EVERYDAY SOCIAL FUNCTIONING IN PEOPLE WITH

AUTISM SPECTRUM DISORDER

A thesis submitted for the degree of Doctor of Philosophy

by

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I, Giulia Bellesi, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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ABSTRACT

Positive social relationships are important for both our physical and psychological well-being, and depend on the ability to engage appropriately with other people across different situational contexts. Although qualitative and clinical reports indicate that people with autism spectrum disorder (ASD) struggle with their everyday interactions, there is a paucity of experimental work examining the nature and severity of their difficulties, especially those of higher-functioning adults. In the present thesis, university students with ASD and matched control participants completed a range of novel or pre-existing scenario-based tasks recreating some of the features and demands of common social situations. Overall, the findings showed that, compared to neurotypical people, individuals with ASD tended to generate less socially skilled strategies in their interactions. Although they often showed relatively intact awareness of many social and normative expectations underpinning everyday situations, their understanding of these appeared to be more limited. The results are interpreted in light of the main social and non-social theoretical models of ASD, and their implications are discussed. In particular, it is hoped that the findings will contribute to the advancement of the current body of evidence, by helping to bridge the gap between theoretical accounts of ASD and performance in the real world, and to guide the development of tailored intervention programmes for higher-functioning adults.

ACKNOWLEDGMENTS

TABLE OF CONTENTS

PART 1: LITERATURE REVIEW

PART 3: GENERAL DISCUSSION AND BIBLIOGRAPHY

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

PART 1: LITERATURE REVIEW

Introduction to literature review

This literature review summarises previous research relevant to the area of interest of the present thesis, i.e. everyday social functioning in people with autism spectrum disorder (ASD). The review comprises four chapters (chapters A, B, C, and D). Chapter A provides a brief summary of the main clinical and diagnostic features of ASD. This includes information about the current diagnostic criteria and process, epidemiology, and the brain areas associated with this condition. Chapter B reviews the most influential theoretical models of ASD, and outlines their possible implications for social functioning. Chapter C discusses the importance of investigating the nature of the everyday social impairments of those with ASD, and explains how doing this might help to inform and improve current intervention programmes. It then reviews previous work examining the strategies used by those with ASD to manage everyday social situations, and their ability to reason about the dynamics underpinning these. The chapter ends by introducing the first three experimental chapters of the thesis (F, G, and H). Chapter D starts by outlining previous evidence concerning the study of moral reasoning and behaviour in those ASD, and then describes the rationale for the last three experimental chapters (I, J, and K).

Chapter A: Introduction to ASD

The present chapter will provide a brief introduction to the main features of ASD. It will start by outlining the diagnostic criteria of ASD and recent information about its prevalence in the population. It will then move on to provide examples of the most common clinical difficulties associated with the condition, and to discuss current issues with the diagnostic process. Finally, recent evidence concerning the possible causes and brain abnormalities associated with ASD will be reviewed.

A.1 DIAGNOSTIC CRITERIA AND EPIDEMIOLOGY

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterised both by marked deficits in social interaction and communication, and also repetitive and rigid patterns of behaviours and interests (DSM-5, 2013). In order to be diagnosed with ASD according to the DSM-5 criteria, symptoms should start in the early developmental period, cause significant impairments in important areas of functioning, such as the social or occupational ones, and should not be better explained by other conditions, such as intellectual disability or global developmental delays.

Recent epidemiological studies indicate that ASD currently affects between 1% and 2% of the general population (e.g., Baird et al., 2006; Blumberg et al., 2013). Prevalence has increased substantially compared to the past; for example, up until twenty years ago, only 4 children in 10000 had a diagnosis (see Fombonne, 2005, 2009 for reviews). There may be many possible reasons underlying such changes in estimates, although little work has examined these empirically. Overall, authors and clinicians have attributed the increase in prevalence of ASD primarily to greater awareness of the condition amongst professionals and the public, and also to improvements in diagnostic practices and tools (Matson & Kozlowski, 2011). ASD is more common in males, who, according to recent data, are almost four times more likely than females to receive a diagnosis (Fombonne, 2009). The reasons for this are currently under debate. Several authors have suggested

that higher prevalence in males may be due to biological factors, such as gender-based differences in genetic susceptibility (e.g., Goldman, 2013; Goin-Kochel, Abbacchi, & Constantino, 2007; Jacquemont et al., 2014). Others have proposed that this might instead reflect a bias in current diagnostic criteria towards the male phenotype of ASD. Previous clinical reports have suggested in fact that females may have a greater ability to 'mask' or compensate for their social and non-social problems, and thus present milder patterns of symptoms compared to males. This, in turn, might lead to under-representation and diagnosis of ASD in the female population (Halladay et al., 2015). It is thus possible that the female phenotype of ASD might differ slightly from that of males, whereby females appear to be more socially skilled but may present impairments in other areas. There is a need for further research concerning the presence of differences between males and females with respect to the nature and pattern of their symptoms (Werling & Geschwind, 2013). The present thesis will take into account the potential influence of gender on the pattern of findings in the experimental chapters by including this in the statistical analyses.

A.2 CLINICAL FEATURES

The nature and severity of the clinical difficulties associated with ASD can vary widely across individuals. Before the latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, 2013), there were four different types of diagnoses that people could receive on the basis of the types of symptoms presented: autistic disorder, Asperger's syndrome, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified. However, the limited agreement among clinicians concerning the difference between these subtypes, and the substantial overlap between them has led to the decision to collapse these under the single diagnostic label of ASD (Ozonoff, 2012). This change has led to some degree of controversy within the professional and patient communities, in particular with respect to the removal of the diagnostic category of Asperger's syndrome. In contrast with individuals diagnosed with other subtypes of ASD, people pre-identified with Asperger's syndrome needed to have average or

above average intellectual abilities and language skills, and milder symptoms. For this reason, they were usually considered more functioning in society than other people on the autistic spectrum (Klin, McPartland, & Volkmar, 2005).

Given the heterogeneity of the manifestations of ASD, it is hard to provide an exhaustive list of examples of the most common clinical difficulties. This is further complicated by the fact that previous research has predominantly focused on the study of the clinical difficulties presented by lower-functioning children, meaning that relatively little is known about the impairments that are more typical of higher-functioning adults. Nonetheless, some frequently reported examples in relation to the social symptoms of ASD include: difficulties developing and maintaining meaningful social relationships, such as close friendships; often violating social conventions and acting or interacting with others in ways that come across as 'socially inappropriate'; difficulties correctly interpreting social cues; problems making or maintaining appropriate eye contact; difficulties engaging in conversations, e.g. chit-chat (Nazeer & Ghaziuddin, 2012; Volkmar, Rogers, Paul, & Pelphrey, 2014).

With respect to the non-social symptoms of ASD, these can include a strong need to follow routines (e.g., always taking the same route to go somewhere, or eating the same foods), the development of obsessional interests for specific topics (e.g., cars, dates, astronomy), and an excessive concern for structure and order (e.g., many report feeling more at ease when their days and activities have clear schedules; Dodd, 2015; Hollander, Kolevzon, & Coyle, 2011).

A.3 ONSET AND DIAGNOSIS OF ASD

ASD onsets early in development, typically within the first 3 years; nonetheless, many people are not diagnosed until later in life, such as during adolescence or adulthood. This seems to be especially the case for higher-functioning individuals, whose symptoms and difficulties may be particularly subtle, and thus harder to notice or interpret (Howlin, 2006). Diagnosis of ASD in children is typically based on a combination of descriptions and reports provided by parents or

teachers concerning their developmental history and everyday difficulties, and also on the use of standardised tools. The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1989) and the Autism Diagnostic Interview–Revised (ADI-R; Lord, Rutter, &, Le Couteur, 1994) are currently considered the 'gold standard' tests to screen for the presence of ASD. The ADOS is a semi-structured assessment, which involves the observation of children's behaviours and difficulties whilst engaging in a number of activities (e.g., make-believe play). The ADI-R is a structured interview with parents or caregivers, which reviews children's clinical and development history. Both tools have been typically found to have high validity and reliability in discriminating between children with and without ASD (e.g., LeCouter et al., 1989; Mazefsky & Oswald, 2006)

Diagnosis of ASD in adults, on the other hand, currently represents a more complex challenge for professionals. Adults seeking a diagnosis often struggle recalling sufficient information concerning their early history and pattern of impairments, and informants (e.g., parents) may not always be available. Since most available diagnostic tools were designed for children, many of their materials and activities (e.g., playing with dolls in the ADOS) are unsuitable for use with older individuals. Finally, as mentioned above, since most previous clinical and empirical work has predominantly focused on children, there is a scarcity of information concerning the specific impairments of adults that professionals can use to inform their clinical judgements and decisions (Seltzer, Shattuck, Abbeduto, & Greenberg, 2004).

A.4 CAUSES

Moving now to reviewing the possible causes of ASD, a vast amount of previous evidence has pointed towards the presence of a strong genetic component. Behavioural genetics research has shown that siblings of children with ASD are at significantly higher risk of being diagnosed with ASD, with concordance rates as high as 70% being found in monozygotic twins (Folstein &, Rosen-Sheidley, 2001). Parents or relatives of people with ASD can also often show autistic-like symptoms and patterns of behaviours, although these may not necessarily meet the threshold

required for a clinical diagnosis (Howlin, 2006). These findings suggest that genetic predisposition might play an important role in the aetiology of ASD, although it is unlikely to be the only explanation (Happé, Ronald, & Plomin, 2006). It is currently unclear which exact genes are responsible for the onset of ASD; recent studies have indicated that more than one gene is likely to be implicated, and that these may vary across individuals (Persico & Bourgeron, 2006). Genes are also likely to interact with each other and with environmental variables, including for example exposure in early pregnancy to infections and toxic substances such as teratogens, which can increase the risk of developing ASD (Landigran, 2010). There is agreement among researchers that parenting and other related social variables (e.g., attachment) do not influence the probability that someone will develop ASD, although these are still likely to contribute to children and adolescents' overall levels of functioning and adjustment (Bernier & Gerdts, 2014; Field & Hoffman, 1999).

Recent advances in neuroimaging research have also revealed the presence of neurological abnormalities in individuals with ASD in relation to structure, function, and connectivity, although the causal role of these for the development of ASD is not clear. With respect to differences in structure, one of the most replicated findings is that of accelerated brain volume growth in early childhood, with about a 10% increase in brain volume in both the grey and white matter, peaking between the age of 2 and 4 years. Some studies have indicated that overgrowth may be then followed by a plateau, although the evidence for this is not clear-cut (Amaral, Schumann Nordahl, 2008). There is disagreement in the literature concerning which specific regions may present abnormalities in brain volume. Initial studies have found increased volume in the amygdala and cerebellum (Piven, Arndt, Bailey, & Andreasen, 1996; Sparks et al., 2002). However, these findings have been hard to replicate; this has been attributed to the use of small sample sizes and presence of high variability in participants' age (Lord & Jones, 2012). More recent univariate analyses on larger samples of participants have hinted that ASD may be associated with differences in the ventricles, the corpus callosum and a number of other smaller cortical regions (Haar, Berman, Behrmann, & Dinstein, 2014).

Differences in the patterns of activation shown by people with and without ASD have also been observed. Previous experiments have mostly examined activation during tasks related to social cognition, such as for example face processing, perspective-taking, or imitation (see Anagnostou & Taylor, 2011 for a review). The most replicated finding is a disturbance in the activation and function of the 'social brain', i.e. the brain circuit specialised for processing social information and emotions. A more detailed discussion of recent findings concerning the 'social brain' in people with ASD is provided in B.2.3.3. Abnormalities in the activation of the prefrontal cortex, the area primarily responsible for executive function, have also been observed in some cases during tasks requiring executive control (e.g., Agam, Joseph, Barton, & Manoach, 2010; Silk et al., 2006). Abnormal activity has also been observed, although to a lesser extent, in brain regions responsible for language, auditory and motor tasks during related tasks (Harris et al., 2006).

Finally, a number of post-mortem studies also found evidence of decreased connectivity in the brains of those with ASD; however, such studies had a number of limitations, including small sample sizes and unclear diagnostic criteria, and usually did not assess the potential impact of variables of age, intellectual impairment, or language (Schultz & Robins, 2005). The presence of differences in connectivity in the autistic brain has been more recently supported by neuroimaging experiments examining both the connection strength and the number of connections of the brains of those with ASD. These have reported both decreased functional connectivity in cortical areas and also an overabundant and more diffuse connectivity overall (Noonan, Haist, & Müller, 2009). On the basis of this evidence, it has been suggested that brain connectivity in ASD may be abnormal relative to neurotypical people; the empirical support for this is however still preliminary (Maximo, Cadena, & Kana, 2014).

A.5 SUMMARY

In summary, ASD is characterised by a combination of social and non-social impairments, and is thought to affect between 1% and 2% of the population, with higher prevalence in males. There

is great heterogeneity across individuals with respect to the nature and severity of their difficulties. Although ASD onsets early in life, this may often not be diagnosed until adolescence or adulthood in the higher-functioning individuals with this condition, since they might present with less obvious or milder symptoms. Assessment of ASD in adults currently represents a complex task for professionals, due to difficulties obtaining comprehensive information about their developmental histories, the lack of suitable diagnostic tools, and paucity of previous research concerning their specific impairments. Many different cognitive and social theories have been put forward by previous work in the field of experimental psychology to explain the pattern of difficulties associated with ASD. Their key ideas and evidence in support of them will be reviewed in the next chapter.

Chapter B: Models of ASD

A vast amount of previous work has been dedicated to explore and define the potential theoretical mechanisms underpinning ASD. Previous theories of ASD have been traditionally classified as either 'non-social' or 'social', depending on whether they aim to account predominantly for the non-social versus social symptoms associated with the condition. The present chapter will review previous literature in relation to both types of models, starting with non-social models.

B.1 NON-SOCIAL MODELS OF ASD

Two influential models of ASD are the weak central coherence theory (Frith, 1989; Happé, 1999) and the impaired executive function theory (Hill, 2004; Ozonoff, Pennington & Rogers, 1991). Although these models aim to explain predominantly the non-social symptoms of people with ASD, such as their narrow and repetitive patterns of interests and behaviours, some authors have suggested that they may also still have some implications for their social functioning. Thus, both theories might be relevant to the area of interest of the present thesis, and will now be reviewed. The key ideas of each theory, and the evidence for and against them will be illustrated. Their possible role to influence everyday social functioning will then be examined. The weak central coherence theory will be reviewed first, followed by the impaired executive function theory.

B.1.1 WEAK CENTRAL COHERENCE THEORY

The weak central coherence theory is grounded in the notion that perceptual organisation in neurotypical individuals is a top-down configuration process of the whole, rather than a bottom-up sum of the parts ('The whole is more than the sum of the parts'). People have a spontaneous drive to process information by focusing on its global features rather than details, in order to extract higher-level coherent meanings ('central coherence'; Frith, 1989). Global processing in the neurotypical population has been supported by a vast amount of previous research, and is thought to apply to the perception of different types of information, including for example visual, auditory and linguistic stimuli (Frith, 1989; Frith & Happé, 1994).

In her book "Autism: Explaining the Enigma", Frith (1989) proposed that central coherence may be disturbed in people with ASD. She suggested that they present an imbalance in the way they process and integrate information, whereby they focus predominantly on details and local information. This, in turn, leads them to perceive the environment in a piecemeal manner, and to neglect the 'bigger picture' ('weak central coherence'). The notion of weak central coherence has been supported by clinical and qualitative reports, where people with ASD have often described their perception as detail-focused and fragmented (Gerland, 1997). A number of experimental studies have also been conducted to examine the validity of the weak central coherence theory; the evidence for it however is mixed, and will now be briefly reviewed.

B.1.1.1 Review of evidence of weak central coherence

The Embedded Figures test (Witkin et al., 1971) has been the first and most commonly used measure to examine central coherence. In this, participants are required to find a simple figure, such as a triangle, within a more complex and larger image in which it is embedded. This is typically a difficult task for neurotypical individuals, as it requires them to inhibit their drive for central coherence, i.e. their tendency to perceive the image as a whole, and to focus on its details. Children, adolescents, and adults with ASD have been often found to perform better than control participants at this test (see Happé & Frith, 2006 for a review). This has been interpreted as evidence that individuals with ASD may have a reduced tendency to perceive the image presented as a whole, and might be more prone to focus on its local characteristics.

Weak central coherence in ASD has also been supported through the use of tasks examining language processing and comprehension. For instance, in a study by Joliffe & Baron-Cohen (1999), adults with and without ASD read words with identical spelling, but different pronunciations and meanings (verbal homographs; e.g., tear) within ambiguous sentences. Those with ASD were found to be less likely to use the context provided by the sentences to infer the correct pronunciation of the homographs, suggesting that they were less able to integrate the relevant

linguistic information to understand the sentences as wholes. Increased tendency to focus on local information in those with ASD has also been shown in tasks examining auditory perception, which found enhanced local processing of musical auditory stimuli (see O'Connor, 2012, and Happé & Frith, 2006 for reviews).

However, there are also many studies which do not support weak central coherence in ASD (e.g., Brian & Bryson, 1996; Ozonoff, Pennington, & Rogers, 1991; Ropar & Mitchell, 1999, 2001). For instance, Joliffe and Baron-Cohen (1997) found that individuals with ASD did not show enhanced performance on the Embedded Figures test. Negative findings have also been found in the context of linguistic and auditory perception (e.g., Lopez & Leekam, 2003). Interestingly, a series of studies have also demonstrated that if individuals with ASD are explicitly asked to pay attention to global rather than local information, they can process information in similar ways to control participants (e.g., Plaisted, Swettenham, & Rees, 1999). For example, it has been shown that cuing children with ASD to consider the special status of homographs leads them to disambiguate pronunciation and meaning on the basis of the preceding sentence context (Snowling & Frith, 1986). Lopez, Donnelly, Hadwin, and Leekam (2004) also demonstrated a similar effect for face perception, as they found that participants with ASD can show configural processing of people's faces when the task at hand required them to do so.

This experimental evidence has led to a number of changes to the original version of the weak central coherence theory. Firstly, evidence that people with ASD can show central coherence if cued to do so has led researchers to no longer see weak central coherence as a discrete deficit, but rather as a cognitive style or an information processing bias towards local or featural information, that can be overcome in tasks with explicit demands for global processing (Booth & Happé, 2010). Secondly, weak central coherence is no longer considered as a primary problem; whilst Frith's original conception gave weak coherence a central and causal role to ASD, this is now seen as a secondary and potential outcome (Happé, 2013).

B.1.1.2 Possible contribution of weak central coherence to social functioning

As mentioned above, the weak central coherence theory has been put forward to account predominantly for the non-social characteristics of those with ASD, such as their insistence for sameness, and their patterns of rigid and narrow behaviours and interests (Frith, 1989; South, Ozonoff, & MacMahon, 2007). Weak central coherence might also contribute to explain the "islets of ability" that have been observed in a significant proportion of individuals with ASD. Many people with ASD can show exceptional performance in areas such as memory, drawing, or mathematics, even when they score below average on measures of general intellectual ability. It has been proposed that such phenomena might be explained in terms of enhanced ability to process and focus on details and unconnected information, at the expense of attention for their overall context and meaning (Frith & Happé, 1994).

Nonetheless, some theorists have argued that weak central coherence might still have a number of implications for people's social functioning. In particular, it is possible that, due to weak central coherence, people with ASD might struggle to construct a global view of social situations. By failing to integrate separate social cues, they might find it difficult to form a comprehensive understanding of the dynamics of social interactions (Frith, 1989; Jarrold, Butler, Cottington, & Jiminez, 2000). For instance, weak central coherence might contribute, at least to an extent, to the problems presented by those with ASD in joint attention. Since this relies on the coordination and integration of verbal and nonverbal cues, including eye gaze, body posture, and pointing gesture, weak central coherence could limit the extent to which people with ASD are able to integrate all these cues to achieve a shared focus of attention.

B.1.1.3 Summary

In summary, the weak central coherence theory (Frith, 1989) suggests that people with ASD have a tendency to process information in a piecemeal manner, by focusing on details rather than wholes; this, in turn, hinders their ability to see the 'bigger picture'. The theory has been examined

using different types of tests, including visuo-spatial, linguistic, and auditory tasks. Whereas some experiments have supported this theory, others have not, or shown that people with ASD are able to focus on global information when explicitly required to do so. On the basis of this evidence, the theory has been modified over time, so that weak central coherence is seen as a cognitive bias, rather than a discrete deficit, and only a possible secondary outcome of ASD instead of a primary problem. Although weak central coherence is thought to account predominantly for the non-social difficulties of those with ASD, such as their insistence for sameness, it might still have some implications for their social functioning, by for example influencing the ability to integrate different social cues. Previous work concerning another influential non-social model of ASD, the impaired executive function theory, will now be reviewed.

B.1.2 IMPAIRED EXECUTIVE FUNCTION THEORY

Burgess (1997) describes executive function as a set of complex cognitive processes that control and regulate other processes to optimise performance; these include, for example, planning, inhibition, working memory, reasoning, task flexibility, and error correction. They are considered responsible for online control of behaviour and handling novel situations successfully where responses are not automatic or well learned (Norman & Shallice, 1986). Previous literature suggests that they are primarily determined by the frontal lobes of the brain, in particular the prefrontal cortex (e.g., Miller, 1999). Although traditional views have proposed that executive functions are all managed by a single central structure (the central executive; e.g., Baddeley, 1996), more recent studies have instead indicated that these consist of multiple discrete processes. This has been supported by evidence of double dissociations for impairment on different executive tasks (e.g., Tsuchida & Fellows, 2013) and by functional imagining and lesion studies showing some degree of functional specialisation in the prefrontal cortex for different executive processes (e.g. Fletcher & Henson, 2001; Stuss & Levine, 2002). There is, however, no consensus between researchers in relation to the number of separable executive processes; for instance, whilst some authors have

proposed dual process accounts (e.g. Petrides, 2000), other studies have hinted that there may be up to eight discrete types of executive functions (e.g. Shallice & Burgess, 1996). Some more recent factor analyses in adults and children have indicated that there may be three core, distinct executive functions: inhibition, cognitive flexibility, and working memory (Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Miyake et al., 2000). These studies, however, took into account only relatively circumscribed executive functions, meaning that it is still unclear how other types of executive skills fit into this framework; some evidence suggests that tasks designed to measure planning may be linked to working memory (e.g., Shah & Miyake, 1999), whereas tasks designed to measure fluency may relate to both working memory and cognitive flexibility (e.g. Rende, Ramsberger, & Miyake, 2002).

The first report of an impairment in executive function in ASD was a single case study of an adult with ASD, who showed severe difficulties on a battery of neuropsychological measures of executive skills (Steel, Gorman, & Flexman, 1984). Since then, a vast amount of work has been conducted on children, adolescents, and adults to establish the presence of deficits in this resource. This will now be reviewed, using the framework indicated by recent factor analyses that have identified inhibition, cognitive flexibility and working memory as the core executive functions underpinning the majority of previous measures.

B.1.2.1 Inhibition

Inhibition involves the ability to control one's attention, behaviours, and thoughts. It allows people to override prepotent and inappropriate responses, and to do instead what is considered more acceptable, needed or required (Diamond, 2013). Inhibition has often been examined in people with ASD using the Stroop task (Stroop, 1935). In this test, participants are presented with different colour words (e.g., "red") written in the same or different ink colours (e.g., in red versus blue ink). They are then required to name the ink the words are written in, and to not read the words, to measure their ability to inhibit automatic verbal responses. Although most previous

experiments have suggested that people with ASD do not differ from control participants in their performance on the Stroop task or other measures of inhibition, such as the Windows task and the Hayling (Hill & Bird, 2006; Ozonoff & Jensen, 1999; Ozonoff & Strayer, 1997; Ozonoff, Strayer, McMahon, & Filloux, 1994; Russell, Jarrold, & Hood, 1999), some studies have contradicted this, by indicating that people with ASD might be less skilled at suppressing automatic, prepotent responses (Biro & Russell, 2001; Hughes & Russell, 1993; Russell, Hala, & Hill, 2003; Russell, Mauthner, Sharpe, & Tidswell, 1991).

The picture of findings is further complicated by the fact that it is unclear to what extent measures of inhibition also tap onto other types of executive skills. For instance, in the Hayling test (Burgess & Shallice, 1997), participants are required to complete the last word of a sentence as fast as possible, and then to complete the same sentence using words that do not fit their context. Hill & Bird (2006) suggested that impaired performance on this test might reflect a fluency deficit, i.e. a problem producing novel words and ideas, rather than a problem with inhibition. The conflicting evidence and the lack of agreement concerning the purity of the measures used, has meant that there is no agreement between researchers yet with respect to the presence or nature of an impairment on this executive skill (Hill, 2004).

B.1.2.2 Cognitive flexibility

Moving now to previous evidence concerning cognitive flexibility, this consists of the capacity to shift one's thoughts or actions according to the demands of or changes in situational contexts. An impairment in this skill might help to explain why people with ASD often struggle to adapt to new situations (e.g., Channon et al., 2001). Cognitive flexibility has been often measured in those with ASD using the Wisconsin card sorting task (Heaton, Chelune, Talley, Kay, & Curtiss, 1993; Nelson, 1976), in which participants are asked to stack into piles a set of cards differing on three dimensions (colour, number, and shape). Participants are not explicitly instructed about what dimension to use to sort the cards, but are provided with feedback about whether they placed the

cards correctly or not. The sorting rules change during the task, so that participants need to shift their responses accordingly to succeed.

There are inconsistent findings in the literature concerning performance of those with ASD on this task. Some studies have indicated that they struggle shifting to new rules, and are more perseverative in their performance compared to neurotypical participants (Ozonoff & Jensen, 1999; Prior & Hoffmann, 1990; Bennetto et al., 1996; Liss et al., 2001; Ozonoff et al., 1991). However, other experiments have found no significant differences in the number of perseverative errors made by participants with and without ASD (e.g., Bogte et al., 2007; Edgin & Pennington, 2005; Goldberg, Mostofsky, Cutting, Denckla, & Landa, 2005; Minshew, Goldstein, Muenz, & Payton, 1992; Landa & Goldberg, 2005). There are also a number of further issues with previous evidence. Firstly, some theorists have argued that the Wisconsin card sorting task is not a pure measure of cognitive flexibility, and that it is likely to also rely on working memory and inhibitory skills (e.g., Monchi, Petrides, Petre, Worsley, & Dagher, 2001). This means that performance on the task may not be an accurate representation of people's flexibility skills. Secondly, it has been noted that accounting for the effect of group differences in verbal or full-scale IQ removes some significant group differences in performance (Liss et al., 2001; Rumsey, 1985), suggesting that mental flexibility and perseveration might be related to IQ rather than to the presence of ASD.

