52 (16)	.75	3.66 (32)	.78	.532	.009
Late-adolescent (Final-year university student)								
1 Aff ToM RT (s)	-.08 (37)	1.03	-.11 (19)	1.02	-.04 (18)	1.07	.839	.001
2 Cog ToM RT (s)	-.18 (37)	.88	-.05 (19)	.86	-.32 (18)	.90	.343	.026
3 Phys Caus RT (s)	.02 (37)	.81	-.12 (19)	.61	.17 (18)	.98	.294 [w]	.005 (ω2)
4 Aff ToM % ER	-.13 (37)	.70	-.24 (19)	.63	-.02 (18)	.78	.345	.026
5 Cog ToM % ER	-.06 (37)	.94	.30 (19)	1.20	-.44 (18)	.15	.015 [w]	.135 (ω2)
6 Phys Caus % ER	-.27 (37)	.86	-.43 (19)	.68	-.11 (18)	1.01	.263	.036
7 Self-efficacy	3.49 (39)	.81	3.74 (19)	.81	3.26 (20)	.76	.067	.088

Corrected for multiple comparisons using Benjamini-Hochberg FDR; a=homogeneity was not met so Welch's test was used instead