B.1.2.3 Working memory

As for inhibition and cognitive flexibility, the evidence of an impairment in working memory in ASD is also not clear-cut. Although there are several different conceptualisations concerning the exact mechanisms of this resource (e.g., Baddeley, 1992; Just & Carpenter, 1992; Pennington, 1994), most authors seem to agree that its main function is to store, update and monitor information in mind while engaging in other tasks or activities. It is considered crucial for processing and keeping track of changes in the environment, and for making connections between

different events. Working memory is thus pivotal for people's capacity for complex thought, reasoning and problem-solving (e.g., Baddeley, 2012; Gray, Chabris, & Braver, 2003).

Working memory has been relatively under-researched in ASD. Some previous experiments have pointed towards the presence of an impairment. For instance, Bennetto et al. (1996) compared children and adolescents with and without ASD on two different working memory tests, requiring them, for example, to generate the last words in a set of sentences, and to then recall these words sequentially. The group with ASD struggled keeping the appropriate information in mind compared to control participants on all tests. Other experiments have supported the presence of an impairment using other measures such as the WRAML finger windows test, or the CANTAB spatial span tests (e.g., Hughes et al., 1994; Goldberg et al., 2005; Ozonoff & Jensen, 1999). However, not all findings have been consistent (e.g., Geurts, Verte, Oosterlaan, Roeyers, & Sergeant, 2004; Happé, Booth, Charlton, & Hughes, 2006). For instance, in a study by Russell and colleagues (1996), children with and without ASD did not differ in their performance when asked to keep in mind a list of word whilst carrying out a related, but different cognitive task. Some experiments have found evidence of an impairment in spatial working memory tasks, but not in verbal working memory ones, suggesting the presence of a dissociation between spatial and verbal working memory in ASD (e.g., Williams, Goldstein, Carpenter, & Minshew, 2005). Nonetheless, the evidence for this is inconsistent (Ozonoff & Strayer, 2001).

B.1.2.3.1 Other tasks relating to working memory

As discussed in B.2, planning is another executive skill that is thought to relate to working memory, whereas fluency has been linked to both working memory and cognitive flexibility (e.g., Rende et al., 2002). Deficits in planning in individuals with ASD have been frequently studied using the Tower of London task (Shallice, 1982). In this, participants are asked to move a number of coloured disks one by one to match a goal state using the smallest number of moves possible. Children, adolescents, and adults with ASD have often been found to present with difficulties on

this measure (e.g. Bennetto et al., 1996; Ozonoff & Jensen, 1999; Ozonoff et al., 1991), and also on other measures of planning, such as the Tower of Hanoi task or the Trail Making test (e.g., Hughes, 1996; Prior & Hoffmann, 1990; Rumsey & Hamburger, 1988). However, many of these studies included participants with low IQ scores and low levels of functioning, meaning that it is unclear whether the identified deficits relate to all individuals with ASD or rather to only those with a learning disability (see Hill, 2004, for a review). Indeed, some previous experiments controlling for groups' intellectual ability levels have found that only children with ASD and low IQ scores show an impairment in planning, suggesting that problems with this skill may be typical of only a subset of those with ASD (e.g., Mari, Castiello, Marks, Marraffa, & Prior, 2003; Ozonoff, South, & Miller, 2000).

Turning now to previous work on fluency, there is only a small number of studies examining this domain in people with ASD. This has been typically done using measures of verbal fluency (e.g., the Verbal Fluency test, Delis et al., 2001), which require participants to generate as many different words as possible within a specified time, in response to either a phonemic or semantic cue (e.g. the letter A or the category of animals respectively). Also in this case, the evidence for an impairment in fluency in those with ASD is mixed, with some studies finding impaired fluency in participants with ASD compared to matched controls, even after controlling for IQ scores (Minshew et al., 1992; Rumsey & Hamburger, 1988; Turner, 1999), and others finding no group differences (Boucher, 1988; Scott & Baron-Cohen, 1996).

The picture of findings concerning the presence of impairments in executive functions in those with ASD is further complicated by evidence that standardised neuropsychological measures might not always be sufficiently sensitive tools (Burgess et al., 2006). For instance, it has been documented that individuals with lesions in the ventromedial prefrontal cortex can often pass tasks such as the Wisconsin Cart Sorting test or the Tower of London, but still present with a range of severe executive impairments in their everyday behaviour (e.g., Shallice & Burgess, 1991;

Tranel, Hathaway-Nepple, & Anderson, 2007). It is thus possible that, due to their abstract nature, traditional laboratory tests may be unable to recreate effectively the complex and multi-faceted demands of real-life situations, and thus might not be sufficiently sensitive at capturing people's deficits in these, especially when their impairments tend to be more subtle (Channon & Crawford, 2010).

B.1.2.4 Possible contribution of impaired executive function to social functioning

Although the impaired executive function theory has been put forward to account mostly for the non-social symptoms of those with ASD, such as their narrow and stereotyped patterns of interests and behaviours (Ozonoff et al., 1991), more recently it has also been argued that this may also account for at least some of their social impairments. Executive functions are in fact likely to underpin many of the skills implicated in successful navigation of the social world. These include, for example, the ability to inhibit socially inappropriate strategies or behaviours; to plan or modify responses flexibly in online and dynamic social contexts; to predict potential future consequences of different courses of actions, and to make comparative judgements between them; and the capacity to identify appropriate goals (Channon et al., 2001; McEvoy, Rogers, & Pennington, 1993; Russell, Saltmarsh, & Hill, 1999). The link between executive function and social functioning has been supported by studies examining social performance in people with frontal lobe damage, who have often been found to present difficulties engaging in appropriate social interactions and communication (e.g., Blumer & Benson, 1975; Damasio, Tranel, & Damasio, 1990; Eslinger & Damasio, 1985). For instance, patients with lesions in orbito-frontal brain areas have been shown to be more likely to make socially inappropriate remarks when talking with other people, and to struggle understanding social cues (Kaczmarek, 1984; Mattson & Levin, 1990). They can also display difficulties in taking others' perspectives (Stone, Baron-Cohen, & Knight, 1998), understanding non-literal language such as sarcastic remarks (Channon, Pellijeff, & Rule, 2005; 2007) and finding solutions to everyday social problems (Channon & Crawford, 1999; Channon,

2004); all these impairments have also been observed in people with ASD (e.g., Channon, Crawford, Orlowska, Parikh, & Thoma, 2014).

B.1.2.5 Summary

In summary, executive function is an umbrella term referring to a wide range of higher-order cognitive processes that are responsible for online monitoring of behaviour. The evidence for an impairment in executive function in people with ASD is currently mixed. Whereas some studies suggest that people with ASD present deficits with inhibition, cognitive flexibility, working memory, planning and/or fluency, other experiments have not supported this. The picture of findings is further complicated by many factors, including the use of different tasks, differing levels of intellectual abilities between participants, and by the fact that the neuropsychological tests used might tap onto more than one single executive ability, and thus not be 'pure' measures, or that they might not always be sufficiently sensitive. It has been proposed that impaired executive function might have implications for people's social functioning, by for example affecting their ability to inhibit socially inappropriate responses or to modify their behaviour flexibly across circumstances.

B.2 SOCIAL MODELS OF ASD

Although, as outlined above, non-social models such as the weak central coherence theory and the impaired executive function theory might help to explain, at least to an extent, some of the social symptoms associated with ASD, other types of accounts known as the 'social' models of ASD might provide better explanations for these. The majority of previous work has indicated that people with ASD have an impairment in cognitive empathy (Frith, 2001), i.e. difficulties taking others' perspectives. A number of recent studies have also hinted that higher-functioning individuals might be able to compensate for these at least to an extent, through reliance on compensatory social knowledge. This second part of the chapter will thus review the evidence in support of this. It will start by outlining the concept of empathy, including its components

(cognitive and emotional) and their implications for everyday social functioning. It will then move on to review previous work concerning the presence of an impairment in this resource in those with ASD, including recent evidence from neuroimaging studies. After this, previous evidence supporting reliance on social knowledge in people with ASD to compensate for some of their difficulties will be examined. The chapter will end by briefly reviewing previous literature in relation to a recent, alternative social model of ASD, the 'alexithymia hypothesis'.

B.2.1 EMPATHY

Although traditional models have considered empathy a unitary process (e.g., Williams, 1990), most researchers now seem to agree that it is most likely a multidimensional construct. In particular, empathy is thought to consist of two basic components: emotional and cognitive (Blair, 2005; Smith, 2006). Cognitive empathy, also defined as 'theory of mind', 'mentalising', or 'perspective-taking', is the ability to take other people's perspectives, and so to infer their thoughts, desires, or emotions ('I understand what you feel'; Frith, Morton, & Leslie, 1991; Premack & Woodruff, 1978; Whiten, 1991). Emotional or affective empathy, on the other hand, is the capacity to resonate emotionally with others' mental states ('I feel what you feel'; Eisenberg & Miller, 1987; Hoffman, 1984; Rogers, Dziobeck, Hassenstab, Wolf, & Convit, 2007). Although the exact features of the relationship between cognitive and emotional empathy are still not fully understood, there is evidence that these are at least partially separable and independent processes (e.g., Smith, 2006). For example, it has been shown that emotional empathy develops significantly earlier than cognitive empathy: although children are often able to share others' emotional experiences, they usually struggle pinpointing their exact thoughts or feelings until later in life (Preston & de Waal, 2002; Singer, 2006). A dissociation between the components of empathy has also been observed in clinical populations such as those with psychopathy, who seem able to understand others' mental states, but still do not 'feel' for them (Blair, 2006). Cognitive and emotional empathy have also been linked with activity in different brain regions. Cognitive empathy has been associated

with activity in the medial prefrontal cortex (in particular the anterior paracingulate cortex), the temporal-parietal junction, and the temporal poles (Castelli, Happe´, Frith, & Frith, 2000; Fletcher et al., 1995; Frith & Frith, 2006; Gallagher & Frith, 2003; Goel, Grafman, Sadato, & Hallett, 1995; Saxe & Kanwisher, 2003). By contrast, emotional empathy has been linked with activity in a more complex network of structures that include the amygdala, the pars opercularis, the inferior parietal lobule, and the insula (Decety & Michalska, 2010; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009; Shamay-Tsoory, 2011; Singer, Critchley, & Preuschoff, 2009).

B.2.2 EMPATHY AND SOCIAL FUNCTIONING

Impaired empathy is currently thought to account for most of the social symptoms associated with ASD (Peterson, 2014). Both cognitive and emotional empathy are in fact thought to have important implications for people's everyday social functioning (Blair, 2008; Dawson & Fernald, 1987; Rogers, et al., 2007), and have been defined as the 'glue' of the social world (Baron-Cohen & Wheelwright, 2004). Starting by examining the contribution of emotional empathy, this is thought to allow people to tune in at a physiological level into how others are feeling, and thus to respond to their mental states with similar or appropriate emotions (e.g., with joy at someone else's good news, or pity at their sadness; Rankin, Kramer, & Miller, 2005; Stotland, 1969). Sensing or sharing other people's states in difficult situations can elicit feelings of concern, compassion or sympathy, and subsequently motivate people to approach others and provide them with the support they need (Batson, Fultz, & Schoenrade, 1987; Coke, Batson, & McDavis, 1978; Eisenberg et al., 1989; Eisenberg & Miller, 1987). For these reasons, emotional empathy is thought to enhance social relationships and to prevent people from engaging in antisocial behaviours and other types of actions that can cause harm to others (Batson, Fultz, & Schoenrade, 1987; Coke, Batson, & McDavis, 1978; Eisenberg et al., 1989; Eisenberg & Miller, 1987; McDonald & Messinger, 2011). Indeed, people with higher levels of emotional empathy typically have greater interpersonal skills and show more socially competent behaviour; for instance, they are generally less aggressive and

are more likely to engage in prosocial activities such as donating to charities or volunteering (Eisenberg & Miller, 1987; Wilhelm & Bekkers, 2010). On the contrary, people with lower levels of emotional empathy tend to be less concerned with others' well-being and are more likely to act in ways that do not take their feelings into consideration (e.g., Bischof-Kohler, 1991).

Moving now to discussing the role of cognitive empathy in social functioning. This helps people to anticipate or predict how others would like them to act or may react to their own actions, and thus to adjust their own behaviours accordingly. The link between perspective-taking and the ability to behave in a socially appropriate manner across social situations has been supported by previous research. For example, children who pass false belief tasks have been reported by their care-givers to be more sociable, to have better social, communication and verbal skills, and to show more insightful social behaviour in their everyday lives (e.g., to be more skilled at befriending others or at playing simple interaction games; Dawson & Fernald, 1987; Frith, Happe & Siddons, 1994; Oswald & Ollendick, 1989; Prior, Dahlstrom, & Squires, 1990). Performance on measures of cognitive empathy has also been associated with the ability to maintain conversation, to respond appropriately and to contribute with novel or relevant information (Capps, Kehres, & Sigman, 1998; Hale & Tager-Flusberg, 2005) and to solve interpersonal conflicts effectively (Chandler, 1973; Gehlbach, 2004). Finally, previous research has also indicated that people with higher levels of cognitive empathy tend to be more successful at forming and sustaining meaningful and lasting social relationships (Selman, Jacquette, & Lavin, 1977).

Thus, in summary, both emotional and cognitive empathy have been shown to have important implications for people's social functioning; this has strengthened the hypothesis that the social symptoms of ASD might be explained in terms of an impairment in this resource. The evidence for this will now be reviewed. Previous work examining emotional empathy in those with ASD will be examined first, followed by literature on cognitive empathy.

B.2.3 EMPATHY IN ASD

B.2.3.1 Emotional empathy

The evidence concerning whether emotional empathy is intact or impaired in people with ASD is mixed (Blair, 2008). Since there is no standardised measure to assess emotional empathy, a wide variety of tools have been adopted by previous work to examine this in ASD. Experiments based on the use of self-report questionnaires have yielded mixed findings. For instance, in a study by Rogers and collaborators (2007), adults with and without ASD did not differ in their scores on the Interpersonal Reactivity Index (IRI; Davis, 1980), a questionnaire measuring their tendency to feel compassion, warmth or concern for others across different types of everyday situations. However, subsequent replications of the questionnaire have not supported this, and found that people with ASD tend to have lower emotional empathy scores compared to neurotypical people (Mathersul et al., 2013; Silani et al., 2008).

Other studies based on the presentation of more naturalistic stimuli, such as stories or pictures, have mostly pointed towards the presence of intact emotional empathy in ASD. For instance, in a study by Dziobek and colleagues (2008), adults with and without ASD performed the Multifaceted Empathy test (MET), in which they saw a series of photographs of people in emotionally charged situations (e.g., a crying child placed within a war scene). No differences between the groups' responses were found when asked to rate their concern for the individuals in the pictures or to state how aroused they felt by them. Consistent findings have been yielded also by other experiments (e.g., Deschamps, Been, & Matthys, 2014; Schwenk et al., 2012; Travis, Sigman, & Ruskin, 2001; Yirmiya, Sigman, Kasari, & Mundy, 1992).

A mixed picture of findings come however from studies examining people's physiological responses. Blair (1999) recorded the electrodermal responses of children with ASD and a control group while watching images of people in distress. No difference between groups was found, suggesting that children with ASD may have intact sensitivity to others' emotions. More recently,

a functional MRI study by Hadjikhani and colleagues (2014) examined the neurophysiological responses of adults with and without ASD while observing videoclips of people experiencing physical pain. Consistent with Blair (1999), also in this case the authors found no difference in performance between the groups, as all participants showed similar levels of activations in areas associated with pain sharing. However, two other recent studies examining participants' responses to pictures of happy and angry expressions or to videoclips of others in pain through the use of electromyography have found limited neurophysiological modulation in those with ASD compared to a control group (McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006; Minio-Paluello et al., 2009).

Thus, in summary, whether emotional empathy is preserved or impaired in those with ASD is thus still under debate. A plausible explanation proposed by some researchers to reconcile the mixed pattern of findings is that although emotional empathy might be intact in those with ASD, they might be able to resonate emotionally with others only if it is made explicit what they are thinking or feeling. Perspective-taking might be necessary to mediate the accurate identification of others' needs and allow people to respond to others' mental states with appropriate emotions. Thus, an impairment in taking others' perspectives might be instrumental in explaining why those with ASD are able to resonate emotionally with others only in specific circumstances (Jameel et al., 2015). The evidence for deficits in this component of empathy in people with ASD will now be reviewed.

B.2.3.2 Cognitive empathy

In contrast with previous research on emotional empathy, the presence of an impairment in cognitive empathy in those with ASD has received more consistent empirical support. Cognitive empathy has been traditionally examined using first-order (involving inference that a story character's beliefs are diverging with reality) and second-order (involving inference about someone's false attribution of belief) false belief tasks (Wellman, Cross, & Watson, 2001; Wimmer & Perner, 1983). A well-known example of a first-order false belief task is the Sally Ann task. In

this test, participants watch a sequence of events involving two fictional characters (Sally and Ann) who are in the same room. In the story, Sally puts a marble in a box, and then leaves the room. While Sally is away, Ann moves the marble from the box into a basket. Children are asked where Sally will look for the marble when she goes back to the room. This examines their ability to recognise that Sally has a belief about the location of the marble that is incongruent with its real location, and with their own knowledge; thus, to give the correct answer, participants need to take Sally's perspective and recognise that this is different from their own. Initial experiments comparing children with and without ASD have found that, whereas more than 80% of typically developing children were able to explain false belief scenarios by 4 years of age, only about 20% of children with ASD could do so (Baron-Cohen et al., 1985; Happè, 1995).

However, it should be noted that not all studies based on the use of false belief tasks have yielded consistent results. Some experiments have found that children and adults with ASD, in particular those with average intellectual abilities or who were very high-functioning, could perform similarly to controls on these measures (Bowler, 1992; Dahlgren & Trillingsgaard, 1996; Happè, 1994; Grossman, Klin, Carter, & Volkmar, 2000; Ozonoff et al. 1991; Tager-Flusberg & Sullivan, 1994). Moreover, false belief tasks have been shown to have a ceiling corresponding to a mental age between 4-8 years (Perner & Wimmer, 1985; Tager-Flusberg & Sullivan, 1994; Wellman et al. 2001). On the basis of this evidence, more naturalistic and sensitive tests of cognitive empathy have been developed. These usually involved presenting participants with different types of social stimuli and stories, and examining their ability to infer or predict the mental states of different characters. Many tasks also explored people's capacity to understand examples of pragmatic language and communication, such as non-literal utterances, sarcasm, irony, and humour, as these also rely on an understanding of other people's beliefs, wishes or intentions. For example, in the Strange Stories test (Happè, 1994), children and adults with ASD, including those who passed first- and second-order false belief tasks, were shown a series of written scenarios where characters said things that they did not literally mean (e.g., a mother made a sarcastic remark about how 'polite'

her daughter was). Participants with ASD have been often found to have difficulties in interpreting nonliteral utterances, and to use fewer and more inappropriate mental state terms in their explanations compared to control participants (Happé, 1994; Jolliffe & Baron-Cohen, 1999; Kaland et al., 2005; Spek et al., 2010).

The presence of deficits in cognitive empathy in ASD has also been supported using tasks based on other types of stimuli, such as pictures or audiotapes (e.g., Bauminger, 2004; Capps, Yirmiya, & Sigman, 1992; Yirmiya et al., 1992). A frequently used test that relies on the use of pictures is the Reading the Mind in the Eyes test (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Baron-Cohen et al., 2001). In this, participants see a series of photographs of the eye-region of the face of different individuals, are asked to select the word that best describes what the person in the picture is thinking or feeling. The test thus aims to measure how well people can put themselves into other people's shoes and 'tune in' with their mental states. People with ASD tend to score significantly lower than control participants at this (e.g., Baron-Cohen et al., 1997, 2001; Golan, Baron-Cohen, & Hill, 2006; Kaland, Callesen, Moller-Nielsen, Lykke, & Smith, 2008). An audio version of the same test has also been developed (the Reading the Mind in the Voice test; Rutherford, Baron-Cohen, & Wheelwright, 2002), in which participants hear brief samples of dialogue, and are then asked to choose the adjective that best represents the mental state of the speaker. Also in this case, those with ASD have been found to struggle in their performance compared to control participants (Rutherford et al., 2002; Golan et al., 2006; Golan, Baron-Cohen, Hill, & Rutherford, 2007). Finally, difficulties in mentalising have also been shown through the use of video stimuli. For example, in the Empathic Accuracy task (Roeyers, Buysse, Ponnet, & Pichal, 2001), adolescents and adults with ASD watched videos of naturally occurring interactions between strangers, showing a variety of complex emotions and mental states (e.g., relief, guilt, loneliness). Consistent with previous findings, when asked to infer and describe the characters'

unexpressed thoughts and feelings, those with ASD were more impaired than control participants at generating correct answers.

An impairment in cognitive empathy in ASD has also been supported by recent neuroimaging and neuropsychological work, which has shown that people with ASD tend to present abnormalities in the activity and connectivity of a number of brain areas specialised in social processing. This evidence will now be briefly reviewed.

B.2.3.3 The Social Brain Hypothesis and the Amygdala Theory of ASD

A vast amount of previous research has been conducted in the last few decades with the aim of unravelling the neural substrates of social processing and behaviour. Notably, converging evidence suggests that there are a number of brain regions selectively responsible for social processing in both social animal species such as monkeys (see e.g., Brothers, 1990) and humans (Frith & Frith, 2007). These regions form a circuit that has been named the 'social brain' (Brothers, 1990). Recent studies suggest that this is likely to include the medial and ventromedial prefrontal cortex (see e.g., Carmichael & Price, 1995), the posterior cingulate/precuneus (see e.g., Cavanna & Trimble, 2006), the amygdala (see e.g., Brothers, Ring, & Kling, 1990) and anterior hippocampus (see e.g., Fanselow & Dong, 2010), the anterior temporal lobes (see e.g., Olson, McCoy, Klobusicky, & Ross, 2012), the posterior superior temporal sulcus and temporo-parietal junction (see e.g., Saxe & Kanwisher, 2003), the lateral portion of the fusiform gyrus (see e.g., Schultz et al., 2003), the left inferior frontal gyrus (see e.g., Keuken et al., 2011), somatosensory and anterior intraparietal cortices (see e.g., Gazzola et al., 2012), and parts of the insula, such as the anterior portion (see e.g., Craig, 2009). There is consensus amongst neuroscientists that the primary function of the social brain is to allow us to make predictions about people's actions on the basis of their mental states, including their intentions, dispositions, desires, and beliefs; this, in turn, guides our behaviours and responses in social interactions (Frith, 2007).

Much of the evidence for the 'social brain' comes from neuroimaging studies, showing consistent co-activation of specific brain areas during performance on social perception and cognition measures, such as tasks examining facial expression or emotion recognition in faces, or mental states attribution (see e.g., Adolphs, 2009). It is important to point out that, although the brain regions implicated in these types of tasks can now be easily identified through the use of neuroimaging technologies, little is known about the functional contributions of the different neural regions involved. For example, it is unclear to what extent specific brain regions that appear to be activated during mentalising tasks are necessary at all in social processing, or whether their activation simply reflects processes that are prompted by, but not necessary for mentalising (Samson, 2009). Some initial steps towards an improved understanding of this have been made by neuropsychological studies, and in particular lesion studies, which have examined how damage to specific regions involved in the social brain network affect empathy and social behaviour (Samson, 2009). For example, work with patients with selective damage in these areas has consistently demonstrated that the superior temporal lobes (see e.g., Samson, Apperly, Chiavarino, & Humphreys, 2004) and the prefrontal cortex (e.g., Stuss et al., 2001) are likely to play an active role in the capacity to take others' perspectives.

Could a dysfunction in the function of 'social brain' circuit underlie the social deficits associated with ASD? So far the available evidence is pointing in this direction. Many recent neuroimaging studies have shown that several regions of the social brain appear to be 'under-activated' in individuals with ASD during social cognition measures, such as tasks examining face processing, perspective-taking, or imitation (see Anagnostou & Taylor, 2011 for a recent review). For instance, it has been consistently shown that the middle portion of the right Fusiform Face Area (FFA) and the Superior Temporal Sulcus (STS) present decreased activation in people with ASD compared to control participants on tasks examining facial expression and non-verbal language processing respectively (Critchley et al., 2000; Schultz, 2005). Emerging work examining anatomical

connectivity using diffusion tensor imaging, and 'functional' connectivity studies have also pointed towards reduced synchronization and connectivity between key brain regions during different social and emotional tasks in individuals with ASD compared to neurotypical people (Gotts et al., 2012); for instance, abnormal functional coupling has been found between amygdala and temporal cortex during face processing (Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2007). This has led to the suggestion that ASD might be a 'neural connectivity disorder'. Such abnormal connectivity seems to affect mostly the components of the 'social brain' rather than the whole brain (Misra, 2014).

Of all the areas implicated in the social brain, particular attention has been devoted to the possible role of the amygdala in the social impairments characteristic of ASD. A central role of the amygdala in social behaviour and processing, as well as in emotional functioning, has been established by studies of non-human primates (see e.g., Brothers, Ring, & Kling, 1990), patients with selective amygdala lesions (see e.g., Adolphs, Baron-Cohen, & Tranel, 2002), and brain activation studies with neurotypical individuals (Baas, Aleman, & Kahn, 2004). The amygdala shares connections with almost every structure implicated in the social brain, and it has been proposed that it modulates a variety of brain networks that are important to social cognition in neurotypical individuals; it has thus been named the "hub" within the social brain (Bickart, Dickerson, & Feldman Barrett, 2014). Current evidence suggests that the amygdala is implicated in receiving input about faces (from temporal cortex), orchestrating emotional responses (via projections to hypothalamus and brainstem), and modulating attention to and perception of social stimuli (via projections to basal forebrain and feedback to sensory cortices) (Bickart et al., 2014). Given its widespread connections, it has been proposed that circumscribed dysfunction in the amygdala is likely to have significant repercussions on multiple cognitive functions associated with the social brain circuit (Shaw et al., 2004). Support for this comes predominantly from examination of

individuals with amygdala damage, who present deficits in diverse aspects of social processing (see e.g., Adolphs et al., 2002).

Evidence for a key role of the amygdala in social cognition and behaviour has led to the suggestion that a selective impairment in this region might account for the symptomatology of ASD (the 'Amygdala Theory of Autism'). Baron-Cohen and colleagues (2000) were the first to posit this after reviewing evidence from animal models, post-mortem and structural studies showing abnormalities in the amygdala in individuals with ASD, as well as behavioural similarities between people with ASD and patients with amygdalotomy (see e.g., Aylward et al., 1999; Salmond, de Haan, Friston, Gadian, & Vargha-Khadem, 2003). However, findings to date have been inconsistent, with some studies reporting smaller amygdala size in those with ASD, others reporting larger amygdala size and others reporting no differences between groups (see e.g., Pierce & Courchesne, 2000; Schultz, Romanski, & Tsatsanis, 2000). These inconsistencies in the findings make it difficult to interpret the evidence, although it is possible that abnormalities in both directions can occur (Pierce & Courchesne, 2000).

The amygdala theory of autism has been further questioned by a number of more recent studies. For instance, there is evidence that individuals with selective damage to the amygdala do not pass diagnostic tests for ASD and their clinical presentation does not present a clear association with the symptomatology typical of ASD (Paul, Corsello, Tranel, & Adolphs, 2010). A recent study by Birmingham and colleagues (2011) comparing the clinical presentation of people with ASD versus those with selective lesions to the amygdala concluded that the differences between these individuals are more striking than their similarities. In a recent review, Gaigg (2012) examined previous research assessing the amygdala theory of autism. He concluded that overall, current findings are inconsistent with the notion of a selective deficit in this region, and that the theory ignores multiple aspects of the interpersonal and widespread deficits associated with ASD. There is thus a growing consensus that the cognitive and behavioural impairments associated with ASD

cannot be fully explained in terms of local dysfunction, but are better understood in terms of a disruption of the complex network of structures with which the amygdala is connected, rather than of the amygdala itself (Kana et al., 2011).

Thus, in summary, a vast amount of recent work has been dedicated to examine the neural substrates underpinning the social and cognitive impairments associated with ASD. The evidence so far has pointed towards the presence of abnormalities in both the activity and connectivity of the 'social brain', a circuit specialized in social processing, and in particular in aiding people to take and understand others' perspectives. The role of the amygdala in particular has received particular attention, since it shares connections with almost every brain area implicated in the social brain, and plays a central role in both social behaviour and processing. The most recent evidence however appears to suggest that mentalising deficits in ASD are probably better accounted by a more widespread disruption of the social brain complex, rather than by a selective deficit in this area.

B.2.4 COMPENSATORY SOCIAL KNOWLEDGE

As mentioned in B.2, despite the abundance of evidence supporting the presence of an impairment in cognitive empathy in ASD, there are also a number of experiments indicating that higher-functioning individuals can sometimes show intact performance on more advanced measures of perspective-taking. To explain these findings, researchers have proposed that higher-functioning people with ASD might rely on learnt social knowledge and rules in their performance, and that this might help them to mask, at least to an extent, some of their deficits. The evidence for this will now be reviewed.

B.2.4.1 Evidence of reliance on compensatory social knowledge in ASD

Evidence in support of reliance on compensatory knowledge and skills in those with ASD comes from previous research examining their performance on mentalising tasks, from clinical and qualitative reports, and neuroimaging studies. Starting with previous studies examining performance on cognitive empathy measures, a number of previous studies have shown that in

some cases higher-functioning individuals with ASD can pass these types of tests. For example, in a study by Ponnet and colleagues (2005), adults with ASD were able to infer the thoughts and feelings of a person with whom they just interacted at similar rates as controls. In another experiment by Begeer and colleagues (2010), adolescents and adults with ASD did not differ from control participants in their performance on a communication game that required taking another player's perspective. Recently, Cassidy and colleagues (2013) showed that adults with ASD could understand what situations would cause a complex emotional response (e.g. feigning a positive response to an unwanted gift), whereas Scheeren and colleagues (2013) found that children and adolescents with ASD could pass a series of social stories examining their understanding of false beliefs, display rules, double bluff, faux pass, and sarcasm. Finally, a number of experiments have also failed to find a difference in performance between high functioning adults with ASD and control participants on the Reading the Eyes in the Mind test (Ponnet et al., 2004; Roeyers et al., 2001; Spek et al., 2010).

To explain these types of findings, it has been proposed that higher-functioning people with ASD might be able to apply knowledge and rules acquired through previous experience to 'hack' mentalistic tasks (e.g., Frith & Happé, 1999; Hill & Frith, 2003). For instance, Frith (2001) suggested that people with ASD learn through experience to form associations between different behaviours and outcomes. This in turn allows a gradual acquisition of mental state concepts, whereby they become able to link different types of social situations or interactions with appropriate thoughts, feelings and emotions in others. Intact performance of those with ASD on cognitive empathy tasks is thus not thought to reflect spontaneous awareness or understanding of others people's mental states, but rather to be driven by a 'slow and conscious calculating' and by the application of static and explicit rules and principles (Dewey, 1991; Frith & Happé, 1999).

As mentioned above, evidence in support of reliance on compensatory knowledge and skills in those with ASD to compensate for their mentalising deficits has also come from clinical and

qualitative reports examining their everyday problems. These indicate that people with ASD often spend time observing how neurotypical people act to improve their understanding of the dynamics of social situations. Indeed, small group interactions have been described by participants with ASD as natural "laboratories", in which they have the opportunity to refine their ability to infer or predict others' mental states and learn more about the social rules and principles underpinning them (Carrington, Templeton, & Papinczak, 2003; Muller, Schuler, & Yates, 2008).

With respect to previous neuroimaging evidence, some previous studies have found activation of different brain networks in those with ASD compared to neurotypical participants during measures requiring perspective-taking, suggesting that they might be relying on alternative routes in their performance on these. For instance, in a study by Happé and colleagues (1996), high-functioning adults with ASD and control participants underwent a PET scan while performing a task that required them to infer the mental states of different story characters. During the study, those with ASD showed reduced activation in brain regions associated with cognitive empathy (such as the medial prefrontal cortex). Interestingly, compared to control participants, they showed significantly more activation in a neighbouring area of the left medial prefrontal cortex (Broadmann's area 9/10), which has been previously implicated with more general reasoning and problem-solving abilities; this occurred even when they could pass the mentalising task successfully. Possible reliance on different neural circuits in those with ASD whilst performing mentalising tasks has also been recently supported by a study by White and colleagues (2014). In their experiment, participants with ASD were subdivided into different groups depending on whether they were able to pass false belief tasks; their brain activation patterns whilst completing these were compared. Regardless of whether they were able or not to pass the tasks, all participants with ASD showed under-activation of the areas associated with cognitive empathy. This was interpreted as possible evidence that even individuals with ASD who can pass mentalising tests may be able to do so through alternative routes.

B.2.5 THE ALEXITHYMIA HYPOTHESIS

Some recent work has suggested that the presence of alexithymia, i.e. an impairment in identifying one's own internal experiences, feelings, or emotions, might also contribute to explain, at least to an extent, some of the social symptoms associated with ASD.

Typically, people with alexithymia are aware that they are experiencing an emotion, but be unable to recognise what this is, e.g. whether it is sadness, anger or fear (Bird & Cook, 2013). Although the incidence of alexithymia in the typical population is estimated at about 10% (Linden, Wen, & Paulhus, 1995; Salminen, Saarijärvi, Äärelä, Toikka, & Kauhanen, 1999), its rates appear to be considerably higher in several psychiatric conditions such as anorexia nervosa, post-traumatic stress disorder, or substance abuse (e.g., Taylor, Bagby, & Parker, 1999).

Alexithymia has been examined in those with ASD using validated, self-report measures, which have found that between 40% and 65% of those with ASD might present with this condition (e.g., Berthoz & Hill, 2005; Hill, Berthoz, & Frith, 2004). This evidence has led to the suggestion that the emotional and social impairments associated with ASD may be due to alexithymia rather than being a feature of ASD per se. The theory finds support in evidence that people with alexithymia also often struggle inferring other people's mental states in a similar fashion to those with ASD (e.g., Guttman & Laporte, 2002; Swart, Kortekaas, & Aleman, 2009), and also present with abnormal neural responses when engaging in these types of tasks (Moriguchi et al., 2007; Silani et al., 2008). This possible link between alexithymia and difficulties with cognitive empathy has been explained in terms of the 'shared-network hypothesis', which suggests that the neural networks responsible for processing one's own emotions overlap with those used to process those of other people (Singer & Lamm, 2009). Nonetheless, the evidence in support of this is still limited, and mixed. Since alexithymia seems to affect only a subset of those with ASD, most theorists seem currently to agree that ASD and alexithymia are most likely independent constructs, and that more

research is needed to understand why this occurs in only a percentage of those with ASD, and the exact contribution of this condition to their social deficits.

B.2.6 SUMMARY

In summary, empathy is thought to comprise two main components: emotional and cognitive. Emotional empathy allows people to resonate with others' feelings and emotions, whereas cognitive empathy helps them understand their mental states; both of them have important implications for everyday social functioning. Whereas it is currently unclear whether emotional empathy is intact or impaired in ASD, a vast amount of previous evidence has supported the presence of deficits in cognitive empathy. Notably, recent studies have indicated that higher-functioning individuals might be able to compensate for some of their perspective-taking difficulties through acquisition and reliance on compensatory social knowledge; support for this comes from evidence of intact performance on advanced measures of mentalising, from qualitative and clinical reports, and also by a small number of neuroimaging experiments. Recently, it has been proposed that ASD might be also be explained in terms of alexithymia, a condition characterised by difficulties understanding and interpreting one's own internal experiences. This however seems to affect only a subset of those with ASD, and the evidence in support of this theory is currently limited.

Thus, as reviewed in this chapter, a vast amount of previous research has been dedicated to the study of the possible theoretical causes and models that might explain the non-social and social symptoms associated with ASD, from the weak central coherence theory to the alexithymia hypothesis. An interesting question is now how these translate into everyday performance and functioning in the real world., i.e. what types of impairments do people with ASD actually present with when navigating their social environment, and how do these influence their behaviours,

judgements or decisions? The next chapter will now move on to examine previous work on this, to then introduce the rationale for the experiments described in this thesis.

Chapter C: Everyday social strategies and reasoning in ASD

C.1 INTRODUCTION TO SOCIAL FUNCTIONING

What does it take to be a skilled member of society, and to be able to navigate the social environment successfully? Although there is no obvious or definite answer to this question, previous research has identified a wide range of capacities and skills that may help people to manage the complex realms of social interactions and situations. The experimental chapters of the present thesis are going to focus on two fundamental aspects of everyday social functioning in people with ASD. The first three chapters will examine their capacity to engage with the social environment in a socially sensitive manner, e.g. to approach or respond to others in ways that show consideration of their preferences and feelings, and that follow common social rules and conventions. The last three chapters will focus on a slightly different but related capacity, i.e. the ability to appreciate and apply important societal and moral norms underpinning people's judgements, exchanges and decision-making.

This chapter will start by introducing why it is important for people to be able to engage in positive social interactions with others and form meaningful social relations. It will then review previous qualitative and clinical evidence concerning social functioning in people with ASD, and the problems and limitations of current interventions targeting this. After this, it will move on to review previous evidence concerning the empirical examination of everyday social performance in people with ASD, with respect to both the types of strategies they use to respond to everyday social situations, and their understanding and ability to reason about these. Finally, it will summarise and highlight current gaps in the literature to outline the rationale for the first three experimental studies of this thesis.

C.2 SOCIAL FUNCTIONING IN ASD

A need for social connection has long been considered a basic aspect of the human experience, and to represent a universal human motivation (Baumeister & Leary, 1995). Friendships and meaningful social relationships have been previously defined as a 'powerful healing force' for both physical and mental health, as they have been shown to lead to important differences in individuals' reactions to different types of environmental stressors (e.g., Taylor et al., 2000). For instance, Cohen, Doyle, Skoner, Rabin, and Gwaltney, (1997) found that as the number of social ties that people had through family, friends, and work increased, their susceptibility to a virus that causes common cold diminished. Friendships provide a strong sense of personal support during difficult times: the larger and more varied their friendship networks, the more likely people are to obtain the social and material help necessary for coping with stressful life events (e.g., Brady, Dolcini, Harper, & Pollack, 2009). Indeed, people who feel supported by their close friends tend to live longer and stay healthier (Myers, 2000). By contrast, a paucity of social ties has been typically associated with a range of negative psychosocial and physical effects, including decreased self-esteem (Schultz & Moore, 1988), reduced satisfaction with life and perceived meaning (Goodwin, Cook, & Yung, 2001), and increased depression and anxiety (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006).

Previous research has indicated that people with ASD typically struggle maintaining and developing positive social relationships, and have smaller social networks compared to the neurotypical population. For instance, a number of studies have shown that children with ASD tend to have fewer close friends than typically-developing children, and that their friendships are characterized by shorter duration and less frequent get-togethers (Bauminger & Shulman, 2003; Koning & Magill-Evans, 2001). Rowley et al. (2012) found that only 34% of children with ASD had at least one close friend according to their parents' reports, as compared to 93% of typically developing children. Studies on adolescents and adults have also confirmed that people with ASD

tend to be unsatisfied with their number of social relationships (e.g., Locke, Ishijima, Kasari, & London, 2010). For instance, in a study by Orsmond, Krauss, and Seltzer (2004), only a small minority of adolescents and adults with ASD reported to have friendships that were reciprocal in nature and occurred outside of prearranged settings, such as school or work. This lack of social connections and support has been shown to have a range of severe implications on the well-being of people with ASD. Adults with ASD have frequently reported to suffer from a strong sense of isolation, and to long for intimacy and social connectedness (e.g., Humphrey & Lewis, 2008; Muller, Schuler, & Yates, 2008). Feelings of loneliness and dissatisfaction with their social lives have been linked with different types of additional, psychological problems in people with ASD (e.g. Bauminger & Kasari, 2000), including decreased feelings of self-worth and life satisfaction (Bauminger, Shulman, & Agam, 2004), increased social anxiety (Gillott & Standen, 2007), depression, and other mood disorders (Mazurek, 2013).

A number of previous qualitative studies interviewing people with ASD about their experiences and everyday problems has asked them why they think that they struggle forming positive social relationships. These have found that, although many individuals with ASD have reported that they would be interested in socialising and befriending others, and forming meaningful social bonds (Carrington, Templeton, & Papinczak, 2003), they often feel that they lack the appropriate abilities to do so (e.g., Stokes, Newton, & Kaur, 2007). For instance, people with ASD have frequently stated that they find it hard to grasp the dynamics of social situations, and that they feel that they are lacking the appropriate skills to engage in them effectively. They claim to struggle anticipating what it is expected of them across different contexts, and to often do or say socially inappropriate things without meaning to do so (e.g., Carrington et al., 2003; Stokes et al., 2007). According to their reports, these difficulties often make their attempts at social interactions unsuccessful, and in turn lead those with ASD to avoid social interactions and to isolate themselves further from the community (e.g., Causton- Theoharis et al., 2009; Daniel & Billingsley, 2010).

This clinical and qualitative evidence has led to the development of a number of intervention programmes over the years to improve the ability of those with ASD to engage effectively with the social environment and thus enhance their everyday social functioning. The nature, outcomes and limitations of these will now be reviewed.

C.2.1 INTERVENTION PROGRAMMES TO ENHANCE SOCIAL FUNCTIONING IN ASD

Although many different intervention programmes have been developed in the last few decades to improve social functioning in those with ASD, these have been designed predominantly for lower-functioning children and younger adolescents (Bishop-Fitzpatrick, Minshew, & Eack, 2013), and are therefore often unsuitable for higher-functioning adults. The evidence concerning their effectiveness is also limited, and far from clear-cut; the majority of previous studies contain different types of methodological weaknesses, including for example small sample sizes (e.g., Hoyson, Jamieson, & Strain, 1984; Smith, Buch, & Gamby, 2000), no random assignment of participants in the groups (e.g., Farrell et al., 2005; Smith et al., 1997), or no matched control groups (e.g., Harris & Handleman, 2000; Eldevik, Eikeseth, Jahr, & Smith, 2006).

Typically, current intervention programmes address either the cognitive abilities, or the behaviours and practical skills of those with ASD. Starting with the former types of interventions, these generally focus on increasing the ability of those with ASD to take other people's perspectives (e.g., Fisher & Happé, 2005; Golan & Baron-Cohen, 2006; Turner-Brown, Perry, Dichter, Bodfish, & Penn 2008), or to identify relevant cues in social situations (e.g., Gantman, Kapp, Orenski, & Laugenson, 2012; Golan & Baron-Cohen, 2006; Trepagnier, Olsen, Boteler, & Bell, 2011). For instance, in many of these interventions, children are presented with materials such as social stories and comic strip conversations, and are trained on how to predict and interpret the characters' thoughts and feelings (e.g., Gray, 1995), or on how to attribute different emotional states to pictures of their faces (Baron-Cohen et al., 2001). Although this type of approach may often prove

effective within the laboratory context, it has been shown that the gains achieved within the training sessions may be difficult to apply and generalise in real life situations (Begeer, et al., 2011; Fisher & Happé, 2005; Howlin & Yates, 1999; Ozonoff & Miller, 1995; Rao, Beidel, & Murray, 2008), and may thus lead to no discernible improvements in the way children or adolescents with ASD navigate social situations in real life (e.g., Locke et al., 2014). For example, Hadwin, Baron-Cohen, Howlin, and Hill (1997) found that teaching children with ASD to pass tasks assessing mental state understanding resulted in no significant gains in their ability to engage in conversations with other people in everyday, real-life contexts.

Turning to the intervention programmes targeting the behaviours and practical skills of those with ASD, these usually involve practising different types of pragmatic responses, such as turn-taking, or how to maintain appropriate eye contact (e.g., Barry, Klinger, Lee, Palardy, Gilmore, & Bodin, 2003; Marriage, Gordon, & Brand, 1995; Rao, Beidel, & Murray, 2008). Behavioural interventions have also been developed to discourage instances of inappropriate behaviours (such as aggression towards others; e.g., Koegel, Stiebel, & Koegel, 1998), or to encourage positive social behaviours (such as approaching and talking to other people), by breaking down the desired behaviours into small, achievable tasks taught in a structured manner. Also in this case, it has been found that improvements in performing socially appropriate responses within the laboratory setting do not automatically result in gains in cognitive skills (e.g., Chin & Bernard-Opitz, 2000), and often do not generalise outside of the therapeutic context or beyond the specific materials and environments used (Howlin & Yates, 1999).

An interesting question is thus why, for either type of intervention, the improvements achieved within the therapeutic setting do not typically translate into enhanced social performance in the real world by children and adolescents with ASD. Firstly, it has been suggested that this may be at least partially attributable to reliance upon teaching abstract and/or broad abilities. For instance, Hillier et al. (2007) noted how individuals with ASD often can learn general rules and skills, but

find it hard to know how to translate or apply them in practice in more specific settings in their everyday life. It has thus been argued that in order to be effective, training programmes should start focusing on the more fine-grained impairments that people with ASD present in everyday situations: learning how to cope with more realistic and specific types of problems and stimuli may be instrumental in teaching them how to generalise their newly acquired skills to situations outside of the therapeutic context (e.g., Channon et al., 2014).

Secondly, another limitation identified with current intervention programmes is that they tend to target individuals' social understanding and behaviour separately. As these two aspects are closely linked and both play an important role for successful social functioning (Spence, 2003), it has been suggested that these should be addressed in combination for intervention programmes to be effective (e.g., Jameel, Vyas, Bellesi, Roberts, & Channon, 2015). For instance, people with ASD could be trained on both enhancing their ability to understand social situations and also about the importance of translating this into practice through generation of socially skilled responses or solutions (Jameel et al., 2015). This might create and strengthen the link between social processing and the principles underpinning successful social interactions, and in turn potentially increase the effectiveness and generalisability of current intervention strategies.

C.2.2 SUMMARY

In summary, previous clinical and qualitative reports have suggested that people with ASD struggle making and maintaining meaningful social relationships, leading to feelings of loneliness, isolation and additional psychological issues. A number of intervention programmes have been developed to target the social difficulties of those with ASD, and thus enhance their social functioning. These, however, have been predominantly designed for lower-functioning children and adolescents, and are thus unsuitable for higher-functioning adults. The evidence concerning their effectiveness is limited, and mixed. A major problem with most intervention strategies is that the gains achieved within the clinical context do not seem to translate into performance into the real-world and are

thus difficult to generalise. It has been proposed that this might be attributable to reliance on teaching broad sets of skills rather than focusing on the more specific difficulties that people with ASD experience in everyday situations, and on the fact that many interventions typically target behaviour and understanding separately.

C.3 EVERYDAY SOCIAL STRATEGIES AND UNDERSTANDING IN ASD: PREVIOUS EMPIRICAL EVIDENCE

Although, as outlined above, a more fine-grained knowledge of the everyday impairments associated with ASD might be instrumental for developing and guiding more effective interventions, examination of previous literature indicates that there is actually a paucity of empirical work examining these; little is known about the nature or severity of the difficulties experienced by people with ASD in their everyday performance. The available, empirical evidence concerning the study of these in those with ASD will now be reviewed. Previous research examining the types of strategies that people use to navigate everyday social situations will be examined, followed by evidence concerning their ability to process and reason about them. Current problems and gaps in the literature will be highlighted, especially in relation to the study of higher-functioning adults with ASD, in order to introduce the rationale for the first three experimental chapters of this thesis.

C.3.1 EVERYDAY SOCIAL STRATEGIES AND SKILLS

Previous experiments investigating the types of impairments presented by people with ASD in responding to the social environment have predominantly involved children and adolescents; the study of adults has been typically neglected. The majority of these have focused on the examination of their difficulties with social communication, through the use of structured and semi-structured interviews and conversations that required them to answer different types of autobiographical and personal questions. The findings from these studies have suggested that children and adolescents with ASD present a range of pragmatic impairments when communicating with others. Compared

to their typically-developing counterparts, they have been reported to show difficulties in deciding what to say or choosing appropriate topics of conversation, to be more likely to provide irrelevant information or to use an inappropriate intonation and an overly formal speech, to interrupt other people more often, and to engage less in turn-taking (Capps, Kehres, & Sigman, 1998; Chin & Bernard-Opitz, 2000; Paul, Orlovski, Marcinko, & Volkmar, 2009; Shriberg et al., 2001). However, since these studies were conducted in the context of formal assessments within clinical or laboratory settings, it is unclear to what extent the impairments found by these experiments also affect and translate into performance in more complex real-life situations. Only one previous study has examined the difficulties in social communication associated with ASD in a real-life setting (Jones & Schwartz, 2009). In this, the researchers observed how children with and without ASD interacted with their family members at dinner time, and found that, compared to typically-developing participants, those with ASD initiated fewer interactions, commented less often and talked for longer.

Apart from previous work on social communication, little research has been dedicated to examine the nature of the verbal responses or strategies used by individuals with ASD to interact with other people, and the possible problems associated with these. To date, only one experiment has been conducted in this respect, on a subclinical population of adults scoring high versus low on a self-report measure of social skill (Channon et al., 2012). In the study, participants read a range of descriptions of social interactions, all ending with an awkward request asked by the main story characters to the participants (e.g., to wear an unflattering jumper to go out later that evening). The authors examined the types of responses generated by the two groups to manage the social situations, and found that those with lower levels of social skill used more simple responses to answer the awkward questions, such as acquiescence ("Ok") or outright refusal ("No"). By contrast, participants with high levels of social skill relied on more sophisticated strategies, which involved the provision of a justification or which tried to reach a compromise to keep all parties happy and safeguard their relationship with the characters. Their emotional tone also tended to be

more polite overall compared to that used by those with lower levels of social skill (Channon et al., 2012). Since the study was not conducted on a clinical population, it was not possible for the authors to draw definite conclusions about whether the findings would certainly extend to those with a clinical diagnosis of ASD; nonetheless, these still hinted that the nature and content of the social strategies used to deal with challenging social situations may vary considerably across individuals depending on their level of social ability, and that these may have important implications for the success and outcome of their everyday interactions.

C.3.2 JUDGING AND REASONING ABOUT EVERYDAY SOCIAL SITUATIONS

Other studies on social performance in people with ASD have focused on their ability to process, judge and reason about social situations and the rules and conventions underpinning these. Like previous work on social communication and skills in ASD, these have also been predominantly conducted on children and adolescents, rather than adults. Most previous studies involved the presentation of descriptions of social interactions between two or more characters, and asking participants different types of questions about them. They have yielded mixed findings, which will now be reviewed.

A number of previous experiments have examined social understanding and reasoning in those with ASD by examining their ability to recognise examples of socially appropriate versus inappropriate interactions and situations. Some of these have found that children and adolescents with ASD are impaired relative to typically-developing participants in their performance on these types of tasks (e.g., Pierce, Glad, & Schreibman, 1997). For instance, in an initial study by Baron-Cohen and collaborators (1999) children with and without ASD read a series of stories where a main character made a faux pas. Faux paus occur when people state or ask something inappropriate, without knowing or realising that they should have not said it; for example, in one story, a main character said "I don't think I've met this little boy", to a child's mother, when, in

fact, the child was a little girl. The authors found that children with ASD were considerably more impaired at identifying when characters had said something inappropriate compared to their neurotypical participants. Similarly, in a subsequent experiment, Loveland et al. (2001) showed children and adolescents with and without ASD videotapes of interactions between two actors, and asked them to recognise instances of socially appropriate versus inappropriate behaviours, such as "when introduced to someone, saying "is your father dead?". Consistent with the findings by Baron-Cohen et al., (1999), those with ASD were systematically less able to identify these compared to the control group.

A number of recent studies, however, have contradicted this evidence, and indicated that children and adolescents with ASD can in fact perform similarly to control participants on these types of questions, although their justifications and rationales for their judgements seem to be more limited. For instance, in a study by Nah & Poon (2010), children with and without ASD read a range of stories in which a character acted in a socially inappropriate manner (e.g., they said "what's up mate?" to a teacher). Participants were first asked to rate the appropriateness of the social interactions, and then to justify their judgements. Although, this time, children with ASD did not differ in their ratings compared to typically-developing participants, their rationales included more "I don't know" responses, or irrelevant reasons (e.g. "Because 'what's up' is a made up word"). Consistent with this, in another recent study by Callenmark and colleagues (2013) adolescents with ASD judged the appropriateness of a series of descriptions of socially inappropriate behaviours (e.g., asking a stranger in the lift for a comb) in similar ways to control participants when they were asked to select their responses from a range of options (from 'fairly normal' to 'shocking'). However, when they were required to justify their selections and thus to explain why the characters' behaviours were socially unacceptable, they were less likely to focus on the relevant social elements of the situations; instead, they referred to practical aspects of the stories (e.g., "the comb may have lice"), or to simple, non-specific rules, such as "it is not normal" or "you cannot do that".

These findings raise the interesting question of why participants with ASD can, at least in some circumstances, make accurate social judgements, but still struggle providing appropriate justifications for them. This might potentially be explained in terms of differences in task demands, since preserved performance in those with ASD seems more likely on tasks requiring them to provide ratings or to select from alternatives rather than on questions asking them to generate free verbal responses. It is possible that methodologies based on closed-ended question formats may discriminate less between the responses of individuals with and without ASD, and thus be less sensitive at detecting more subtle impairments in the performance of those with ASD compared to question formats requiring them to give free verbal responses.

C.3.3 SUMMARY AND AREAS OF INTEREST FOR THE FIRST THREE EXPERIMENTAL CHAPTERS

In summary, although previous qualitative and clinical reports indicate that adults with ASD tend to struggle with their social relationships and interactions, there is currently a paucity of empirical work examining the nature and severity of their everyday social impairments. Previous research concerning the skills of and strategies used by people with ASD to manage everyday social situations have indicated that they tend to struggle with many aspects of social communication, such as intonation or turn-taking. However, since these mostly involved the use of formal assessments such as semi-structured interviews, or of sub-clinical participants with high versus low levels of self-reported social skills, the extent to which the findings also extend to the real-life performance of those with a clinical diagnosis of ASD is unclear. Studies examining their everyday social understanding have indicated that children and adolescents with ASD can sometimes reach accurate conclusions when evaluating the social appropriateness of different interactions, but that their justifications for their judgements tend to be less sophisticated compared to those provided by typically-developing participants. However, since these studies have predominantly involved

children and adolescents, the extent to which their findings also apply to adults with ASD is unknown.

The first three experimental chapters of the present thesis (chapters F, G and H) are thus based upon these limitations, and aim to fill in some of the gaps identified in previous literature. In the studies, adults with and without ASD will complete a range of novel or adapted versions of previous scenario-based tasks, with the purpose of exploring the types of strategies that they use to navigate everyday social situations, and their ability to process and reason about the dynamics of these. As discussed above, a more fine-grained understanding of the types of difficulties experienced by people with ASD in these domains might contribute to gain more insight as to why they struggle engaging in successful interactions and relationships, and also inform and guide the development of tailored interventions and strategies.

In particular, chapter F will examine the types of strategies used by participants to respond to everyday awkward questions e.g., an unwelcome relative asking to be their guest for the weekend), and how they evaluate and reason about different types of responses that people could use in those situations (the 'Social Strategy task'). Chapter G will investigate their ability to adapt their social judgements flexibly across different types of circumstances, by asking them to rate the appropriateness of raising different types of awkward issues (e.g., bad breath) with different individuals varying in the degree of familiarity, and in different settings varying in the degree of formality (the 'Social Appropriateness questionnaire'). Finally, chapter H will follow-up on the findings of chapter G, by examining participants' ability to raise the same awkward issues in a sensitive way, and to reason about the interactions in a sophisticated manner (the 'Social Appropriateness Scenario task').

Overall, the tasks used by the present research project will contain a range of new elements compared to previous research. Firstly, in contrast with more traditional and abstract measures, they will attempt to recreate the features and demands of many social situations and interactions

that adults with ASD may encounter in common life settings, such as at work or at family gatherings. Different situational aspects will be manipulated across them, to examine participants' ability to adapt their responses flexibly to different types of circumstances, and also to explore the presence of any specific factors that may facilitate or impinge on successful social performance. Secondly, the tasks will examine both the types of strategies used by people to engage in social situations, and also their ability to judge and reason about these. These aspects of performance are both important to successful social functioning (Spence, 2003) but have been rarely examined in concert in people with ASD. Doing this might help to illuminate to what extent practical impairments in social interactions are associated with impaired versus intact aspects of understanding. Finally, the experiments will purposefully use a combination of more and less demanding question formats to vary task demands. As outlined at the end of C.3.2, it has been proposed that performance in those with ASD might be facilitated by the use of less complex questions, involving for example giving ratings or selecting from alternatives, whereas the requirement to generate free verbal responses might be more effective at detecting subtle impairments. Since this suggestion has not been systematically investigated yet, especially in higher-functioning adults with ASD, the present research will use a combination of closed- versus open-ended questions to examine the impact of this on group differences.

Chapter D: Everyday moral reasoning and behaviour in ASD

D.1 INTRODUCTION

As mentioned at the beginning of chapter C, another important aspect of positive everyday social functioning is the ability to reason about and apply the moral norms and principles underpinning interactions in one's society and culture. Moral norms have been defined as the 'fabric' of human societies (Bzdok et al., 2012), and inform people about how they ought to act, or how to decide which behaviours are 'right' or wrong'. They are structured around intrinsic issues of human welfare and rights, and not causing damage to others' well-being. In contrast with social rules, which are arbitrary and contextually-bound, moral norms are considered universally applicable (e.g., Stich, Fessler, & Kelly, 2009). Application and reinforcement of moral norms is thought to contribute to minimise criminal behaviour and conflict, and to promote cooperation, prosocial behaviour and fitness in shaping people's decisions and actions while living in complex social groups (e.g., Staub, 2003).

Despite their importance, moral reasoning and behaviour have been relatively under-researched in ASD. Moral reasoning has been predominantly examined in those with ASD by investigating their ability to recognise moral transgressions, to explain why these are wrong, and to differentiate between intentional and unintentional transgressions. Moral behaviour has been mostly examined by investigating how they apply principles such as fairness or reciprocity in their interactions with others. The available evidence will now be reviewed. The chapter will start by outlining the mechanisms that underpin moral reasoning and behaviour, before moving on to discuss previous work in those with ASD. It will end with a summary of current gaps in the literature, in order to outline the rationale for the last three experimental studies of the thesis.

D.2 MECHANISMS UNDERPINNING MORAL REASONING AND BEHAVIOUR

Traditional theories of moral reasoning diverge into two categories: those which argued that morality is based on deliberate reasoning (e.g., Kohlberg, 1984), and those which proposed that morality is driven by intuitive, socio-emotional processes (e.g., Prinz, 2004). According to the former school of thought, people evaluate the moral appropriateness of actions or events through conscious and effortful weighting of explicit principles and norms (e.g., 'never treat humans as means to an end'; Kant, 1965/1785). Actions or events are considered morally acceptable or unacceptable depending on whether they are in accordance or violate such principles, regardless of any emotions accompanying that judgement (Cudworth, 2006; Kant, 1965/1785). By contrast, theorists from the latter school of thought have suggested that moral judgements are driven by people's 'gut feelings', i.e. the emotions spontaneously evoked by events. If these are positive, then the event in question is considered morally acceptable; if negative, then it is considered morally inappropriate (Hume, 1785/1985). Recent empirical evidence has led most researchers to now agree that morality is probably based on a combination of both reasoned and automatic socio-emotional processes (Cushman, Young, & Greene, 2010; Moll, Zahn, de Oliveira-Souza, Krueger, & Grafman 2005; Ugazio, Lamm, & Singer, 2012). This has led to the development of a dual theory of morality that integrates the contribution of rational deliberation and socio-emotional responses (Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Greene, Nystrom, Engell, Darley, & Cohen, 2004; Haidt, 2001, 2003).

Both cognitive and emotional empathy are considered important socio-motional processes influencing moral judgements and behaviour. For instance, by taking others' perspectives, people can understand what 'it is like' to be in their shoes (e.g., to be the victim of a transgression), and simulate in their minds what they would or would not like to happen if they were in the same situation (Kohlberg, 1984; Gibbs, Basinger, Grime, & Snarey, 2007). Previous research has indeed

found that children and adolescents with better perspective-taking abilities show more sophisticated moral reasoning and understanding compared to participants of the same age who perform worse at mentalising tasks (see Timmerman, 2014, for a review). Identification of others' perspectives and feelings is thought to motivate people to act in a 'moral' manner towards others, by for example providing them with the necessary help or support; for instance, it has been shown that people with better perspective-taking skills are more likely to help others in need and show reduced levels of antisocial criminal behaviour (Batson, 1991; Chandler, 1973; Underwood & Moore, 1982). With respect to emotional empathy, this is thought to play a central role in moral reasoning by allowing individuals to 'feel' for others and share their emotions (Pizarro, 2000). For example, it has been shown that witnessing someone being harmed elicits congruent affective and physiological changes in the observers, and activation in brain regions specialised for emotions matching those experienced by the victim (e.g., in the brain pain network; Singer et al., 2004). Vicariously invoked distress or discomfort and increased physiological arousal can in turn trigger other types of feelings, such as concern, sympathy and compassion, which are considered powerful motivators for people to act in in accordance with morally prescribed behaviours (e.g., Eisenberg & Strayer, 1987).

Since, as reviewed in chapter B, previous evidence has suggested that people with ASD have a deficit in the cognitive component of empathy, and potentially also in its emotional one, then they might be expected to present differences in their moral reasoning and behaviour compared to neurotypical individuals. The evidence for this, however, is not clear-cut, and will now be examined. Previous work on moral reasoning in ASD will be discussed first, followed by literature on moral behaviour.

D.3 MORAL REASONING IN ASD

As mentioned at the beginning of this chapter, previous research has examined moral reasoning in those with ASD by investigating their ability to identify moral transgressions, to explain why

these are wrong, and to differentiate between intentional and unintentional wrongdoings in their judgements. D.2.1.1 will review previous studies concerning the capacity of those with ASD to detect and explain moral transgressions, whereas D.2.1.2 will review previous work on intentionality.

D.3.1 RECOGNISING AND REASONING ABOUT MORAL TRANSGRESSIONS

One of the main markers of moral development is thought to be the emergence of the moral/conventional distinction, i.e. the ability to discriminate between conventional norms (i.e., culturally- and context-dependent rules referring to social etiquette, such as 'do not wear your pyjamas to go to school') and moral norms (i.e., universally applicable rules referring to rights, injustice, and harm, such as 'do not kill'; Smetana, 1985; Turiel, 1983). Several cross-cultural studies have shown that typically-developing children as young as three years old are able to distinguish between socio-conventional and moral transgressions along a number of dimensions (Nisan, 1987; Smetana & Braeges, 1990); for instance, they judge moral transgressions as more serious, less permissible and less authority-dependent (Smetana, 1981; Turiel, 2008). Emergence of the capacity to differentiate between conventional and moral transgressions is thought to signal development of responsivity to the distress of others in children (Blair, 1995).

Given their difficulties inferring others' mental states, theorists initially argued that people with ASD should be expected to struggle making this distinction compared to neurotypical individuals. The available pattern of evidence has predominantly involved children and adolescents, and yielded a more complex pattern of findings. In an initial experiment by James and Blair (1996), children from 9 to 12 years old with and without ASD read stories about a main character carrying out either a moral rule transgression (e.g., hitting another child) or a conventional rule transgression (e.g., talking in class). Contrary to the authors' expectations, the groups did not differ in their evaluations of these: all children, regardless of group membership, considered moral

transgressions as less permissible and authority-dependent, and more severe than conventional ones. Interestingly, performance was found to be independent of participants' ability to pass two false-belief tasks assessing their ability to mentalise. These findings have been recently replicated by another study by Leslie and collaborators (2006). They presented children with and without ASD with descriptions of prosocial and antisocial acts (e.g. a child sharing sweets with a friend versus a child hitting another child), and found that all participants, regardless of group membership, considered antisocial transgressions worse and more deserving of punishment compared to prosocial acts.

However, a number of more recent experiments examining in more depth the ability of those with ASD to evaluate moral transgressions have indicated that there might actually be a number of differences between groups in their ability to reason about these. These studies have suggested that, although children and adolescents with ASD are able to identify moral transgressions in similar ways to their typically-developing counterparts, they still tend to struggle providing sophisticated justifications for their judgements (e.g., Grant, Boucher, Riggs, & Grayson, 2005; Shulman, Guberman, Shiling, & Bauminger, 2012; Zalla, Barlassina, Buon, & Leboyer, 2011). For example, in a study by Grant et al., (2005), children with ASD and typically-developing control participants read pairs of vignettes in which a character either harmed another person (e.g. hit them with a ball) or caused damage to property (e.g., broke a ball). They were then asked to state which protagonist was the 'naughtier' in each pair of stories, and to explain why. Although both groups judged injury to people more severely than damage to property, children with ASD provided more limited rationales compared to their typically-developing counterparts to motivate their judgements. These tended to reiterate the stories or referred to irrelevant elements of the scenarios, in contrast with those provided by the control participants, which referred to more abstract norms or to the victim's thoughts or feelings. Consistent with this, in a more recent study by Shulman et al (2012), pre-adolescents and adolescents with and without ASD were presented with a series of both moral and conventional schoolyard transgressions (e.g., a student harming

another schoolmate versus drawing on a wall). Although all participants rated moral transgressions as less permissible than conventional ones, when required to justify why it was wrong for the scenario characters to act that way, the justifications provided by those with ASD were consistently less sophisticated. They contained more nonspecific condemnation of the characters' actions (e.g., "that's bad", "you can't do that") and were more likely to cite basic rules that prohibited these ("it is forbidden to hit others"). This was in contrast with the rationales provided by the control group, which referred to more abstract principles and were more likely to consider the victims' perspectives (e.g., "he/she will be hurt"). It should be noted that in both the experiments by Grant et al. (2005) and by Shulman et al. (2011) the clinical and control groups were matched with respect to their verbal abilities and mental age; it is thus unlikely that difficulties generating sophisticated rationales in these studies were due to more limited language skills in children and adolescents with ASD.

Thus, the available evidence indicates that, although individuals with ASD can often recognise moral transgressions appropriately, their understanding of these may be less advanced compared to that of neurotypical people. Two main alternative explanations have thus been put forward by previous authors to account for these findings. Firstly, it is possible that, although people with ASD lack the necessary socio-emotional skills to make appropriate moral judgments, they might have learnt to identify moral transgressions and to differentiate these from conventional ones through experience or explicit teaching by their parents or caregivers (Grant et al., 2005); people with ASD might thus be able to develop a normative theory that allows them to correctly identify rule violations. Exclusive reliance on explicit norms and principles in the absence of the ability to understand and resonate with others' perspectives might however not be sufficient to reach a comprehensive and sophisticated understanding of moral transgressions (De Vignemont, 2007).

A second possibility is that serious moral transgressions, such as those used in previous experiments, may be activating the same emotional responses in those with ASD as neurotypical

individuals. As reviewed in chapter B, some previous studies have shown that people with ASD might present intact ability to resonate emotionally with others, and thus might have preserved emotional empathy. It is possible that intact sensitivity to the distress of others in those with ASD might allow them to make appropriate moral judgements (Blair, 2008). Nonetheless, due to impaired cognitive empathy, people with ASD might still struggle representing the internal states of other individuals, and thus providing rationales for their judgements that consider the broader context or the victim's perspectives.

D.3.2 DIFFERENTIATING BETWEEN INTENTIONAL AND UNINTENTIONAL WRONG-DOINGS

There are several factors that influence how people judge others' actions; a central role is played by whether these were intentional or unintentional. For instance, it been shown that people are significantly more likely to praise someone for achieving something positive when they know that they intended and worked towards that outcome, compared to when this occurred by chance (Zalla & Leboyer, 2011). They also tend to attribute greater blame and responsibility to an individual for pursuing a detrimental course of action (e.g., physically harming someone) if they think that they carried it out on purpose, rather than by accident (Lagnado & Channon, 2008).

It has been suggested that the ability to infer intentionality is a mentalistic process, as it relies on ascribing an internal state to an individual at a given time (Kahn, 2004; Young, Cushman, Hauser, & Saxe, 2007). Indeed, previous studies have shown a positive relationship between measures of cognitive empathy and people's capacity to make judgements about intentionality. For example, Baird and Astington (2004) found that the ability to distinguish intentional from accidental harm is correlated with performance on standard false belief tasks in typically developing children; Young and Saxe (2009) also reported that the activity of the right temporo-parietal junction (TPJ), a region implicated in reasoning about beliefs (Saxe, Xiao, Kovacs, Perrett, & Kanwisher, 2004), correlates with participants' ability to exculpate an agent who had previously harmed someone

accidentally. If intentionality is based on mentalistic processes, people with ASD might be expected to be insensitive to it in their evaluations of other people's transgressions, for example when they are required to judge their permissibility or to make attributions of blame. However, the evidence for this is currently limited, and reveals a slightly complex picture, with some studies indicating that people with ASD may struggle differentiating between intentional and unintentional actions in their judgements (e.g., Buon et al., 2013; Moran et al., 2011), and others contradicting this (e.g., Channon et al, 2011; Grant et al., 2005). It has been suggested that the inconsistencies in the findings may depend on the extent to which differences in an agent's intent are made salient by the task at hand.

Tasks in which the agent's intentions are not clearly spelt out or contrasted have predominantly found that people with ASD tend to over-attribute intent to unintentional actions, and thus to judge these in harsher ways than control participants (Buon et al., 2013; Moran et al., 2011). For example, Moran and colleagues (2011) presented adult participants with and without ASD with two different sets of scenarios. In one set, an agent harmed a victim on purpose (e.g., they invited them to enter an unsafe toxic room), whereas in the other set they did so by accident (e.g., they put poison in their coffee falsely believing that the white powder was sugar). The scenarios used in the intentional and unintentional conditions were completely different; thus, the difference between the two sets may have not been particularly clear-cut, and put a requirement for participants to work out the agent's intentions by themselves. It was found that, although the groups did not differ in their ratings for the intentional condition, those with ASD blamed the agent of the accidental harm more severely than control participants. A different experiment by Buon and collaborators (2013) also yielded similar findings. Adults with and without ASD were presented with a series of non-verbal, cartoon scenarios depicting a victim being harmed by an agent, either intentionally or by accident. In this case, the stories did not contain any written or verbal information, and thus required participants to infer the agents' intentions on the basis of the images provided. Consistent with the findings by Moran et al. (2011), in the unintentional

condition those with ASD again overrated the agent's intention to harm the victim, and also considered him as more responsible and punished him more severely than control participants.

However, other tasks that made the difference in the agents' intent more salient have yielded a different pattern of findings, and showed that people with ASD can correctly differentiate between intentional and unintentional actions under these circumstances. In a study by Grant and colleagues (2005), children with ASD were presented with a range of stories where a main character did something harmful to someone else (e.g., a boy burned his little brother's hand). To manipulate intentionality, the authors presented participants with different variants of the same stories, so that the same character acted either intentionally or by accident; thus, compared to the studies described above, contrasting between different variants of the same set of scenarios may have made the difference between intentional and unintentional actions more obvious for participants. In contrast with the findings by Moran et al. and Buon et al., in this case those with ASD did not differ in their judgements from typically-developing counterparts, as they all evaluated deliberate harm more severely than accidental harm.

A more recent study by Channon and colleagues (2011) using a similar methodology supported and expanded on these findings. They presented adults with and without ASD with a range of stories depicting complex causal chains of events, all leading to an unpleasant outcome for a victim. Similarly to the study by Grant et al. (2005), each story had three different variants, so that it either involved an intentional or unintentional human action, or a chain of physical events; for instance, in one of the stories a man took an overdose of his tablet, either because his wife had given him too many on purpose (intentional condition), or by accident (unintentional condition), or because the medication had a wrong label (physical condition). This time, the authors found that, when assigning blame, not only those with ASD were able to differentiate between intentional and unintentional actions, but they did so even more than control participants: compared to

neurotypical people they blamed the characters more for their actions when these were intentional, and less when these were unintentional.

Why are individuals with ASD able to differentiate between intentional and unintentional actions when this distinction is made salient (as shown by the studies by Grant et al., 2005, and Channon et al., 2011), but do not appear able to do so when the difference in the agent's intent is not as clear (as indicated by the experiments by Moran et al., 2011, and Buon et al., 2013)? It is possible that, by using written scenarios which spelt out the agent's intentions, and also by contrasting different variants of the same set of scenarios, the studies by Grant et al. (2005) and Channon et al. (2012) may have reduced the need for participants to infer the agents' intentions from scratch, and thus the demand on their mentalistic abilities. On the other hand, since the experiments by Moran et al. (2011) and Buon et al. (2013) did not spell out or differentiate between the characters' intentions as clearly, they may have increased the need for participants to infer the characters' mental states in the stories; a capacity which, as previously discussed, is likely to be impaired in those with ASD. This evidence thus suggests that people with ASD might use information about intent in similar ways to neurotypical people to guide their moral judgements, but only when mentalistic demands are kept to a minimum.

D.3.3 SUMMARY AND LIMITATIONS OF PREVIOUS STUDIES EXAMINING MORAL REASONING IN ASD

In summary, morality is thought to be based on both deliberate reasoning and more automatic socio-emotional mechanisms in neurotypical individuals. Both cognitive and emotional empathy are thought to play a significant contribution to moral reasoning and to be important in motivating individuals to act in accordance with their moral principles. Moral reasoning in ASD has been relatively under-researched; thus, it is currently unclear whether this is intact or impaired. Previous research has suggested that children and adolescents are typically able to identify moral transgressions and to differentiate these from socio-conventional ones, but that their justifications

for their judgements tend to be more limited compared to those provided by their typically-developing counterparts. The evidence examining sensitivity to intent in their moral judgements is mixed: while some studies indicate that people with ASD tend to over-attribute intent to accidental actions, and thus judge these more severely than neurotypical people, other studies have found either no difference between groups, or that adults with ASD might differentiate even more strongly between intentional and unintentional actions compared to neurotypical people. It has been proposed that this could be attributable to differences in task demands, and in particular to whether these require participants to infer the agent's mental states from scratch or not. It should be noted that previous work on moral reasoning has been conducted predominantly on children and adolescents; it is therefore unclear to what extent these findings also apply to adults with a diagnosis of ASD. Moreover, all previous tasks have involved the presentation of unusual, emotionally-salient situations (e.g., an agent killing a victim). This means that little is known about the capacity of those with ASD to evaluate and reason about more common and less serious types of moral problems and transgressions. It cannot be excluded that more subtle differences between groups might emerge in their judgements and reasoning when less emotionally charged stimuli are presented.

D.4 MORAL BEHAVIOUR IN ASD: ALTRUISM, FAIRNESS, RECIPROCITY

The literature reviewed so far has focused on how people with ASD judge and reason about moral actions and transgressions. This second part of the chapter will now discuss previous work examining moral behaviour in those with ASD. This has predominantly focused on the study of three important moral principles underpinning people's interactions: altruism, fairness, and reciprocity. These are considered interrelated constructs, since they all require concern for others, and, at times, a willingness or ability to engage in personal sacrifice (Fehr & Fischbacher, 2003). They are all thought to facilitate the development of social bonds, and the maintenance of balanced

and cooperative relationships between individuals; they thus all have important implications for both people's day-to-day interactions and also society as a whole (Schmidt & Sommerville, 2011). Previous studies concerning the presence of differences between those with and without ASD in the application of these will now be reviewed, starting with altruism, followed by fairness and reciprocity. Current limitations with the tasks used by previous research will then be outlined.

D.4.1 ALTRUISM

Altruistic acts can be defined as behaviours that are typically costly to oneself but beneficial to the recipient (West, Griffin, & Gardner, 2007). Altruism in ASD has been explored using different types of methods. Some previous experiments have done this by assessing their propensity to sacrifice their own benefit in order to cooperate with others; this has been investigated using the Prisoner's Dilemma, a task drawn from experimental economics, where participants have to decide whether to compete or cooperate with another player. Since competing offers a greater personal reward to participants, all purely rational self-interested players would be expected to make this choice. However, studies within the neurotypical population have indicated that most participants display a systematic bias towards cooperative behaviour, and choose this option at least between 20% and 40% of the times (e.g., Fehr & Fischbacher, 2003). Only one previous study has examined performance on this task in children with ASD, who, interestingly, were not found to differ from their typically-developing counterparts in their choices (Downs & Smith, 2004).

Other studies have examined altruism by exploring people's willingness to donate to others, through the use of another test drawn from experimental economics, the Dictator Game. In this, a player (the 'dictator') receives a sum of money, and has to decide whether they are willing to donate anything to another person. Although the rules of orthodox economics predict that people should prioritise their own interest, and thus give nothing to the recipient, dictators tend to show a systematic propensity for generosity, as they donate something at least 50% of the time (Camerer, 2003). Studies examining performance of those with ASD on the Dictator Game have yielded

inconsistent results. Whereas Sally and Hill (2006) found no difference between typically-developing children and those with ASD in their mean allocations, more ecological versions of the same task have contradicted this. In two recent studies (Izuma, Matsumoto, Camerer, & Adolphs, 2011; Lin, Tsai, Rangel, & Adolphs, 2012) adults with and without ASD were presented with variants of the Dictator Game in which they had to decide whether and how much to donate to a number of different, real charities, those with ASD were consistently found to donate less money compared to the control group in both studies.

Finally, altruistic behavior has been studied by examining people's propensity to help others in need. This has been recently done by a couple of experiments comparing people scoring high versus low on their number of autistic traits (Jameel et al., 2014; 2015). In the studies, participants read descriptions of situations involving a fictional character in need (e.g., a woman in need of seat in a crowded waiting room), and were asked what they would do in response. Those with a high number of autistic traits consistently generated fewer prosocial courses of actions (e.g., they were less likely to offer their seat). Their rationales to explain why it might be appropriate to help the characters were also less sophisticated, as they were more likely to refer to basic rules (e.g., "it is common courtesy to offer your seat") and referred less often to the characters' thoughts, feelings or needs (e.g., "It is difficult for her to stand in a crowded waiting room"). Since these experiments did not involve clinical populations, it was not possible for the authors to draw definite conclusions about whether the findings would also apply to those with a diagnosis of ASD; nonetheless they still hint that ASD might be associated with decreased propensity to engage in prosocial behaviour, and with a more limited understanding of the reasons why people might engage in this.

D.4.2 FAIRNESS

Previous research within the neurotypical population indicates that people display an intrinsic motivation for fairness and equality from a very early age. Children as young as 3 years old notice and react negatively to unequal distributions (LoBue, Nishida, Chiong, DeLoache, & Haidt, 2011).

From 5 years of age, they can start to explicitly talk about fairness, and by 7 to 8 years of age, a preference for equality seems well established in most individuals (Fehr et al., 2008). Fairness has been typically examined using the Ultimatum Game in both the neurotypical and the ASD populations. In the task, the first player (the 'proposer') has to decide how to divide a sum of money between him/herself and a second player (the 'receiver'), who has the right to decide whether to accept or reject the offer. If they accept it, then the money is split according to the proposer's offer; if they refuse, then neither player receives any money. According to the rules of orthodox economics, the proposer should always offer the smallest possible amount, and the receiver should accept any offer greater than zero. In practice, the proposer's offer is typically somewhere between 40% and 50% of the whole amount of money, and most receivers refuse offers that are below a third of the total amount (e.g., Camerer & Thaler, 1995). To explain these findings it has been argued that both players are typically driven by fairness consideration in their decisions concerning how much to allocate or accept (e.g., Güth & Tietz, 1990).

Research examining performance of those with ASD on the Ultimatum Game has suggested the presence of only subtle differences in performance between them and neurotypical people (Sally & Hill, 2006). For example, an experiment by Sally and Hill (2006) found no overall difference in the total mean allocations made by children with and without ASD. However, the authors found that the majority of participants with ASD employed one of two salient rules when distributing their dowry, i.e. they either cut the total in half, or kept it all. This was in contrast with the types of decisions made by the typically-developing participants, who typically offered to share equally. To explain this finding, the authors suggested that children with ASD might have been more 'black-and-white' in their approach to the task, as they were either very fair, or not fair at all. This could potentially result from rigid reliance on normative rules in the allocation of the resources (De Vignemont, 2007).

D.4.3 RECIPROCITY

Previous research has identified many factors that consistently heighten or reduce people's inclination to donate, share or cooperate with others. For example, people are more willing to cooperate with others if they are related or familiar, and donate more to individuals who they like or share interests with (Sally, 2000). A central factor influencing people's choices is reciprocity. Examination of performance on repeated trials of tasks such as the Prisoner's Dilemma, the Dictator Game and the Ultimatum Game has shown people are significantly more likely to help someone if this individual has also previously helped them in the past. Conversely, people tend to act more selfishly and make fewer other-oriented choices towards those who previously caused them damage (Keysar et al., 2008). Similar phenomena have also been replicated by observational studies within social psychology, examining people's behaviours in naturally-occurring contexts (Cialdini et al., 1975; Regan, 1971): for example, people are significantly more likely to do someone a favour (e.g., fill in a survey) if this person previously did something positive for them (e.g., gave them something for free; Burger, Sanchez, Imberi, & Grande, 2009).

It is currently unclear whether people with ASD show intact sensitivity to reciprocity in their exchanges. Clinical reports concerning the difficulties of children with ASD indicate that they struggle engaging in several types of reciprocal aspects of social performance such as turn-taking or joint attention (e.g., Lord et al., 1997; Schopler, Van Bourgondien, & Bristol, 1993). However, a number of previous studies examining their choices in repeated trials of games from experimental economics has yielded a different pattern of results. Downs & Smith (2004) found no difference between children with and without ASD in their tendency to reciprocate in the Prisoner's Dilemma: all participants were more likely to cooperate with the other player if he or she had previously done the same towards them. Consistent with this finding, Sally and Hill (2006) also found no difference in the degree of reciprocity by children with ASD and a typically-developing group on several trials of the Prisoner's Dilemma and of the Ultimatum Game.

It has however been argued that the use of tasks drawn from experimental economics to study social behaviour has a number of limitations, which raise questions regarding the extent to which findings also extend to naturally-occurring environments. Some of the main problems with the usage of these measures will now be outlined.

D.4.4 PROBLEMS WITH THE USE OF GAMES FROM EXPERIMENTAL ECONOMICS

As reviewed above, previous studies examining how people with ASD apply societal principles such as altruism, fairness and reciprocity have predominantly involved the use of tasks drawn from experimental economics, such as the Prisoner's dilemma, the Dictator Game or the Ultimatum Game. However, previous literature has highlighted a number of problems with these measures. Firstly, it has been argued that the external validity of these types of tasks is limited. Due to their abstract nature, they are unlikely to recreate the same demands that people experience in social situations (Bardsley, 2008). Indeed, some previous studies have suggested that performance on these tasks does not predict people's behaviour in naturally-occurring contexts (see Levitt & List, 2006, for a review). For example, Gneezy et al. (2004) found that although people exhibited higher levels of cooperative behaviour in their performance on the Prisoner's dilemma, there was almost no evidence of this in the same sample of participants in a framed field experiment resembling the laboratory task.

Secondly, there is controversy concerning what resources these games tap onto. Although some previous experiments have suggested that mentalising might be important to performance on them (Polezzi et al., 2008), other studies have suggested people's choices in these games may be predominantly driven by strategic considerations to maximise their personal final win. For example, in a study by Hill, Sally, and Frith (2004), adults with and without ASD were interviewed about the types of strategies they used to play the Prisoner's Dilemma; most of them, regardless of group membership reported to have relied on a logical and rational approach and interpretation

of the pay-off matrix in their performance. In particular, participants stated to have made their choices on the basis of the points awarded (e.g., "this choice can get me x points, this other y point; I will always choose this to maximise my gain"), and irrespectively of how they felt or what they thought about the other player. Similar findings have also been shown by a more recent study by Castelli and collaborators (2014), which found no relationship between reliance on mentalising processes and the degree of fairness shown in the Ultimatum Game. These findings indicate that socio-emotional processes such as cognitive empathy may not be needed or used during performance in experimental economics games. In the context of everyday social relationships, however, it is unlikely that people's choices will only be driven by deliberations concerning the gain or loss of practical resources; social considerations regarding the potential reaction of others or their effect on their relationship with them are also likely to be involved in these circumstances (e.g., Pelligra, 2011).

D.4.5 SUMMARY AND LIMITATIONS OF PREVIOUS STUDIES EXAMINING MORAL BEHAVIOUR IN ASD

Moral behaviour in those with ASD has been investigated predominantly through the use of tasks drawn from experimental economics. Examination of participants' responses on traditional versions of the Prisoner's Dilemma and of the Dictator Game have indicated that children with ASD do not differ in their altruistic choices compared to their typically-developing counterparts. However, more ecological versions of the tasks examining participants' propensity to donate to charities, and two previous scenario-based tasks examining prosocial behaviour in sub-clinical populations have suggested that ASD might instead be associated with decreased generosity and prosocial behaviour. Previous studies examining fairness and reciprocity through the use of the Ultimatum Game and examination of performance on repeated trials of experimental economics tasks have suggested that children with ASD do not differ in the application of these principles compared to typically-developing participants. However, there are a number of issues associated

with the use of these types of measures to examine people's behaviour. Firstly, these have a relatively abstract nature, which raises concerns regarding their ecological and external validity. Secondly, it has been suggested that performance on them might be driven exclusively by strategic consideration aiming to maximise one's own final profit. The extent to which findings from these types of tasks extend to performance in the everyday social environment is thus unclear.

D.5 SUMMARY AND AREAS OF INTEREST FOR THE LAST THREE EXPERIMENTAL CHAPTERS

In summary, research examining morality in people with ASD is relatively limited, and reveals a relatively complex picture. The majority of these experiments have been conducted on children and adolescents; the extent to which their findings also apply to adults with ASD is thus unknown. There also seem to be a number of limitations with respect to the types of tasks used by previous studies. All experiments examining moral reasoning have involved the use of relatively serious and emotionally charged stimuli (such as a victim being killed); it is thus unknown whether people with ASD also present a similar pattern of performance when reasoning about more common, everyday types of situations that are less emotionally salient. Moral behaviour, on the other hand, has been mostly examined through the use of tasks drawn from experimental economics; these have a relatively abstract nature, and it has been suggested that participants' responses on them might be driven predominantly by strategic considerations; it is thus unclear to what extent performance on these types of tasks also affects people's judgements and decisions in the real world.

The last three experimental chapters of the thesis (chapters I, J, and K) aim to extend previous literature by examining how higher-functioning adults with ASD apply and reason about different types of moral principles in the context of everyday social situations. In a similar fashion to the first three experimental chapters, the studies will involve the use of both previous and novel scenario-based tasks recreating the features and demands of everyday situations, and will examine both participants' behavioural responses (i.e., what they would do) and also the reasoning

underlying these. Various situational factors that may affect people's judgements and decisions will be manipulated.

In particular, chapter I will examine participants' sensitivity to reciprocity in everyday social exchanges (e.g., how they would interact with a friend who had previously treated them to lunch; the 'Social Exchange task'). chapter J will explore how people judge and react to intentional and unintentional everyday transgressions (e.g., someone revealing one of the participants' secrets to others; the 'Social Intentionality task'). Finally, chapter K will investigate people's decisions and reasoning in situations where transgressing a norm can lead to a personal advantage (e.g., lying in an application form in order to be considered for an important job; 'the Rule Transgressions task').

D.6 GENERAL IMPLICATIONS OF THE PRESENT RESEARCH

It is hoped that the findings from the studies described in the thesis will have important implications. Firstly, they might help to inform current intervention programmes designed to improve everyday functioning in those with ASD. As discussed in C.2.1, there is currently a paucity of intervention strategies for higher-functioning adults. Moreover, the gains showed by people with ASD within the therapeutic setting do not often generalise to their performance in the real world; this has been attributed to the fact that current interventions often focus on teaching abstract and/or broad sets of skills, and target the understanding and the behaviour of those with ASD separately rather than in combination. Knowledge of the specific difficulties experienced by those with ASD in their social and moral reasoning and approach to everyday problems might thus be instrumental for designing more effective and tailored interventions. Secondly, the present work may contribute to advance the existing body of evidence on ASD, by potentially helping to bridge the gap between theoretical models of ASD, and their everyday struggles. Although a considerable amount of work has been dedicated to develop theoretical accounts for the pattern of symptoms of those with ASD (see chapter B for a review), little is known about how these

translate into practice. The present studies may thus help to illuminate this, and contribute to create clearer links between theories of ASD and their performance in the real world.

PART 2: EXPERIMENTAL CHAPTERS

Chapter E: General methods

The scope of this chapter is to provide an overview of the methods used throughout the experimental chapters described in this thesis. It will first discuss how the tasks used in the thesis were developed, including how the scenarios and scoring systems were devised and refined. It will then provide information about the number of participants who took part in the studies, how they were recruited, the inclusion and exclusion criteria, and type of research design used. The chapter will then move on to describe how diagnosis of ASD was confirmed (or excluded) in each participant. Finally, it will give an overview of the different impairments and issues that those with ASD talked about when responding to the interview that confirmed their diagnosis, including the nature of their everyday social and non-social impairments, and the extent to which these impact on their functioning.

E.1 DEVELOPMENT AND PILOTING OF SCENARIO BASED-TASKS

All the experiments described in the thesis involved the use of scenario-based tasks. Scenario-based measures have been shown by previous research to present various advantages in social sciences; for instance, they have higher ecological validity compared to more abstract, traditional laboratory measures. They also allow the exploration of participants' thought and reasoning processes in a more rigorous way, and are more cost- and time-effective compared to observational experiments. They permit quantitatively-focused research questions, and when the information contained within the vignettes is defined and standardised, they enable all participants to respond to the same stimuli, leading to higher uniformity in the data collected (for more detailed discussion of the benefits of using vignettes in social research, see e.g. Anderson & Anderson, 1951; Hughes & Huby, 2001).

The scenarios used in each of the tasks developed for this thesis all described common everyday situations and attempted to approximate the demands and circumstances of real-life as much as possible. Many of the ideas behind these originated from verbal reports of situations that high-

functioning people with ASD of different age, ethnicity and social backgrounds have described as difficult. This information was collected from previous studies carried out in Professor Channon's research laboratory on adults with ASD, and during a one-year part-time placement in a neurodevelopmental disorders clinic specialised in the assessment of ASD in high-functioning children and adolescents. Ideas for the scenarios and questions also stemmed from participants' responses to the semi-structured interview examining ASD described above collected over the course of the research. Taken together, these provided insight into many of the less obvious struggles that high-functioning people with ASD present in social situations. For instance, many individuals with ASD reported finding it difficult to know in what circumstances it might be appropriate for them to give their honest opinion to people around them. When asked about difficulties with interpersonal relationships, some reported having a rigid sense of morality and 'what is right or wrong' and thus finding it difficult to 'let go' and forgive others such as relatives or friends when they believed that they had done something wrong to them. They also reported finding it hard to work out other people's intentions, and in particular whether they acted on purpose or not. The experimental tasks described in the thesis drew upon these insights in addition to the previous literature to investigate issues such as, for example, knowledge of the social norms underpinning everyday social exchanges and sensitivity to intentionality in people's moral judgements.

Each experiment described in the thesis was initially piloted on samples of neurotypical individuals, in order to refine the measures and develop preliminary ideas for how to code the qualitative data. The first two experimental studies (the 'Social Strategy task' and the 'Social Appropriateness questionnaire', described in chapter F and G respectively) were piloted on 20 neurotypical males and 20 neurotypical females, who were matched with respect to age (male mean=20.90, S.D.=2.17; female mean=19.50, S.D.=2.26, $t(38)=2.00$, $p=.06$). All participants were university students and were recruited through advertising within the university. Inclusion criteria for the pilot studies were fluency in English, age between 18 and 35, and no history of neurological or psychiatric illness.

Participants performed the two tasks within the same testing session, in counterbalanced order, in order to reduce possible order effects. The scope of these studies was mainly to pilot the scenario-based measures before running these with the clinical group, but also to explore whether gender might play a possible influence in performance, since there is evidence that females tend to be more skilled at social interactions than males (e.g., Hall, 1978; Leeb & Rejskind, 2004). Thus, the performance of males and females was compared for each task; no significant difference between the groups was found on either aspect of the task, suggesting that gender did not affect performance.

All the remaining scenario-based tasks described in the thesis (chapter H, I, J, K) were piloted on smaller samples of neurotypical individuals, using the same procedure described above to refine the scenario-based tasks and questions, and develop ideas for the possible scoring systems. Participants of these smaller pilot studies were usually friends or relatives of the researcher, all of similar age; the same inclusion and exclusion criteria described above were used for recruitment. Similar numbers of males and females were recruited where possible for each pilot study, in order to have more representative samples of participants.

Piloting served to refine and inform the design of the final version of each of the subsequent tasks in a number of ways. During and at the end of the pilot studies for each task, participants were asked to provide feedback about the ease of comprehension of the scenarios and questions presented, to provide their views about how realistic and close to real-life the scenarios were, and to consider whether the wording or details of these could be improved. Participants' responses were carefully recorded and subsequently reviewed with the rest of the research team. The time taken by participants to complete the studies was also measured to check whether these were going to take a similar amount of time for each individual, whether tasks might need to be reduced in length, and whether participants might need breaks in-between tasks. All this piloting work led to several modifications of the wording and number of scenarios and follow-up questions, in order

to enhance clarity and quality of these and develop the final version of the tasks run in the experimental chapters of the thesis.

Participants' responses to the closed-ended questions were inspected for each group. Scores were examined for skewness and outliers using the procedure described in F.3.1, to check for the presence of any ceiling or floor effect for each scenario and question, or evidence that items might have been misunderstood. Participants' responses to the open-ended questions were also individually transcribed and examined. Details concerning how the scoring systems were developed are provided below in E.1.1. Inspection of the responses provided by participants to open-ended questions in the pilot studies were used to identify and generate ideas as to what dimensions might differentiate participants' responses and what themes might underlie these.

E.1.1 SCORING OF DATA

In the tasks described in the experimental chapters of the thesis, participants were asked a combination of closed- and open-ended questions. More detailed information about how these were scored is provided below.

E.1.1.1 Scoring of closed-ended questions

The closed-ended questions asked to participants throughout the tasks required them either to provide ratings on a scale from 0 to 10 (e.g., *"on a scale from 1 to 10, where 1 represents 'not at all acceptable' and 10 represents 'very acceptable', how acceptable is it to do that in this situation?"*, the Rule Transgressions task, chapter K), to select between a 'Yes' versus 'No' response (e.g., *"Should Sam tell his friend that he has bad breath in this situation?"*, the Social Appropriateness Scenarios task, chapter H), or to rank-order different options (e.g., *"Please rank-order the following types of answers to the character's question from the most to the least appropriate"*, the Social Strategy task, chapter F). Ratings or the number of times participants provided 'Yes' versus 'No' responses were individually added across scenarios and converted into percentages for each participant in each study. With respect to rank-ordering, when there were only two options to rank-order, the number of times each

option was ranked as the best was added across scenarios and converted into percentages (see rank-ordering of 'simple' versus 'sophisticated' strategies for the "reasoning" condition of the Social Strategy task, chapter F). When there were more than two options to rank-order (see rank-ordering of response strategies in the Social Intentionality task, chapter J), only the response options ranked first were considered.

E.1.1.2 Scoring of open-ended questions

Responses to open-ended questions (such as, for example, *"What would you say in response?"*, the Social Exchange task, chapter I, or, *"Why might people think that it is wrong for someone to do that in this situation?",* the Rule Transgressions task, chapter K) were all transcribed verbatim for later coding. When tasks from previous literature were used (such as the "application" condition of the 'Social Strategy task', described in chapter F, and the 'Social Exchange task', described in chapter I), the same scoring systems devised and adopted by previous studies were adopted to code qualitative data. For novel tasks, the scoring system was devised from scratch, drawing upon principles used in previous scenario-based studies by Professor Channon and others. This process comprised multiple stages. First, all qualitative data collected for each question was initially pooled across participants (without reference to group membership) by the main researcher and inspected carefully to identify recurrent themes or ideas in the responses. Second, participants' responses were sorted into different categories. These categories typically differed depending on the level of social skill or complexity of reasoning shown by participants' responses. Detailed guidelines were written which described each category and gave sample answers for each. These guidelines were then reviewed by members of the research team, who also attempted to classify participants' responses using the same scoring categories. Any difficulties arising were discussed further in order to refine the classification system and create the final version.

Once the final version was developed, revised guidelines describing each category were created. The main researcher and an additional, blind rater who was not a member of the research team

and had not seen the data before then scored the responses one last time using these. All disagreements between the main researcher and the blind-rater were resolved through discussion. For example, the responses provided by participants to explain why people might use simple and sophisticated strategies to respond to everyday awkward questions in the Social Strategy task ("reasoning" condition, chapter F) were originally scored by the main researcher into three different categories: 'practical', 'social' and 'emotional'. Practical responses referred to practical aspects of the situations, social rationales referred to social expectations underpinning the scenarios, and emotional rationales referred to the emotions or feelings the character would experience. After the guidelines for defining these categories were created, three additional raters attempted to classify participants' responses into them. From this process, it emerged that differentiating between 'social' and 'emotional' responses was often difficult for the raters, and that the distinction between these two categories tended to be subjective and arbitrary. It became clear that both 'social' and 'emotional' rationales shared the common characteristic of always taking the point of view of the characters, and that this differentiated them both from 'practical' rationales. This led thus to refinement of the scoring system and to the development of the two final scoring categories, 'practical' and 'character-based'. For each study, participants' responses were assigned a score depending on the category to which they belonged. Scores were always added across scenarios and converted into percentages for each participant.

E.2 RESEARCH DESIGN

A mixed between-within design was used in each experimental chapter, since different groups (those with ASD versus control participants) were compared on the same tasks. For all the studies, the clinical and control group were matched on gender, age, and their WTAR-predicted Full Scale IQ scores (FSIQ). Matched-groups designs combine the benefits of using between- and within-groups designs, since they allow us to compare the performance of different groups (the main strength of between-groups designs) whilst controlling for individual differences (the main

strength of within-groups designs). By ensuring that participants in each group have similar key features and abilities, they reduce the influence of these extraneous variables in explaining group differences.

Due to this major advantage, matched- group designs tend to be the most frequently used types of design by research studies with individuals with neurodevelopmental conditions such as ASD (Jarrold & Brock, 2004). Nonetheless, it is still important to point out that they present with some possible limitations. One common pitfall is that matching groups on a variable may lead them to be mismatched on a different one (Jarrold & Brock, 2004). A frequent disadvantage of previous experiments with individuals with neurodevelopmental disorders is that matching groups on their IQ scores means that groups are then mismatched on chronological age, whereby individuals in the clinical group are older than control participants; consequently, deficits presented by the clinical group may be masked by their greater 'experience' with the world (Bishop, 1997). This issue, however, is especially pertinent to research work with lower-functioning populations with impaired intellectual abilities. In the present research, since participants in the clinical group were all high-functioning university students, the groups did not differ significantly on either age or intellectual ability, and could thus be easily matched on both variables.

Other possible limitations of matched-group designs are that they allow only limited exploration of the developmental course of people's impairments and of individual differences presented by people with ASD. Developmental approaches include cross-sectional designs (comparing the performance of individuals of different ages at the same point in time), and longitudinal studies comparing groups (or people with themselves) at different time points. Compared to matched-design studies, these allow more insight into the trajectory through which people start to present specific deficits, and the relationship between these (e.g., between development of theory of mind and symptoms severity; Joger & Tager-Flusberg, 2004). However, they are still limited with respect to their capacity to establish causal relationships between developmental abnormalities in different

domains. Other disadvantages include possible cohort effects (for cross-sectional designs); high drop-out rates and greater sample size requirements (for longitudinal studies); greater costs and longer times required to conduct the studies. Moreover, comparison of different age groups on the same materials poses problems for many types of questions, such as those addressed in the current research. The scenario-based tasks used in the present studies were in fact developed to describe common problems experienced by adults; they are thus unsuitable for children or adolescents and would need to be adapted.

Other approaches include a focus on the examination of individual differences by exploring in depth how individuals with ASD vary in different aspects of performance. They tend to concentrate on mapping out associations among experimental task performance and multiple background measures of important domain-general abilities (e.g., attention, cognitive control, memory). It has been recommended that the effect of variance associated with variables such as age or IQ is accounted for by these studies through analysis of covariance (Jarrold & Brock, 2004). This, however, assumes certain statistical properties of the data and requires large sample sizes. Moreover, the results may be difficult to interpret if the groups differ substantially on the covariate in question (Evans & Anastasio, 1968). With respect to the current research, administration of additional background measures would have also been impractical since the participants already performed a lengthy battery of tasks.

Thus, alternative approaches to the study of neurodevelopmental disorders such as those examining developmental trajectories and individual differences also come with their own advantages and limitations. An additional (and perhaps fundamental) reason as to why a matched-group design was preferred over these approaches in the present research relates to the limited evidence currently available with regards to the types of deficits presented by higher-functioning adults with ASD. Examination of developmental trajectories and individual differences is undoubtedly important to gain a better understanding of the cognitive routes underlying

performance in those with ASD; nonetheless, at this stage, it is perhaps more urgent and helpful to improve current knowledge of what their difficulties are in the first place, and in what ways adults with ASD are likely to differ (or not differ) in their everyday social functioning compared to neurotypical individuals. The present research aimed to contribute to current knowledge by comparing adults with and without ASD whilst controlling for the effect of important key variables on performance. Once differences in performance between adults with and without ASD are more clearly established by future work, studies focusing on the exploration of developmental trajectories and individual differences might be of great informative value in addressing developmental questions and informing theoretical models.

E.2.1 INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria were fluency in English, age between 18 and 35, and a full scale IQ (FSIQ) score of 85 or above on the Wechsler test of adult reading (WTAR; Wechsler, 2001). This measure was chosen since it has been shown to have good validity and reliability with respect to predicting IQ (e.g., Spreen & Strauss, 2006), and is relatively cost- and time-effective compared to other measures of intellectual ability. All participants were relatively high-functioning, since they were all students at a leading UK university. Participants with any learning disability or history of physical illness or injury that would be likely to have affected brain function were excluded. The clinical and control groups were matched with respect to age, gender and WTAR-predicted FSIQ.

The groups were matched on their WTAR-predicted FSIQ scores because intellectual disability and ASD are known to co-occur frequently (APA, 2013). There is evidence that individuals on the autism spectrum may vary considerably with respect to their level of intellectual and cognitive functioning (Fombonne, 2003, 2005). A frequent limitation of previous studies examining social and cognitive functioning in ASD is that they have not measured or controlled for participants' level of intellectual abilities, which made it difficult to disentangle to which extent impaired

performance in those with ASD is a result of ASD versus impaired lower levels of intellectual abilities (Hill, 2004).

Age was considered an important characteristic to account for since, evidence shows that people of different ages are likely to differ significantly on a variety of domains that may influence their social functioning. These include, for example, their cognitive development and functioning, the amount of exposure that they have had to social situations, the number and nature of previous life experiences, their language, communication and social skills, self-image and perceived role in society (see e.g., Helson, Jones, & Kwan, 2002; Parks, Mitchell, & Perlmutter, 1986; von Hippel, 2007). There is also some evidence that empathy may vary as a function of age, whereby younger adults report more empathy than older adults (Phillips, MacLean, & Allen, 2002; Schieman & Van Gundy, 2000). Executive skills such as inhibition, cognitive flexibility, and working memory have also been shown to be impaired in elderly individuals (Zelazo, Craik, & Booth, 2004).

Gender has also been shown to have a key influence on social performance and functioning, and was thus controlled for across studies, despite the finding in the initial pilot work that there was no evidence of a gender effect. Females have been frequently found to display superior social skills in the neurotypical population (see e.g., Hall, 1978; Leeb & Rejskind, 2004). For instance, women seem to be more proficient at reading people's facial expressions and emotions (e.g., Erwin et al., 1992), and perform better on tests examining more subtle aspects of cognitive empathy, such as the Reading the Mind in Eyes test (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Kirkland, Peterson, Baker, Miller, & Pulos, 2013). Within the ASD population, as also reviewed in chapter A, there is evidence that females with ASD may show less pronounced social deficits than males; for example, they make more effort to engage in social interactions and try to 'blend in', are more likely to engage in pretend-play during childhood, and may present fewer or less marked obsessional or repetitive interests compared to males (see e.g., Holtmann et al., 2007).

E.2.2 PARTICIPANTS ACROSS STUDIES

Each individual study consisted of groups of 19-20 participants in the ASD group, and a similar number in the control group. Those with ASD were identified by advertising within the university for students who had been given a diagnosis of Asperger's syndrome or autism by a clinician in the past. Control participants were recruited within the same university through an online subject pool.

Since ASD is a relatively rare disorder, a relatively circumscribed pool of participants with ASD was available within university to draw upon for the studies of the thesis. Thus, a number of participants took part in more than one study. In particular, 12 participants with ASD took part in all studies, 7 took part in 4 studies (5 in chapters F and G, 2 in chapters H and I), and 8 took part in 2 studies (2 in chapters F and G, 6 in chapters H and I). The same control participants were recruited when possible. Specifically, 9 control participants took part in all studies, 8 took part in 4 studies (4 in chapters F and G, 4 in chapters H and I), and 12 took part in 2 studies (6 in chapters F and G, 6 in chapters J and K).

E.2.3 AGE AND IQ SCORES FOR PARTICIPANTS ACROSS STUDIES

Age, WTAR-predicted FSIQ, Verbal IQ (VIQ), and Performance IQ (PIQ) were examined for each group. There was no difference between groups with respect to age, $t(54)=.05$, $p=.960$, WTAR-predicted FSIQ, $t(54)=1.85$, $p=.070$, WTAR-predicted VIQ, $t(54)=1.87$, $p=.068$, or WTAR-predicted PIQ, $t(54)=1.78$, $p=.081$. Means, standard deviations and scores range for each variable are presented in Table E.1 below.

Table E.1. Minimum (Min) and maximum (Max) values, mean scores, standard deviations and significance for age, WTAR-predicted FSIQ, VIQ, and PIQ for each group.

	Group						
	Group with ASD (N=27)			Control group (N=29)			
Variables	Min	Max	Mean (SD)	Min	Max	Mean (SD)	Significance
Age	18	30	21.59 (3.09)	18	29	21.55 (2.92)	NS
WTAR-predicted FSIQ	100	117	110.56 (5.37)	95	117	107.59 (6.55)	NS
WTAR-predicted VIQ	100	117	110.41 (5.29)	95	117	107.45 (6.48)	NS
WTAR-predicted PIQ	102	117	111.04 (4.78)	97	117	108.48 (5.88)	NS

E.2.4 HEALTH HISTORY AND PRESENCE OF COMORBID DISORDERS

All participants were screened for the presence of major co-morbid mood and anxiety disorders to ensure that they met the inclusion criteria described above. This was done using the Structured Clinical Interview for DSM–IV–TR (SCID-I/NP; First, Spitzer, Gibbon, & Williams, 2002), with the addition of questions relating to DSM–IV–TR criteria for diagnosis of ADHD, which is not addressed by the SCID-I/NP.

Participants were also screened for comorbid neurological disorder by asking them for details of any history of physical illness or injury that would be likely to have affected brain function (see Figure E.1 for the full list of questions).

On the basis of this screening, three participants from the clinical group and one participant from the control group were excluded from the studies.

Figure E.1. List of questions examining presence of comorbid neurological disorders and physical health history.

1. How is your physical health? Do you have any medical problems? *Yes / No*

2. Have you ever had to stay in hospital for any reason? *Yes / No*

If Yes: Please give details

3. Are you currently taking any prescribed medication? *Yes / No*

If Yes: Please give details

4. Have you ever had:

   Heart surgery *Yes / No*

   Meningitis *Yes / No*

   Encephalitis *Yes / No*

   Diabetes *Yes / No*

   Tuberculosis (TB) *Yes / No*

   Epilepsy/seizures/fits *Yes / No*

If Yes to any: Please give details

5. Have you ever had any other serious or chronic illness? *Yes / No*

If Yes: Please give details (brief summary of type of illness, duration, age at time, treatment)

6. Have you ever fainted? *Yes / No*

If Yes: Please give details

7. Have you ever had a serious accident? *Yes / No*

If Yes: Please give details

E.3 PROCEDURE AND ETHICS

All experimental studies were carried out in pairs in a counterbalanced order (chapters F and G, chapters H and I, chapters J and K). All participants read an information sheet before taking part in the study, which outlined the rationale and procedure of the study. They provided written, informed consent, and were paid at the end for their participation. The study was approved by the UCL Research Ethics Committee and carried out in accordance with the Declaration of Helsinki as revised in 2000.

E.4 DEVELOPMENT OF DIAGNOSTIC INTERVIEW FOR ASD

The presence or absence of ASD was confirmed (or excluded) in those with ASD and neurotypical participants through the use of a semi-structured interview, which assessed whether they currently met DSM-5 criteria for ASD. The interview was devised by the research team, which included two clinicians with extensive experience in the field, who trained the main researcher to conduct the interviews. The use of this interview was preferred over standardised diagnostic measures such as the ADOS (Lord et al., 1989) for several reasons. Firstly, previous research and experience with the ADOS suggests it to be rather limited and somewhat inappropriate with high-functioning adults, since it focuses predominantly on activities relevant to lower-functioning children. Secondly, the ADOS was not designed to relate directly to DSM-5 criteria, and does not attempt to assess some of the information needed to make a diagnosis, rendering it inadequate for the purpose. Finally, the ADOS is a costly and time-consuming tool. The semi-structured interview used in the studies was developed specifically to examine different aspects of participants' everyday functioning and developmental history relevant to ASD diagnosis, and is described in more detail below.

E.4.1 GENERAL INFORMATION ABOUT THE INTERVIEW, USE OF PROMPTS, AND SCORING

The interview lasted between 45 and 70 minutes for each participant and comprised a total of 54 questions. It related closely to the current DSM-5 criteria for ASD. The first part of the interview asked participants about the presence of any qualitative impairments in social interactions (see E.4.2). This was the longest and most detailed section of the interview (22 questions in total), since the focus of the present research was to gain a better understanding of the nature of the difficulties that people with ASD present in their social functioning. The second part of the interview examined the presence of the non-social symptoms associated with ASD, and in particular of any repetitive and stereotyped patterns of behaviour, interests, and activities. It comprised a total of 14 questions (see E.4.3). The third part of the interview examined whether and to what extent participants' symptoms interfered with their everyday functioning, and comprised 4 questions (see E.4.4). The final part of the interview assessed the presence of any other condition, intellectual disability or delay that might better explain participants' symptoms (see E.4.5).

Different prompts were used throughout the interview. When participants provided only brief responses to the questions (e.g. "Yes"; "always"), they were asked standard prompts such as "Can you tell me a bit more about it?" or "Can you give me any examples?", in order to encourage them to provide more detailed information about the nature and extent of their impairments. Participants were also given prompts about the length of their difficulties, since one of the DSM-5 criteria for ASD states that symptoms need to have started in the early developmental period (although it also recognises that "these may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life"). Thus, when the history of participants' difficulties was unclear, standard prompts such as "When did this start?", or "Has this always been difficult for you?" were asked.

Each time participants gave a response that was consistent with the DSM-5 ASD diagnostic criteria, they were assigned a score of 1 for their answer; otherwise, they were assigned a score of 0. A total score was calculated for each criterion for each participant (see Table E.2). More detailed information about the types of questions asked in the interview for each criterion is provided below. Examples of responses from the group with ASD to the questions are also given in order to give a broad illustration of the range of issues reported by participants, the nature of difficulties presented, how these interfered with their everyday functioning and some of the types of strategies they developed to manage these.

E.4.2 PRESENCE OF QUALITATIVE IMPAIRMENTS IN SOCIAL INTERACTION

This section of the interview explored three different areas of impairment: (1) deficits in socio-emotional reciprocity; (2) deficits in non-verbal communicative behaviour; and (3) deficits in developing, maintaining, and understanding relationships (please see Figure E.2 below for the full list of questions asked in this section of the interview). According to the DSM-5 criteria, people need to present impairments in all of these areas of social interaction in order to be diagnosed with ASD (APA, 2013).

Deficits in socio-emotional reciprocity were examined by questions number A14-A20 (see Figure E.2). Since there were 7 questions for this domain, participants could score a maximum of 7 for this criterion. Most participants in the clinical group said that they not typically enjoy talking with other people (e.g., *"I don't thrive talking to others"; "It's not bad, but I prefer doing other things"*). Some participants stated that they enjoy talking with others only on some occasions, typically when they have "common grounds" with their interlocutors and/or have the opportunity to discuss topics that they are interested in (e.g., *"I enjoy conversations only if we can talk about what I like"*). When asked about the presence of any difficulties with turn-taking, most participants reported finding it hard to understand when it is their turn to speak in conversations, or when they should let other people

speak (e.g., "*When I start talking, I can't stop*"), although some of them described having picked up on the rules underpinning turn-taking through experience (e.g., "*I got better at it over time*") or to have developed strategies to avoid social mistakes (e.g., "*I always wait until when everyone is quiet, so I don't interrupt anyone*"). Many participants said they find it easier to know when they should let someone else talk in one-to-one conversations, and to struggle more in big groups (e.g., "*It is more difficult to make conversations in groups of people*").

When asked whether they enjoy sharing important news with others, most participants answered positively, but specified that this is typically the case only when something positive (rather than negative) happens (e.g., many participants reported being accepted to university as an example of a time when they were keen on sharing something with others). They also often specified that they enjoy more talking about their own news compared to listening to those of others *(e.g., "I'd want to hear about it, but not as much as I'd want to talk about my own thing"*). Most participants described being bothered by physical touch or contact in the context of everyday social interactions (e.g., "*I don't like people touching me, but I am not often with other people*").

Moving now to deficits in non-verbal communicative behaviours, these were examined by questions number A2-A5 (see Figure E.2). The maximum score that participants could obtain for this criterion was 4. Most participants reported finding it difficult to make eye contact with others, and that this is not a natural process for them (e.g., *"I never really make eye contact"; "I have to remind myself constantly to look at people in the eyes"),* although some of them stated that this has become easier with experience (e.g., "*I got better at it over time*"; "*it used to be a conscious effort, but it's become more automatic now*"). Some participants stated that they have developed strategies to "simulate" eye contact, such as looking between other people's eyes rather than directly into them, to avoid the discomfort associated with it whilst still coming across as socially appropriate. Difficulties with eye contact seemed to be worsened by specific factors and situations *(e.g., "When I am anxious, my eye contact drops")*; overall, most participants associated eye contact with a sense of uneasiness.

When asked about the presence of any other difficulties with non-verbal communication, many of the participants reported having been told by others about unusual features or behaviours (e.g., *"I have been told that I always look unhappy"; "People say that I never smile at the right moment"*). Notably, many participants reported to use their hands to gesture when talking to other people; however, when asked further about this, they often specified that this was common only when they were "pointing somewhere" (e.g., giving directions to someone) or "showing the dimension of an object", and much less frequent (if not completely unusual) in the context of everyday social exchanges or conversations with others.

Finally, deficits in developing, maintaining, and understanding relationships were examined by questions number A1, A6-A13, A21-A22 (see Figure E.2); participants could score a maximum of 11 for this criterion. Although many participants reported finding social situations generally difficult to manage (e.g., *"I find it difficult to start conversations, or to understand what is expected of me in social situations"),* some of them said "it depended" on various factors (e.g., how structured the situation is, *"The more structured situations are, the easier they are";* whether they are with friends versus strangers, *"I never know what to say around strangers"*). A minority of participants stated that they enjoy social situations, but acknowledged that they still them challenging (e.g., *"I enjoy social contact, but it's hard work"; "I always have to think consciously about what it might be acceptable to say or do").* When asked about their friendships, there was considerable variation in participants' responses; many reported having no close friends at all, whereas others said that they had managed to build a small circle of trustworthy friends over the years. Interestingly, a considerable number of individuals reported having close friends or partners who also had ASD, or who *"was probably also on the spectrum"*. A number of participants reported that most of their close friends are much older than them (e.g., more than ten years older), and that they find it easier to get along with older people, as they tend to be "more mature" and more "understanding" of people who are more introverted or different. When asked what friendship meant to them, many participants seemed to show only a limited understanding of this (e.g., *"A friend is someone you can have fun with"; "A friend is someone who knows*

you well"). Notably, however, there was still a number of participants who showed a more sophisticated understanding (e.g., *"Friendship means respecting and trusting one another, and being there for them to give support in times of need")*.

Most participants also described difficulties taking others' perspectives, and referred to this as a major obstacle to developing and maintaining meaningful relationships with others (e.g., *"I can't understand what other people think unless they spell it out for me"")*. Many people also said that they often struggle understanding non-literal language, such as sarcasm or jokes, and added that this can often lead to misunderstandings with friends (e.g., *"I cannot always understand when my friends are being serious or are joking. This can cause friction and arguments between us")*. Notably, some participants reported that they had become better at picking up on non-literal language over the years, and a number of them reported no difficulties at all at any point in their lives. Interestingly, some individuals reported no difficulties at understanding jokes, but specified that despite this they do not enjoy them or find them funny, and/or that they struggle to tell them in a convincing way (e.g., "*I like jokes, but I am awful at making them - nobody ever laughs!"*).

When asked whether they had ever been in trouble for something that they had said or done, all participants answered positively. A high number of them provided examples by referring to situations in which they had been asked for their opinions, and responded honestly, leading to other people being hurt (e.g., *"When people ask for my opinion, I tend to be completely honest; people find this very hurtful")*. They also often referred to having made rude comments in the past without meaning to be offensive (e.g., *"Sometimes I say socially inappropriate things without being aware")*. When participants were asked about whether they used to engage in pretend-play when they were younger, responses were mixed, with many participants who answered positively, others who were sure that they never did or enjoyed it, and others who could not remember. Interestingly, when individuals who stated that they used to engage in pretend-play were asked about the nature of their games, it emerged that these often had a repetitive and rigid connotation; for example, participants often said that

they used to spend a lot of time lining and arranging their toys in particular orders (e.g., "*I used to spend a lot of time lining up my toys in different ways*"). Many participants commented on the fact that they used to prefer playing on their own (rather than with other children), and used to be "dominating" when interacting with their peers (e.g., "*We always had to do what I wanted to do*").

Figure E.2. List of questions examining the presence of qualitative impairments in social interaction.

A1: Do you find social situations difficult? *Yes/No*

A2: Is it hard for you to make eye contact with other people? *Yes/No*

A3: Have you ever been told that there is anything unusual about your facial expressions, for example that you don't use your face to express your emotions? *Yes/No*

A4: Have you ever been told that there is anything unusual about your body language, for example that you stand too close to other people? *Yes/No*

A5: Do you use your hands to gesture when talking to other people? *Yes/No*

If Yes: Does it feel natural to use your hands? *Yes/No*

A6: Do you have friends of your own age? *Yes/No*

A7: Is it difficult for you to make friends of your own age? *Yes/No*

A8: What about with people older or younger than you? *Yes/No*

A9: What does friendship mean to you?

A10: Do you find it hard to understand what other people are thinking or feeling? *Yes/No*

A11: Do you have difficulties understanding when people say one thing but mean another, such as sarcasm and double meanings? *Yes/No*

A12: Do you understand jokes easily? *Yes/No*

A13: Have you ever been told off or in trouble for something that you have said or done, even if you thought it was OK? *Yes/No*

A14: Do you enjoy talking to other people? *Yes/No*

A15: Do you find it difficult to know when it is your turn to speak in a conversation? *Yes/No*

A16: Do you find it difficult to know when you should let someone else speak in a conversation? *Yes/No*

A17: If something important happens to you, do you want to talk about it? *Yes/No*

A18: If something important happens to someone you know, do you want to hear about it? *Yes/No*

A19: Do you prefer your own company to being with other people? *Yes/No*

A20: Does it bother you if somebody makes physical contact with you in everyday social encounters, such as touching your arm or giving you a hug? *Yes/No*

A21: When you were a child, did you like games in which you had to pretend to be different characters? *Yes/No*

A22: Did you like to make up your own stories and actions for the characters? *Yes/No*

E.4.3 PRESENCE OF REPETITIVE AND STEREOTYPED PATTERNS OF BEHAVIOUR, INTERESTS, AND ACTIVITIES

The second part of the interview examined the presence of non-social symptoms of ASD. It focused on four different areas of impairments: (1) repetitive and stereotyped patterns of behaviours or movements; (2) insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal or nonverbal behaviour; (3) presence of restricted, fixed interests that are abnormal in intensity or focus; and (4) hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspect of the environment (see Figure E.3 below for the full list of questions asked in this section of the interview). According to the DSM-5 criteria, people with ASD need to present impairments in at least two out of these four domains in order to be diagnosed with ASD.

Starting with examination of the presence of repetitive and stereotyped patterns of behaviour or movements, this was examined by questions number B8-B9 (see Figure E.3); participants could score a maximum of 2 for this criterion. Interestingly, very few participants reported the presence of stereotyped movements or behaviours, although some said that they often "tap their fingers", especially when concentrating or feeling tense. Interestingly, many participants stated that they used to show a range of repetitive and stereotyped movements when they were younger, but that they stopped doing these as they grew up. In particular, several participants reported that they used to "flap their hands" "bang their heads on walls", or "bite their clothes", usually "without knowing why".

Moving now to examining insistence on sameness and adherence to routines, or ritualised patterns of behaviour, this criterion was examined by questions B5-B7, and B10-B11 (see Figure E.3). Participants could score a maximum of 5 for this criterion. Most participants reported enjoying having routines (e.g., "*I am renowned for my routines*") and struggling significantly when these are disrupted (e.g, "*If I can't follow my routine, I get very depressed*"; "*If things don't go to plan, the rest of the day is ruined*"). Notably, some participants reported struggling significantly with change when they were

younger but having become better at it, having learnt that "in life you have to be flexible" and "things often get in the way". The routines described seemed to revolve mostly about the order in which people did different activities during the day, following certain morning or bedtime routines, eating specific foods or wearing specific clothes on certain days of the week, and taking the same routes to go to places. When people were asked about the types of steps they take to make sure that they can follow their routines, many individuals mentioned timetabling, planning ahead, using diaries or lists, phone apps, keeping food logs, and buying specific foods in "blocks". Many people also reported an exceptional capacity to spot details in the environment such as pictures out of line, and a tendency to fixate on these (e.g., *"If things are in the wrong place, I need to move them to the right place")*

With respect to the presence of restricted, fixed interests, this was assessed by questions B1-B4 (see Figure E.3); participants could score a maximum of 4 for this criterion. Although most participants reported the presence of specific interests, there was high variation among them with respect to the nature of these; frequent ones were: collecting coins, miniatures, stones, books, DVDs or music records; reading; playing chess; playing instruments; solving puzzles; exercising or playing sports; sewing; cooking. A number of participants reported spending a lot of time during the week collecting information about different topics online (e.g. through Wikipedia). Most participants stated that they find it very distressing when they cannot engage in their favourite activities (e.g., *"I get really annoyed"*), and that they find these "an important way to release stress". People varied in the amount of time dedicated to their interests, although most of them reported the need to engage in these most days of the week and at specific times.

Finally, abnormal reactivity or interest to sensory input or aspects of the environment was examined by questions B12-B14 (see Figure E.3); participants could score a maximum of 3 for this criterion. Most participants reported a marked ability to notice patterns in various aspects of environment (e.g., numbers, text, tiles, situations). Many of them also stated that they disliked

crowded places (e.g., *"Being in crowded places makes me anxious"*), and were particularly sensitive to loud noises (e.g., *"I find loud noises very stressful"*). Only few participants reported heightened sensitivity to bright lights, although some of them stated that this used to be more of a problem when they were younger.

Figure E.3. List of questions examining the presence of repetitive and stereotyped patterns of behaviour, interests, and activities.

B1. Do you have any special activities or interests that you like, such things collecting specific things, or any particular hobbies? *Yes/No*

B2. *If Yes to B1:* How many days in a week do you typically engage in them? *One or two days a week / Three or four days a week / Five or six days a week / Every day*

B3. *If Yes to B1:* How many hours do you typically engage in them each time? *0-1 hour / 2-3 hours / 4-5 hours / 5+ hours*

B4: *If Yes to B1:* If you couldn't do them, or were stopped from doing them, how distressed would you be? *Not at all/A little / moderately so / very much so*

B5. Do you have any strong routines or habits that you like to follow, like always taking the same route to somewhere or eating the same thing for breakfast? *Yes/No*

B6: *If Yes to B5:* If you couldn't do them, or were stopped from doing them, how distressed would you be? *A little / moderately so / very much so*

B7: If Yes to B5: What steps do you take to try to make sure you can do them?

B8. Do you have any mannerisms or habits like flapping your hands or twisting your fingers? *Yes/No*

B9. Do you know if you had any as a child? *Yes/No/I don't remember*

B10. Do you tend to notice or fixate on small details, like if there is a small flaw in an object or if things are out of line, such as a picture hanging unevenly? *Yes/No*

B11. *If Yes to B10:* Do you have trouble moving on to other things? *Yes/No*

B12. Do you tend to notice patterns in things, like numbers or dates? *Never/ Sometimes/ Often*

B13. Are you particularly sensitive to things like bright lights or loud noises? *Yes/No*

B14. Are you troubled by noisy or crowded environments? *Yes/No*

E.4.4 PRESENCE OF SIGNIFICANT IMPAIRMENT IN EVERYDAY FUNCTIONING

This part of the interview examined whether people's symptoms were causing any significant impairment in social, occupational and other important areas of functioning (please see Figure E.4 below for the full list of questions asked in this section of the interview). This was examined by questions D1-D4 (see Figure E.4); participants could score a maximum of 4 for this criterion. All participants said that their symptoms have a considerable impact on their social lives. Many people reported to have "no social life at all" or that this tends to be "very limited" *(e.g., "I always stick to the same friends"),* and that they often wish that they had more friends and a wider social circle. Surprisingly, people varied depending on the extent they found their symptoms distressing; some of them reported having "got used to it", and "not minding so much anymore", whereas others said that they found it upsetting not be able to "fit in" (e.g., *"I just want to be like other people"*). Often, participants reported distress when their social impairments lead to not knowing what to do in social situations and avoid them as a consequence (e.g., *"It's difficult to approach social situation, so I avoid them if I can"*; *"I have to force myself to go to social situations because they make me anxious"*), and to misunderstandings with friends or family members.

There was variation among participants depending on whether they felt their impairments affect their studies. Many felt that that having ASD has had a positive effect on their academic achievement, since for them it means that "they are more logical" than other people, and "notice things that other people can't". Some participants reported that their enhanced ability to notice details or patterns has aided them to perform successfully in their studies, especially in subjects such as maths, physics or chemistry. Other participants, however, said that their symptoms have caused them difficulties both at school and at university, especially in situations in which they are expected to work in groups or to interact with lecturers or tutors (e.g., *"It makes it harder to interact with supervisors and lecturers"*) A number of participants reported "dreading" going to lectures as this

means having to interact socially with others and often having to sit in crowded and loud environments such as lecture theatres (e.g., *"It's more difficult to concentrate if there are other people around"*). Some of them also reported difficulties with respect to adapting flexibly to the demands of studying at university, e.g. some participants described feeling stressed when lectures are cancelled or timetables change with little notice.

Individuals also varied with respect to the level of interference reported for their home lives. Some reported having "very understanding parents" who encouraged them to see being different as a "strength" and helped them to build on their social skills; indeed, some participants said that they feel they can be their "true selves" only when they are with their families (e.g., *"I feel that I am more myself at home with my family"*). Others reported that their symptoms and social difficulties often lead to arguments and misunderstanding with their family members (e.g., "*they often tell me I am selfish and not empathic*") and to significant strains on their relationships with them.

Figure E.4. List of questions examining interference of symptoms in everyday functioning.

We have talked about lots of different types of social difficulties or habits that you might have, such as (*use examples provided during the interview*). Now I am going to ask you to think about how they relate to your everyday life.

D1. Do they interfere with your social life? *Yes/No*

D2. Do they upset or trouble you? *Yes/No*

D3. What about your studies? *Yes/No*

D4. What about your home life? *Yes/No*

E.4.5 ABSENCE OF INTELLECTUAL DISABILITY OR DELAYS

According to the DSM-5 criteria, people's symptoms should not be better explained by any intellectual disability or global developmental delay. This was confirmed in several ways. Firstly, as aforementioned, participants were all students at a leading UK university, and thus relatively high-functioning. Secondly, as described in E.2 and E.3 above, they all presented WTAR-predicted FSIQ, VIQ, and PIQ scores in the average, if not above average, range. Finally, in the last part of

the interview, participants were asked to respond to a number of questions that examined the possible presence of delays or difficulties in language and motor development, cognitive skills, and academic achievement (see Figure E.5 below for the full list of questions asked in this section of the interview). This section of the interview served to confirm that participants met the inclusion criteria described in E.2, such as that they were fluent in English, and the potential presence of any other factors that might impair performance on the tasks, e.g. hearing impairments. This was not the case for any of the participants included in the studies.

Language impairment

Speaking:

E1. At what age did you learn how to speak?

E2. Do you know if it took you a bit longer than usual to learn how to speak? *Yes/No/I can't remember*

E3. Is your first language English? *Yes / No*

If No: How fluent are you in English?

E4. Please tell me all the languages you speak:

E5. What age did you start to learn each one?

Reading:

E6. At what age did you learn how to read?

E7. Have you ever been diagnosed as having dyslexia? *Yes / No*

E8. Do you have trouble with your vision that prevents you from reading ordinary print, even with glasses on? *Yes / No*

Hearing:

E9. Do you have difficulty understanding conversations because of your hearing? *Yes / No*

Cognitive impairment

Academic progress:

E10. Do you know if your parents/carers or teachers were worried about your academic progress as compared to other children your age, e.g. numeracy, reading or writing? *Yes / No*

E11. Did you have any special schooling needs? *Yes / No*

Physical impairments:

E12. Do you have difficulty in using your fingers for fine movements, such as doing up buttons? *Yes / No*

E13. Do you have any physical disabilities? *Yes / No*

Other impairments/delays in development:

E14. Do you know if your parents/carers were worried about atypical behaviours you had as a young child? For example, not showing an interest in your environment, or being slower than other children of your age to develop practical skills? *Yes / No*

E.4.6 SCORES ON THE SEMI-STRUCTURED INTERVIEW

The scores of those with ASD on each section of the interview described above were explored (see Table E.2). This provides an approximate idea of how participants within the clinical group varied on the different dimensions, and in particular on the extent of their social and non-social impairments. Although all participants were very high-functioning individuals, who often lived independently and were conducting high-level academic studies, they all still appeared to meet the DSM-5 criteria for ASD as examined by the semi-structured interview. With respect to qualitative impairments in social interactions, they all reported difficulties in socio-emotional reciprocity; non-verbal communicative behaviour; developing, maintaining, and understanding social relationships. With regards to their non-social impairments, they all presented at least two out of the four criteria provided by the DSM-5, i.e. presence of stereotyped patterns of behaviours or movements; insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal or nonverbal behaviour; presence of restricted, fixed interests that are abnormal in intensity or focus; hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspect of the environment. Moreover, all participants described their symptoms as being present from a young age, although for some individuals these became more evident in concomitance with more demanding life phases or transitions, such as for example when they started university or went to live on their own. All participants in the clinical group reported that their difficulties interfered with their everyday functioning, although, as described in E.4.4, there was variation among individuals with respect to what domain was affected the most (i.e., social, academic, or home life). None of the participants reported or seemed to present any intellectual or cognitive disability or delay that might better explain their symptoms.

Although the qualitative responses provided by participants in the interviews suggested that individuals varied considerably in the specific details and nature of their difficulties, inspection of SDs of their scores in Table E.2 indicate that participants did not seem to vary extensively on their total scores for any of the main domains. Examination of the distribution of the scores indicated

that the total scores for Domain A (qualitative impairments in social interaction), Domain B (Repetitive and stereotyped patterns of behaviour, interests, and activities), and Domain D (significant everyday impairment) were all normally distributed within the group.

Table E.2. Scores obtained by participants in the group with ASD on the semi-structured interview assessing the presence of ASD in accordance with the DSM-5 criteria.

Variables	No. of participants in the ASD group who met criterion	Min score	Max score	Mean (SD)
Domain A: Qualitative impairments in social interaction (need to present all three symptoms below) *(max score: 22)*	All	12.00	21.00	16.67 (2.20)
Deficits in socio-emotional reciprocity *(max score: 7)*	All	3.00	7.00	5.33 (1.33)
Deficits in non-verbal communicative behaviour *(max score: 4)*	All	2.00	4.00	3.07 (.68)
Deficits in developing, maintaining, and understanding relationships *(max score: 11)*	All	6.00	11.00	8.26 (1.68)
Domain B: Repetitive and stereotyped patterns of behaviour, interests, and activities (need to present at least two out of the four symptoms below) *(max score: 14)*	All	6.00	14.00	10.48 (2.29)
Repetitive and stereotyped patterns of behaviours or movements *(max score: 2)*	18	0.00	2.00	1.19 (.88)
Insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal or nonverbal behaviour *(max score: 5)*	24	2.00	5.00	4.11 (.93)
Presence of restricted, fixed interests that are abnormal in intensity or focus *(max score: 4)*	20	0.00	4.00	2.67 (1.62)

Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspect of the environment *(max score: 3)*	24	1.00	3.00	2.52 (.70)
Domain C: presence of symptoms in early developmental period	All	N/A	N/A	N/A
Domain D: significant everyday impairment *(max score: 4)*	All	2.00	4.00	3.56 (.75)
Domain E: absence of intellectual disability or delays	All	N/A	N/A	N/A

Chapter F: Social strategies to respond to awkward questions

F.1 INTRODUCTION

As reviewed in chapter C, one of the main struggles of people with ASD is to form and sustain meaningful social relationships (e.g., Locke et al., 2010). Previous clinical and qualitative reports have indicated that, although adults with ASD would be interested in befriending others, their attempts at this are typically unsuccessful. For instance, they report feeling unsure about how to approach or respond to other people's questions, and to often make rude or offensive comments without meaning to do so (e.g., Causton-Theoharis et al., 2009; Daniel & Billingsley, 2010; Frith, 1989). Problems developing lasting relationships have been linked to a range of negative consequences for well-being, such as for example isolation and loneliness (e.g., Mazurek, 2013). Despite this evidence, little empirical work has examined or identified the specific problems that they present in their everyday social interactions. A more fine-grained knowledge of the type of impairments shown by those with ASD when navigating their social environment has important implications for understanding why they may be struggling to engage in positive social interactions and for the development of more effective and tailored intervention programmes.

The present study examined the performance of those with ASD when managing relatively common but particularly challenging everyday social situations involving awkward interactions. The experiment assessed both the strategies generated by participants to manage the situations, and also their ability to judge and reason different responses that people could use in them. A closer examination of how those with ASD perceive social situations and the different ways to deal with them may illuminate the extent to which any potential difficulties in generating skilled responses are associated with impaired versus preserved aspects of understanding.

The current research extended previous work by Channon and colleagues (2012), who compared individuals with high and low self-reported levels of social skill on the Social Strategy task.

Participants were presented with a range of descriptions of social interactions, all ending with an awkward question asked by the story main character. They were then asked what they would say to the characters, and to rate how awkward each situation was. Since compliance with the characters' questions would benefit the characters, but also lead to a personal cost for participants, their verbal responses were classified as: 'simple' when they did not consider both components, i.e. participants either fully agreed to the characters' questions, or outright refused; or as 'sophisticated' when they modified the awkward questions to achieve a compromise, or provided reasons to turn them down. Sophisticated strategies were considered to reflect a higher level of social skill, since they showed greater consideration for both parties, and balanced participants' interests against the characters' expectations in a more effective way compared to simple strategies. Consistent with their predictions, the authors found that the low social skill group used fewer sophisticated strategies and a less positive emotional tone in their responses compared to the high social skill group.

In the present experiment, participants with ASD and a control group carried out two conditions of the Social Strategy task. The impact of high versus low task demands was also examined in each condition through the use of a combination of open- and closed-ended questions, since, as discussed in chapter C, this may be an important determinant of any group differences in performance (e.g., Channon et al., 2001; 2014; Callenmark et al., 2013). The first condition of the study consisted of the original version of the Social Strategy task (referred to here as the 'application' condition). Participants were asked what they would say in response to the awkward questions (high demand) and also to rate the awkwardness of the situations (low demand). This was followed by a new 'reasoning' condition, which examined how participants reasoned about a range of simple and sophisticated strategies to deal with the same awkward situations as the 'application' condition. In this latter condition, participants read descriptions of simple and sophisticated strategies, and were asked to rank-order them from the most to the least appropriate

(low demand), and to explain why people might use each of them to respond to the social scenarios (high demand).

F.1.1 HYPOTHESES

With respect to the 'application' condition, it was predicted that the group with ASD would perform in comparable ways to the low social skill group from Channon et al. (2012), i.e. that they would use fewer sophisticated strategies and a less positive emotional tone than control participants when generating responses to the situations, but would not differ from them for the lower demanding question of rating awkwardness.

With respect to the 'reasoning' condition, on the basis of previous evidence that higher-functioning people with ASD are more likely to perform in similar ways to control participants when task demand is low (e.g., Channon et al., 2014) it was hypothesised that there would be no difference between groups in how they rank-ordered the strategies, and that both groups would consider sophisticated ones to be the most appropriate. However, consistently with previous findings that people with ASD often struggle providing appropriate verbal justifications for their responses (e.g., Callenmark et al., 2013), it was expected that, compared to the control group, they would generate fewer rationales referring to the character's point of view and more practical justifications when asked to explain why people may use simple and sophisticated strategies.

F.2 METHODS

F.2.1 PARTICIPANTS AND PROCEDURE

Nineteen university students with ASD and 19 control participants (13 males, 6 females in each group) took part in the study. There was no significant difference between groups in age (ASD group mean=22.11, SD=3.30, control group mean=21.58, SD=3.02), $t(36)=.51$, $p=.611$, or IQ (ASD group mean=110.74, SD=5.56, control group mean=107.79, SD=6.16), $t(36)=1.55$, $p=.130$.

F.2.2 THE SOCIAL STRATEGY TASK, 'APPLICATION' CONDITION

The original Social Strategy task (Channon et al., 2012; termed here the 'application' condition) assessed the types of strategies that people use to respond to everyday awkward social situations. It consisted of 10 vignettes describing social interactions between participants and a main character (see Appendix A for the full list of vignettes). Each scenario ended with the character asking the participants a question, which involved either offering or requesting a favour, or an opinion. The characters' questions were designed to be socially awkward, since complying would lead to beneficial consequences for the characters, but also to a personal cost for the participants. Two different orders of presentation were used within each participants group, to control for order effects. The gender of the characters, the degree of relationship with the participants (i.e., friend, colleague, schoolmate, or neighbour) and the type of social context (i.e., family, social, or workplace) were varied across scenarios. After reading the task instructions, participants worked through an example scenario. They were then asked to state what they would say in response to the characters' questions (Figure F.1, question 1), and then to rate on a scale from 1 to 10 how awkward the situation was (Figure F.1, question 2). Each scenario was shown one at a time in printed form on a separate page of the same booklet, and remained on display when the question was presented to avoid potential confounding effects from memory load.

F.2.3 SCORING OF THE 'APPLICATION' CONDITION

F.2.3.1 Social strategies

Participants' verbal responses to the characters' questions were categorised as either 'simple' or 'sophisticated', on the basis of the extent to which they took into account both the participants' and the characters' interests. Simple strategies consisted of short responses that met only either the characters' or the participants' wishes. They included two different types of responses: 'acquiescence' or 'refusal'. Acquiescence referred to responses in which participants fully agreed without qualifying their compliance, whereas refusal referred to responses in which participants

refused outright to comply, without providing a justification (see Figure F.1 for examples of each type of strategy).

Sophisticated strategies comprised responses that showed consideration for both the participants' and the characters' perspectives. These responses negotiated a solution that limited the personal sacrifice of the participants, but also took into account the characters' expectations. They included four different types of responses. 'Qualification with excuse' and 'justification with excuse' respectively referred to responses in which participants qualified their compliance or justified their refusal on the basis of an excuse that interpreted the undesirable aspects of the situation in a more favourable light, or that mentioned the participants' inability to comply. 'Qualification with factual feedback' and 'justification with factual feedback' respectively referred to responses in which participants qualified their compliance or justified their refusal by mentioning some or all of the undesirable aspects of the situation (see Figure F.1 for examples of each type of strategy).

Participants' responses were scored by a rater blind to group membership and by another independent, non-blind rater. There was an inter-rater agreement rate of 91%; all disagreements were resolved through discussion. The scores for each strategy were added across scenarios and converted into percentages.

F.2.3.2 Emotional tone

Participants' responses were also scored depending on their emotional tone, in order to examine the manner in which participants expressed their responses. Responses were assigned a score of 1 when the emotional tone was judged to be negative (blunt or denigratory responses); a score of 2 when no particular emotional tone was identified (neutral responses); or a score of 3 when the emotional tone was judged to be positive (polite or sympathetic responses). There was an inter-rater agreement rate of 94%; all disagreements were resolved through discussion. Scores for emotional tone were firstly added up across scenarios, so that each participant received a total score ranging between 10 and 30. These were then converted into percentages.

F.2.3.3 Awkwardness ratings

Awkwardness ratings were added and averaged across scenarios.

Figure F.1. Example scenario and questions from the 'application' condition of the Social Strategy task

Example scenario:
Your cousin likes to come and stay with you. She is good company, but when she visits she expects you to pay to take her out to expensive places. She asks: 'Can I come and visit you next weekend?'

Question 1: What would you say to them in this situation?

Examples of simple strategies:

- Acquiescence: *"Ok"; "Yes"; "Fine"*
- Refusal: *"No"; "No, sorry"; "I don't think so"*

Examples of sophisticated strategies:

- Qualification with excuse: *"Of course, but I probably won't have much time to accompany you to places, because I'll be busy from work"; "Great; however, I had already planned to go to a couple of free exhibitions this weekend. You are welcome to join if you would like"; "That sounds lovely; however, you should know that I have a lot of things to do this weekend, so I am afraid that I will not be around very much"*
- Qualification with factual feedback: *"I'd like to see you, but I'm quite broke at the moment, so I think that we are going to have to look after saving money when you come here - I hope you don't mind"; "That sounds great; however, I think we should be a bit more careful looking after money this time"; "That sounds good. I am struggling a bit financially at the moment though, so it would be good if we could stay in during the evenings, instead of going out"*
- Justification with excuse: *"I'm sorry, but I'm really busy next weekend, it doesn't look like I'm going to have enough time"; "I'd love to see you, but I am already hosting another friend this weekend"; "Unfortunately I already have plans for this weekend"*
- Justification with factual feedback: *"I'd love for you to come, but unfortunately I can't afford to host you at the moment - I don't have enough money"; "I am sorry, but my budget is quite tight at the moment, I can't really afford to have a guest"; "I am a little low on cash right now, it would be best if we could see each other another time if you don't mind"*

Question 2: On a scale from 1 to 10, where 1 represents 'not at all awkward' and 10 represents 'very awkward', how awkward would you say this situation is?

F.2.4 SOCIAL STRATEGY TASK, 'REASONING' CONDITION

This novel condition of the Social Strategy task was designed to examine how participants evaluated and reasoned about different ways to deal with the same awkward situations used in the 'application' condition. Participants were first presented with an example scenario, along with a list of descriptions of six response strategies (see Figure F.2). For each strategy description (e.g., 'to agree'), they were asked to generate an example of what people might say if they chose it, to ensure that they understood each of the strategy labels. Participants were then shown practical examples of each type of strategy. Once they had completed the example, they were asked to rank-order the six different types of response strategies, from the most to the least appropriate (Figure F.2, Question a), and to explain why people might choose each type of response strategy for each of the same ten scenarios of the 'application' condition (Figure F.2, Question b). Participants were instructed to base their responses on how most people would answer, to encourage them to reflect on what is generally appropriate rather than to consider only their personal preferences.

F.2.5 SCORING OF THE 'REASONING' CONDITION

F.2.5.1 Strategies rank-ordering

The number of times each strategy was selected as the best was added across scenarios and converted into percentages.

F.2.5.2 Rationales

The rationales provided by participants to explain why people might use each type of strategy were categorised as 'practical' or 'character-based'. Rationales were scored as practical when they referred to practical resources, such as time or money. They were classified as character-based when they referred to the story characters' expectations, thoughts or feelings (see Figure F.2 for examples of each type of rationale). Responses could score for only one of the two categories; if both were met, then the best answer would be taken, and participants' rationales would score in the character-based category. There was an inter-rater agreement rate of 92%; all disagreements

were resolved through discussion. Scores for each type of rationale were added across scenarios and converted into percentages.

Figure F.2. Example scenario and questions from the 'reasoning' condition of the Social Strategy task

Example scenario:
Your cousin likes to come and stay with you. She is good company, but when she visits she expects you to pay to take her out to expensive places. She asks: 'Can I come and visit you next weekend?'

Question a: Please rank-order the following types of answers to the character's question from the most to the least appropriate:
    a) To agree
    b) To suggest a compromise based on a polite excuse
    c) To suggest a compromise based on your honest opinion about the situation
    d) To refuse based on a polite excuse
    e) To refuse based on your honest opinion about the situation
    f) To refuse

Question b: Why might people choose a)?
              Why might people choose b)?
              Why might people choose ..)?

Examples of rationales:
E.g., why might people choose to compromise based on a polite excuse?
- Practical: *"If they want to save at least some money"; "They are worried about taking the time and spending the money on something they don't really need"; "They can't afford to host their cousin"*
- Character-based: *"They don't want to get into a fight with a family member"; "They don't want to risk upsetting someone they care about"; "They want to keep their cousin happy"*

F.3 RESULTS

F.3.1 NOTES ON STATISTICAL ANALYSES

Variables across all experimental studies were initially examined for skewness and outliers using the methods described by Tabachnick and Fidell (1983). When variables approximated a normal distribution, parametric analyses were performed, since parametric tests are more robust than non-parametric ones (e.g., Howell, 1997), and allow testing for interactions between multiple variables. When assumptions for normality were not met, transformations were performed to meet assumptions of normality where possible. When variables could not be transformed to normality, non-parametric tests were carried out. All statistical analyses held with and without transformations or outliers, unless stated otherwise. A significance level of p=.05 was adopted across all experimental chapters. A stricter significance level of p=0.5/number of comparisons was used to control for multiple comparisons. Since the number of male and female participants in each group was imbalanced in all studies, the analyses were always repeated with gender as a covariate to control for the influence of this on the pattern of findings. These were reported at the end of the 'Results' sections of each experimental chapter.

F.3.2 DATA ANALYSIS

Means and standard deviations (SDs) for each measure are shown in Table F.1 for the 'application' condition, and in Table F.2 for the 'reasoning' condition. All variables were normally distributed; thus the parametric analyses were reported.

F.3.3 SOCIAL STRATEGY TASK, 'APPLICATION' CONDITION

F.3.3.1 Social strategies

The two groups were compared on their usage of simple and sophisticated strategies. The group with ASD used a significantly lower percentage of sophisticated strategies compared to the control group, $t(36)$=5.17, p<.0001. Whilst the group with ASD used simple strategies almost half of the

time, sophisticated strategies accounted for the majority of the responses given by the control group.

F.3.3.2 Emotional tone

The two groups were compared on the emotional tone of their responses. The group with ASD was found to score significantly lower overall for emotional tone than the control group, $t(36)=4.38$, $p<.0001$.

F.3.3.3 Awkwardness ratings

The two groups were compared on their ratings of perceived awkwardness. There was no significant difference between groups in their ratings, $t(36)=1.06$, $p=.298$.

Table F.1. Mean scores, standard deviations, significance, and effect sizes for the 'application' condition of the Social Strategy task.

	Group			
	Group with ASD (N=19)	Control group (N=19)		
Variables	Mean (SD)	Mean (SD)	Significance	Effect size
Social strategies (%)			***	
Simple	47.37 (23.53)	14.74 (14.29)		1.68
Sophisticated	52.63 (23.53)	85.26 (14.29)		1.68
Emotional tone (%)	59.65 (11.96)	75.79 (10.71)	***	1.42
Awkwardness ratings (%)	41.47 (15.25)	45.74 (8.79)	NS	0.34

* p<.05, ** $p<.01$. *** $p<.001$

F.3.4 SOCIAL STRATEGY TASK, 'REASONING' CONDITION

F.3.4.1 Strategies rank-ordering

The two groups were compared on their rank-ordering of simple and sophisticated strategies as the most appropriate. There was no significant difference between groups in the number of times they rank-ordered sophisticated strategies as the most appropriate, $t(36)=.99$, $p=.328$. Both groups rank-ordered sophisticated strategies as the most appropriate overall.

F.3.4.2 Rationales

The two groups were compared on the types of verbal rationales they generated to explain why people might use simple and sophisticated strategies. A repeated-measure 2x2 ANOVA (group by type of strategy: simple versus sophisticated) was conducted to examine the percentage of rationales classified as practical versus character-based. The main effect of type of strategy was not significant, $F(1,36)=1.76$, $p=.193$. There were a significant main effect of group, $F(1,36)=10.10$, $p=.003$, and a significant group by type of strategy interaction, $F(1,36)=6.33$, $p=.016$. Post-hoc t-tests using a corrected significance level ($p=0.5/2=0.025$) showed that the group with ASD provided a significantly lower percentage of character-based rationales to justify the use of simple strategies, $t(36)=4.14$, $p<.0001$; there was no significant difference between groups in percentage of character-based rationales to justify the use of sophisticated strategies, $t(36)=1.48$, $p=.149$.

F.3.4.3 Analyses with gender as a covariate

As outlined in F.3.1, any effect of gender on the results was examined by repeating the analyses using this as a covariate; this did not alter the pattern of findings.

F.3.4.4 Correlations between interview scores and performance on the task

Correlational analyses between the scores of participants with ASD on each domain of the semi-structured interview examining whether they met current diagnostic criteria (see Table E.2 in chapter E), and their scores on each task were performed for each chapter, using a strict significance level (p<.01). The scope of this was to explore whether participant inter-variability

might have had any influence on participants' performance on the tasks. Thus, for the Social Strategy task, correlations between scores on the interview and scores on each variable from the "application" and "reasoning" condition of the Social Strategy task were conducted for participants with ASD. None of these correlational analyses were statistically significant, p>.05.

Table F.2. Mean scores, standard deviations, significance, and effect sizes for the 'reasoning' condition of the Social Strategy task.

	Group			
	Group with ASD (N=19)	Control group (N=19)		
Variables	Mean (SD)	Mean (SD)	Significance	Effect size
Strategies rank-ordering (%)			NS	
Simple	31.05 (21.83)	25.26 (13.07)		0.32
Sophisticated	68.95 (21.83)	74.74 (13.07)		0.32
Character-based rationales (%)			Strategy NS Gp ** Strategy x Gp *	
Simple	46.84 (14.74)	66.58 (14.63)	***	1.34
Sophisticated	56.18 (15.01)	63.68 (16.32)	NS	0.48

* p<.05, ** *p*<.01. *** *p*<.001

F.4 DISCUSSION

In the present study, participants with ASD and a control group performed two conditions of the Social Strategy task (Channon et al., 2012): 'application' and 'reasoning'. The 'application' condition presented the groups with a range of scenarios ending with an awkward question asked by a main character, and examined how participants responded to it. The 'reasoning' condition was a novel condition examining how the groups evaluated and reasoned about simple and sophisticated strategies to respond to the same awkward questions as in the 'application' condition. Both conditions presented participants with different types of task demand, by asking them to respond

to both open-ended and closed questions, to explore how this may also impact on group differences in performance.

One of the key findings in the 'application' condition of the current study was that, as expected, the group with ASD generated fewer sophisticated strategies and expressed themselves overall in less courteous terms with respect to emotional tone. Strategies of this type negotiated solutions that limited participants' personal cost, but also still showed consideration for the characters' expectations. Participants with ASD, instead, used more simple strategies, which mostly consisted of one- or two-word responses that either fully complied with the characters' questions ("Ok"), or refused outright without giving a reason ("No, you can't"). With respect to perceived awkwardness, it could be argued that people with ASD may feel less capable of dealing with social situations, and thus feel more awkward; on the other hand, reduced awareness of the nuances characterising the social situations may mean that they do not perceive the awkwardness. The similar awkwardness ratings provided by the two groups appear to suggest that the group with ASD did not differ in their perceptions.

The present pattern of findings replicates and extends those of Channon et al. (2012). Using only the 'application' condition of the current study, they also found that people with low levels of self-reported social skill generated fewer sophisticated strategies with an overall less positive emotional tone than participants with high levels of self-reported social skill. This suggests that the Social Strategy task is potentially a sensitive research tool to identify quantitative and qualitative differences in performance in both subclinical and clinical populations. With respect to the 'reasoning' condition, the finding that on rank-ordering both groups judged sophisticated strategies to be the most appropriate responses to the scenarios suggests that the group with ASD was able to recognise these as the most skilled ways to deal with the characters' awkward questions, despite having generated fewer of them in the 'application' condition. Their performance across

the two conditions differed from that of control participants, who were able to both generate more sophisticated strategies, and also rank-order them as the most appropriate.

However, when the more demanding task of generating rationales for using the different strategies is considered, the picture becomes more complex, since the group with ASD performed similarly to the control group on the sophisticated strategies but not on the simple ones. Whilst the control group was more likely to generate reasons involving the character to justify the use of simple strategies, the group with ASD made more references to the practical aspects of the situations; this implies differences in the ways that the two groups reasoned about simple strategies. The finding that the groups gave similar number of both practical and character-based rationales for sophisticated strategies, however, suggests that the group with ASD could reason in similar ways to the control participants about these. It is possible that the provision of sophisticated response strategy descriptions that explicitly cued participants to consider compromises or justifications for refusals may have drawn their attention to the need to take into account the characters' viewpoints, as well as their own. Thus, it is possible that the group with ASD was either not able or not motivated to consider the characters spontaneously in their reasoning unless cued to do so.

An intact ability to rank-order strategies and to use character-based rationales for evaluating sophisticated strategies by the group with ASD in the context of impaired performance in the 'application' condition is consistent with previous evidence suggesting that individuals with ASD can perform similarly to control participants on less demanding questions. For instance, a recent study by Callenmark and colleagues (2013) also found that adolescents with ASD were able to judge the appropriateness of a range of social behaviours using a multiple-choice answering format. However, when they were required to justify their ratings by generating free verbal responses, the group with ASD provided rationales of poorer quality compared to the control participants. The authors suggested that the use of a multiple-choice format may have reduced the demands on participants' cognitive and social abilities, and thus accounted for intact performance by the group

with ASD. With respect to the current study, a number of theoretical models might help to explain the pattern of findings; given the social nature of the task at hand, social accounts such as impaired empathy and reliance on social knowledge seem particularly plausible. The possible contribution of less empirically supported types of accounts or of the non-social models of ASD will be examined in the general discussion of the thesis, in chapter L.

One possible explanation for the less socially skilled performance by those with ASD is that they may have struggled to consider the characters' perspectives in producing their responses, due to deficits in cognitive empathy. The awkward scenarios of the Social Strategy task involved a conflict between the interests of the participants and those of the characters. With respect to the 'application' condition, impaired ability by the group with ASD to take the characters' points of view into account might have translated into decreased motivation to generate sophisticated response strategies that considered both the participants' and the characters' interests, and also to adopt a more positive emotional tone. Participants with ASD might have been less able to appreciate how the use of simple strategies and harsher tone would impact on the characters, and in particular how these might be more likely to cause a negative reaction. In contrast, the control group might have been more aware of the characters' perspectives, and thus been more motivated to generate sophisticated strategies and use a more courteous emotional tone, which would keep the characters happy and not hurt their feelings.

With respect to the 'reasoning' condition, impaired mentalising in those with ASD might also explain why the group with ASD was less likely than control participants to provide rationales that considered the characters. There were two types of simple strategies: acquiescence and refusal. Acquiescence referred to complying fully with the characters' questions; although this strategy may appear to be an easy way to spare the characters' feelings by immediately agreeing to satisfy their wishes, the participants with ASD were still more likely than the control group to focus on its practical advantages in their rationales. For instance, acquiescence was often seen as an efficient

method of escaping the awkward situations ("Sometimes it's just easier to say yes"), or as a way of deceiving the characters when these asked for a favour ("You can say yes now, but not actually do it in the end"). This was in contrast with the types of rationales provided by the control group, which instead referred more often to the impact that compliance would have on the characters ("The cousin is family, and they care about keeping a good relationship with their family"). An impairment in cognitive empathy might have led the group with ASD to be less likely to focus on the characters' points of view in their reasoning about acquiescing. The types of rationales used by the group with ASD also indicate that in the 'application' condition, their increased tendency to generate this strategy may have been attributable to its practical benefits, rather than the benefits for the characters' feelings or their relationship with them. Participants with ASD may thus have chosen to acquiesce in order to make a rapid escape from the awkward situations rather than with the intention of pleasing the characters. This is especially plausible since the scenarios made it clear that individuals would generally not wish to comply with the characters' requests.

Refusal, on the other hand, consisted of declining outright to comply with the characters' awkward requests. Thus, this strategy clearly favoured the interests of the participants, and at the same time was likely to have a negative impact on the characters' feelings. Like for acquiescence, the group with ASD was more likely to refer to the practical advantages of refusing ("you will save money if you say no"), whilst the reasoning of the control group was more likely to focus on the characters, for instance highlighting circumstances in which the relationship would not suffer through refusal ("people might refuse if they are close enough to their cousin to know that she will not be offended"). Also in this case, impaired cognitive empathy might have led those with ASD to be more likely to focus on the practical advantages of refusing over its impact on the characters' feelings compared to the control group; this further supports the suggestion that an inability to appreciate how refusing would affect the characters' feelings might explain why the group with

ASD used this strategy more frequently to respond to the awkward questions in the 'application' condition.

Another possible explanation for the present pattern of findings might relate to the presence of differences between the groups in their language abilities. As reviewed in chapter B, there is some evidence that verbal fluency is reduced in those with ASD compared to neurotypical individuals (e.g., Minshew et al., 1992). It is possible that, with respect to the current study, participants with ASD might have unable to generate skilled strategies or more elaborated rationales due to limited language abilities, rather than because of difficulties processing the social situations effectively. Reduced language skills might also explain why those with ASD could rate perceived awkwardness or rank-order simple and sophisticated strategies in similar ways to neurotypical individuals. Since these questions did not involve the requirement to produce free verbal responses, they were unlikely to place heavy demands on participants' language abilities. This account is, however, implausible, since a number of experiments have contradicted the notion of impaired verbal fluency in ASD; indeed, recent work has found intact or even superior language skills in higher-functioning individuals with average IQs (Ghaziuddin & Mountain-Kimchi, 2004; McCrimmon, Schwean, Saklofske, Montgomery, & Brady, 2012). Moreover, an explanation in terms of reduced language skills fails to explain why those with ASD could still provide similar rationales to control participants for the sophisticated strategies. If impaired language was at the root of their difficulties in generating skilled strategies and rationales, then this would be expected to affect all their free responses and not only a subset of them.

Reliance on compensatory social knowledge might provide a better explanation for the present pattern of findings. The use of compensatory social knowledge and skills is thought to be one of the main reasons why those with ASD can sometimes pass social cognition tasks, despite still lacking intuitive empathic skills in everyday social interactions (Bowler, 1992; Happé, 1994). In the current study, reliance on this resource may have aided the group with ASD to give similar

estimates to the control group of the awkwardness of the situations in the 'application' condition. Similarly, compensatory knowledge may also have been sufficient for the group with ASD to rank-order strategies as more or less appropriate in similar ways to control participants. This is especially plausible considering that both ratings and rank-ordering are considerably less demanding tasks than generating free verbal responses.

Could reliance on compensatory social knowledge also explain why those with ASD were able to give a similar number of character-based rationales for sophisticated strategies in the 'reasoning' condition, although not for the simple condition? It is plausible that practical rationales were overall easier to access for the group with ASD compared to character-based ones, as a result of difficulties in taking the characters' perspectives. However, the requirement to reflect on why people might choose compromises or justifications may have encouraged those with ASD to take the characters' perspectives into consideration in reasoning about these strategies, in contrast with the simple strategies, which did not contain such cues. Moreover, it might be hard to imagine why someone would make the effort to compromise or give a justification on the basis of the practical aspects of the situation alone. Considering someone else's perspective in their responses is likely to be a less natural process for people with ASD, and responding to questions about compromises or justifications may have helped them to appreciate the inadequacy of practical rationales alone, and thus to put more effort into thinking about alternative explanations. Thus, this finding suggests that the provision of cues might, at least in some circumstances, help those with ASD to consider more carefully other people's perspectives in their reasoning. Future research might follow-up the present findings by swapping the order of the conditions of the current task, by presenting the 'reasoning' condition first. It would be interesting to examine whether cuing participants through the presentation of simple and sophisticated strategies in the 'reasoning' condition would affect subsequent performance when required to generate strategies to respond to the awkward questions in the 'application' condition.

In summary, the present study extended the Social Strategy task (Channon et al., 2012) to explore how people with ASD respond to everyday awkward social situations, and how they reason about different ways to respond to them. Participants with ASD were found to generate fewer socially skilled responses and to use a harsher emotional tone to respond to everyday awkward situations. When their ability to reason about simple and sophisticated strategies was examined, they generated fewer character-based rationales to justify the use of simple strategies, but did not differ from control participants in their rationales for sophisticated strategies, or in their ability to rank-order strategies on the basis of their social appropriateness.

The study described in the next chapter was conducted in conjunction with the experiment described here. It aimed to examine everyday social performance and skills in those with ASD with a new task, assessing their ability to adapt their social judgements flexibly across different types of situations and circumstances.

Chapter G: Judging social appropriateness across circumstances

G.1 INTRODUCTION

Chapter F examined how people with ASD responded to and reasoned about everyday awkward interactions between themselves and a familiar character. This experiment will now investigate their ability to adapt flexibly their social judgements and behaviours to situations where different types of social rules apply.

Social rules play an important role in guiding people's everyday social interactions, by defining what types of behaviours are considered acceptable and how people are (or are not) expected to act. One of the core features of social norms is that they are not absolute, but rather depend on the type of circumstances or situation at hand. For instance, rules often differ substantially across cultural groups (e.g., whereas tipping is normative in many European and American states, in some countries such as Japan it is considered a rude practice), and tend to change over time (e.g., not all behaviours that are considered acceptable today were deemed appropriate fifty years ago). A behaviour that is accepted or praised in one group, culture or situation may not be well tolerated in another; thus, people need to be aware of the fluctuating nature of social norms, and to be able to apply these flexibly across different situations and circumstances in order to navigate social situations successfully (Bicchieri, 2005; Xenitidou & Edmonds, 2014; Zager., Wehmeyer, & Simpson, 2012).

There is an extremely wide range of factors other than culture or time determining which behaviours are to be considered appropriate in a given social situation. One aspect that influences many of people's everyday interactions is the type of relationship they have with one another (e.g., Argyle, Henderson, & Furnham 1985). For instance, it is considerably less appropriate for a woman to advise a stranger on the street to lose some weight than it is for her to do the same with her husband of many years. Social rules also vary extensively across different contexts (e.g., Argyle,

Furnham, & Graham, 1981). Many social behaviours that are considered acceptable in informal settings (e.g., at a relaxed social gathering) are not as well-received within more formal situations (e.g., during a lecture). For example, whereas there might be nothing wrong with bursting into laughter during an informal party with friends, this is less likely to be seen as an appropriate behaviour in the context of a funeral.

Overall, situations involving less familiar individuals and/or occurring within more formal contexts appear to posit stricter constraints, since fewer behaviours are considered acceptable in them compared to other types of situations. Indeed, studies within the field of social psychology have suggested that in the presence of familiar individuals and/or within informal situations people are more likely to act on the basis of their honest thoughts, preferences and opinions, whereas they are more concerned with scripts and manners when interacting with strangers and/or within more formal settings (Snyder & Ickes, 1985). For instance, people are more self-aware, monitor their behaviours more carefully, and talk and disclose less when conversing with unfamiliar individuals (Dindia, Fitzpatrick, & Kenny, 1997). Similarly, in formal situations, they report being more concerned about etiquette, feeling less confident about what they should do or say, and worrying more about the possibility of making social mistakes (Latané, 1981).

Do people with ASD show similar sensitivity to these situational factors in guiding their judgements of and responses to social situations? As reviewed in chapters B and C, previous evidence indicates that people with ASD might be able to learn many of the social rules underpinning everyday interactions. However, it is unclear whether they are also able to apply these flexibly across situations. Clinical observations indicate that children with ASD may interpret rules differently compared to their typically-developing counterparts, whereby they struggle to appreciate their relative nature, and see them as absolute or carved-in-stone codes of conduct. Indeed, some authors have suggested that children with ASD may even 'cling' to rules, as these help them to give themselves a sense of predictability and control over the world (Grandin &

Barron, 2005). This may lead to a rigid understanding and application of them across situations; for instance, once told that they should not lie, children with ASD might struggle appreciating that this might still be considered acceptable in other types of situations, such as for example in the case of white lies to protect someone else's feelings (Li, Kelley, Evans, & Lee, 2011). There is however little empirical work examining understanding and application of social norms in ASD, especially in relation to the performance of higher-functioning adults.

The present study was thus designed to examine the ability of adults with ASD to adapt their judgements and responses flexibly to a range of situations characterised by different types of expectations and norms. Participants with and without ASD read a range of brief descriptions of everyday social interactions, which all involved raising an awkward issue with another individual. They were then shown descriptions of three different characters, varying in their degree of familiarity to the participants, all presented within each of three different contexts, varying in degree of formality. The groups were asked to rate both how socially appropriate it would be and also how comfortable they would feel raising the awkward issues with each character in each context.

G.1.1 HYPOTHESES

As reviewed above, although the empirical support for this is limited, previous clinical evidence suggests that children with ASD struggle adapting social rules flexibly across different situations. For this reason, it was expected that, compared to neurotypical participants, those with ASD would show reduced sensitivity in their judgements to the situational variables manipulated in the study. In particular, an interaction between the manipulations and group was expected, so that both the appropriateness and discomfort ratings provided by the group with ASD would be less strongly affected by the familiarity of the characters and formality of contexts compared to those given by control participants.

140

G.2 METHODS

G.2.1 PARTICIPANTS AND PROCEDURE

Nineteen university students with ASD and 19 control participants (13 males, 6 females in each group) took part in the study. Participants were recruited and diagnosed using the same procedure, inclusion and exclusion criteria as those described in chapter E. There was no significant difference between groups in age (ASD group mean=22.11, SD=3.30, control group mean=21.58, SD=3.02), $t(36)=.51$, $p=.611$, or IQ (ASD group mean=110.74, SD=5.56, control group mean=107.79, SD=6.16), $t(36)=1.55$, $p=.130$.

G.2.2 THE SOCIAL APPROPRIATENESS QUESTIONNAIRE

This questionnaire was designed to assess participants' ability to judge the appropriateness of a range of everyday social interactions, and to adapt their judgements flexibly according to the characteristics of different situations. Participants were presented with 8 descriptions of social behaviours that involved raising an awkward issue (e.g., bad breath) with a fictional character (see Appendix B for the full list of vignettes). Two factors were manipulated throughout the questionnaire: a) the familiarity of the characters and b) the formality of the contexts they were in. Thus, for each interaction participants were shown descriptions of 3 characters, who were either very familiar, moderately familiar, or not very familiar to the participants. These were presented within each of 3 different contexts, which were either very, moderately, or not at all informal (see Figure G.1 for examples). Two different orders of presentation of the behaviours were used within each group of participants, to control for order effects. After reading the task instructions and working through an example, participants were asked to rate on a scale from 1 to 10 (1) how appropriate it would be, and (2) how comfortable they would personally feel raising each of the awkward issues with each character and in each context (see figure G.1 for an example). When rating appropriateness, participants were instructed to base their responses on how most people would answer, to encourage them to reflect on what is generally appropriate rather than to consider

only their personal preferences. Participants' ratings for each of the nine options (i.e., each character in each context) were added across items and converted into percentages for each question.

Figure G.1. Example item and questions from the Social Appropriateness questionnaire

Example item: To tell someone that they often have bad breath

Question 1: On a scale from 1 to 10, where 1 represents "not at all appropriate" and 10 represents "very appropriate", how appropriate would most people think it is in the following circumstances to:

- Tell someone <u>very familiar</u> (for example a close friend or a family member of a similar age) that they often have bad breath
      a) When you are alone together
      b) In a casual social setting with others
      c) In a formal social setting with others

- Tell someone <u>moderately familiar</u> (for example a neighbour or a fellow student) that they often have bad breath
      a) When you are alone together
      b) In a casual social setting with others
      c) In a formal social setting with others

- Tell someone <u>not very familiar</u> (for example an acquaintance or someone you have recently met) that they often have bad breath
      a) When you are alone together
      b) In a casual social setting with others
      c) In a formal social setting with others

Question 2: On a scale from 1 to 10, where 1 represents "not at all comfortable" and 10 represents "very comfortable", how comfortable would you personally feel if you:

- Told someone <u>very familiar</u> (for example a close friend or a family member of a similar age) that they often have bad breath
   a) When you are alone together
   b) In a casual social setting with others
   c) In a formal social setting with others

- Told someone <u>moderately familiar</u> (for example a neighbour or a fellow student) that they often have bad breath
   a) When you are alone together
   b) In a casual social setting with others
   c) In a formal social setting with others

- Told someone <u>not very familiar</u> (for example an acquaintance or someone you have recently met) that they often have bad breath
   a) When you are alone together
   b) In a casual social setting with others
   c) In a formal social setting with others

G.3 RESULTS

G.3.1 DATA ANALYSIS

Means and SDs for each measure are shown in Table G.1. All variables were normally distributed, except for the appropriateness ratings for 'not very familiar' characters when 'alone together', and the discomfort ratings for 'not very familiar' characters in a 'formal social setting with others', which were both negatively skewed for the group with ASD. Thus, square root transformations were performed on the relevant measures to meet criteria for parametric analysis.

G.3.2 APPROPRIATENESS RATINGS

A repeated-measure 3x3x2 ANOVA (type of character: very, moderately, not very familiar; by type of context: very, moderately, not very formal; by group) was conducted to compare the appropriateness ratings provided by the groups. There was a significant main effect of type of character, $F(2,35)=166.16$, $p<.0001$, a significant main effect of type of context, $F(2,35)=158.74$, $p<.0001$, and a significant type of character by type of context interaction $F(4,33)=58.78$, $p<.0001$. There was no significant main effect of group, $F(1,36)=.01$, $p=.919$, no significant type of character by group interaction, $F(2,35)=.41$, $p=.669$, no significant type of context by group interaction, $F(2,35)=.99$, $p=.383$, and no significant type of character by type of context by group interaction, $F(4,33)=1.33$, $p=.280$. The lack of significant group interactions suggests that groups' ratings were not differentially affected by the familiarity of the characters or by the informality of the contexts. From inspection of the means presented in Table G.1, it is clear that ratings for both groups increased as a function of the familiarity of the characters and of the informality of the contexts.

G.3.3 'HOW COMFORTABLE' RATINGS

A repeated-measure 3x3x2 ANOVA (type of character by type of context by group) was conducted to compare the discomfort ratings provided by the groups. There were a significant main effect of type of character, $F(2,35)=138.70$, $p<.0001$, a significant main effect of type of context, $F(2,35)=171.25$, $p<.0001$, and a significant type of character by type of context interaction

$F(4,33)=23.85$, $p<.0001$. There was no significant main effect of group, $F(1,36)=.32$, $p=.576$, no significant type of character by group interaction, $F(2,35)=.55$, $p=.582$, no significant type of context by group interaction, $F(2,35)=1.12$, $p=.337$, and no significant type of character by type of context by group interaction, $F(4,33)=.49$, $p=.743$. The lack of significant group interactions suggests that groups' ratings were not differentially affected by the familiarity of the characters or by the formality of the contexts. From inspection of the means presented in Table G.1, it is clear that ratings for both groups increased as a function of the familiarity of the characters and of the informality of the contexts.

G.3.4 ANALYSES WITH GENDER AS A COVARIATE

Any effect of gender on the results was examined by repeating the analyses using this as a covariate; this did not alter the pattern of findings.

G.3.5 CORRELATIONS BETWEEN INTERVIEW SCORES AND PERFORMANCE ON THE TASK

Correlations between scores on the interview examining whether participants met current diagnostic criteria, and scores on each variable from the Social Appropriateness questionnaire were conducted for participants with ASD. None of these correlational analyses were statistically significant, p>.05.

Table G.1. Mean scores, standard deviations, significance, and effect sizes for the Social Appropriateness questionnaire

	Group				Effect size
	Group with ASD (N=19)	Control group (N=19)			
Variables	Mean (SD)	Mean (SD)	Significance		Effect size
'How appropriate' ratings (%)			Character	***	
			Context	***	
			Gp	NS	
			Char x Cont	***	
			Char x Gp	NS	
			Cont x Gp	NS	
			Char x Cont x Gp	NS	
Very familiar characters					
Alone together	78.55 (9.12)	79.80 (12.12)			0.12
In casual setting	57.89 (12.19)	57.83 (13.38)			0.00
In formal setting	40.86 (12.88)	40.92 (13.25)			0.00
Moderately familiar characters					
Alone together	54.87 (14.06)	58.88 (11.78)			0.31
In casual social setting	43.36 (13.34)	42.30 (9.72)			0.09
In formal social setting	32.30 (11.79)	30.39 (9.30)			0.18
Not very familiar characters					
Alone together	36.51 (15.03)	36.64 (11.18)			0.00
In casual social setting	29.34 (12.37)	26.58 (7.37)			0.27
In formal social setting	22.96 (9.99)	20.46 (6.56)			0.30
'How comfortable' ratings (%)			Character	***	
			Context	***	
			Gp	NS	
			Char x Cont	***	
			Char x Gp	NS	
			Cont x Gp	NS	
			Char x Cont x Gp	NS	
Very familiar characters					
Alone together	76.91 (12.79)	76.78 (11.47)			0.01
In casual setting	59.54 (17.46)	58.09 (12.29)			0.10
In formal setting	44.93 (20.08)	43.36 (12.73)			0.09
Moderately familiar characters					
Alone together	54.36 (19.22)	54.61 (9.44)			0.02
In casual social setting	44.01 (19.61)	41.71 (8.38)			0.15
In formal social setting	34.80 (18.92)	30.53 (5.97)			0.30
Not very familiar characters					

Alone together	37.24 (18.96)	35.46 (10.78)	0.70
In casual social setting	30.46 (17.44)	25.72 (5.45)	0.37
In formal social setting	24.80 (16.26)	19.01 (4.50)	0.49

* p<.05, ** *p*<.01. *** *p*<.001

G.4 DISCUSSION

The present study examined participants' ability to adapt their social judgements and responses flexibly to a series of situations characterised by different social rules and expectations. Participants with and without ASD were presented with a range of descriptions of interactions that involved raising an awkward issue (e.g., bad breath) with another individual. They were then asked to rate how appropriate it would be and how comfortable they would personally feel raising these issues with different characters varying in their degree of familiarity to them, and within different contexts varying in their degree of formality. It was predicted that the ratings provided by those with ASD would be less affected by the familiarity of the characters and formality of contexts compared to those given by control participants. This hypothesis was not supported, since no difference was found between the groups in their ratings; all participants, regardless of group membership, judged the behaviours as more appropriate and reported feeling more comfortable in the presence of more familiar people and within more informal contexts.

Social rules underpinning everyday interactions vary across circumstances, so that a behaviour that is accepted in a group, culture or situation might not be in another. The degree of familiarity between individuals and the context they are in are two among the many factors that influence what types of behaviours can be considered acceptable versus unacceptable in a given situation. The findings of the present study suggest that people with ASD may be able to recognise the importance of these situational aspects in their judgements, and to adapt their responses accordingly in a similar fashion to neurotypical people.

There are at least two possible explanations for the present pattern of findings. Firstly, it is possible that people with ASD may have learnt, potentially through experience or explicit teaching, about

the importance of these situational factors in determining the acceptability of different types of interactions. For example, people with ASD may have developed similar awareness of the fact that behaviours such as telling someone that they have bad breath are typically less acceptable in the presence of a less familiar person (e.g., a stranger) or in the context of a formal situation (e.g., a work meeting) compared to other types of circumstances involving more familiar individuals and more informal contexts.

Another potential account for the present pattern of findings is that the questionnaire may have not been sufficiently demanding in order to detect group differences in performance. As outlined in the discussion of chapter F, providing ratings is likely to be a significantly less complex task compared to, for example, generating free responses. Performance might have further facilitated by the layout of the options, which systematically presented familiar character and informal contexts first and unfamiliar character and formal contexts last. This may have made the difference between characters and contexts especially salient, and aided those with ASD to make correct approximations. This possibility is consistent with the findings of chapter F, which was conducted within the same experimental session of the current experiment. In the study described in chapter F, participants with ASD did not differ in their performance from the control group on the less demanding questions involving rating the awkwardness of the situations or rank-ordering simple and sophisticated strategies. However, when asked what they would say to respond to the scenarios or to generate rationales to explain why people might use each type of strategy, differences between the groups emerged, whereby those with ASD produced fewer skilled responses compared to the control group. Consistent with this, it is possible that in the current study the requirement to provide ratings may have 'masked' the presence of more subtle differences in performance between the groups, and that these might become more evident through the usage of more demanding question formats requiring them to generate free responses.

On the basis of this potential limitation of the questionnaire, a new experiment using the same awkward interactions described here was devised to follow up on the findings of the present study. In the new experiment, participants were presented with a combination of more and less demanding questions (i.e., open- versus closed-ended questions), to increase the sensitivity of the task. The reasoning behind their judgements was also examined in more depth. The study is described in more detail in the next chapter.

Chapter H: Raising awkward issues

H.1 INTRODUCTION

In the study described in chapter G, people with ASD were similarly able to control participants to judge the appropriateness of a range of awkward interactions with different characters and within a range of contexts: all participants, regardless of group memberships, were able to adapt their judgements flexibly across circumstances. To explain this finding, in the discussion of chapter G it was suggested that the task used may have not been sufficiently demanding in order to detect more subtle differences in performance between the groups. The requirement to provide ratings in particular may have, at least to an extent, cued participants with ASD to make their judgements in the expected direction. The present study thus aimed to follow-up the findings from the previous chapter by presenting participants with a modified and more demanding version of the same task, the 'Social Appropriateness Scenarios task'.

This new task differed in a number of ways compared to that described in chapter G. Firstly, it involved the use of social scenarios describing an interaction between two characters, rather than brief descriptions of behaviours. This was done to recreate the features of real-life situations more effectively and to make the social situations easier to imagine for the participants. Secondly, the degree of familiarity between the story characters was manipulated, so that they were either more or less familiar with one another (e.g., good friends versus neighbours). This was in contrast with the previous task, which presented participants with three different types of characters ('very', 'moderately', 'not very' familiar), and also manipulated the contexts they were in. These changes in the new task were due mainly to practical reasons: the presentation of three different types of characters and the manipulation of context would have increased the overall length of the task, making it harder for participants to remain focused throughout or to complete it. Finally, this time, the task involved a combination of more and less demanding task demands, since it asked participants both to make forced-choice ratings, and also to respond to open-ended questions

about the scenarios. These explored both participants' reasoning behind their responses, and their ability to raise the awkward issues in a socially sensitive manner.

Thus, in the task described below, participants read a range of social situations, where a main character had to decide whether to raise an awkward issue (e.g., bad breath) with a secondary character, who was either very or not familiar to them (e.g., a close friend versus a neighbor). In the scenarios, raising the issues would always be beneficial to one of the two characters (e.g., it might improve the secondary character's date experience), but might also come across as rude or inappropriate. Participants were asked (a) whether the main character should raise the awkward issues, (b) what they should say if they did that, (c) to explain why it may be inappropriate to do that in the situations, and (d) to rate how awkward the main character would feel if they decided to raise the awkward issues.

H.1.1 HYPOTHESES

On the basis of evidence from previous studies and from the findings of chapter F and G that people with ASD tend to perform in similar ways to neurotypical people when task demands are low, it was hypothesised that they would not differ from control participants on the less demanding questions of deciding whether to raise the awkward issues and to rate awkwardness. In particular, it was expected that, when the characters were more familiar to one another, all participants would be more likely to choose to raise the awkward issues and to give lower awkwardness ratings compared to when the characters were less familiar to one another.

With respect to the more demanding questions of raising the awkward issues and providing rationales, however, it was predicted that participants with ASD would be less skilled in their performance compared to the control group. Specifically, it was expected that, compared to control participants, those with ASD would use more blunt and fewer socially sensitive strategies to raise the issues overall, and that they would rely on more rule-based and fewer mentalistic rationales to explain why raising the awkward issues might be inappropriate.

H.2 METHODS

H.2.1 PARTICIPANTS AND PROCEDURE

Nineteen university students with ASD and 19 control participants (13 males, 6 females in each group) took part in the study. Participants were recruited and diagnosed using the same procedure, inclusion and exclusion criteria as those described in chapter E. There was no significant difference between groups in age (ASD group mean=22.21, SD=3.43, control group mean=21.47, SD=3.04), $t(36)=.70$, $p=.488.$, or IQ (ASD group mean=111.05, SD=5.26, control group mean=108.37, SD=6.36), $t(36)=1.41$, $p=.165$.

H.2.2 THE SOCIAL APPROPRIATENESS SCENARIOS TASK

The Social Appropriateness Scenarios task was designed to examine participants' ability to reason about and raise the same awkward issues presented in the Social Appropriateness questionnaire (see chapter G). This time, the task involved the use of social scenarios rather than a questionnaire (see Appendix C for the full list of vignettes). The wording of some of the behaviours presented in the original questionnaire was slightly modified to suit the stories. The current task comprised 8 scenarios describing an interaction between a main and a secondary character. Each scenario had 2 versions, so that the characters were either more or less familiar to one another (e.g., siblings versus colleagues). As in the Social Appropriateness questionnaire, this manipulation aimed to explore participants' capacity to adapt their responses to different types of characters. Contexts were not manipulated in the present task for practical reasons (see H.1 for a more detailed justification), but were still varied across scenarios. In each scenario variant, the main character had to decide whether to raise one of the same awkward issues from the Social Appropriateness questionnaire (e.g., bad breath) with the secondary character. Raising the awkward issues would always benefit one of the story characters, but may also come across as impolite. Thus, each scenario involved a conflict between the potential practical advantages of raising the issues and the possible social costs of offending the secondary characters. Two different orders of presentation

of the scenarios were used within each group of participants, to control for order effects. After reading the task instructions, participants worked through an example scenario. For each scenario variant, participants were asked: 1) whether the main character should raise the issue or not; 2) what the main character should say, if they decided to raise the issue; 3) why it might not be appropriate for the main characters to raise the issues; 4) to rate on a scale from 1 to 10 how awkward the main character would feel if they decided to raise the issue (see figure H.1). Each scenario was shown one at a time in printed form on a separate page of the same booklet, and remained on display when each question was presented to avoid potential confounding effects from memory load.

H.2.3 SCORING

H.2.3.1 Forced-choice responses

Participants' forced-choice responses included: the number of times they chose to raise the awkward issues (Figure H.1, question 1), and their awkwardness ratings (Figure H.1, question 4). Scores for both were individually added across scenarios and converted into percentages for each condition ('more familiar' and 'less familiar').

H.2.3.2 Strategies to raise the awkward issues

Participants' verbal responses when asked what the main character should say to raise the awkward issues were classified into two different categories, 'blunt' or 'socially sensitive', based on their level of sophistication (see Figure H.1 for examples of each type of strategy). 'Blunt' strategies consisted of brief responses that mentioned the issues without any additional information. 'Socially sensitive' strategies comprised more elaborated responses that provided a justification for raising the issues or tried to soften the blow, by for example acknowledging the sensitivity of the situations. Participants' responses were scored by a rater blind to group membership, and by a another independent, non-blind rater. There was an inter-rater agreement rate of 93%; all disagreements

were resolved through discussion. Scores for each category were added across scenarios and converted into percentages for each condition ('more familiar' and 'less familiar').

H.2.3.3 Rationales

The rationales provided by participants to explain why it may not be appropriate to raise the awkward issues were classified into two different categories, 'social rules' or 'mentalistic', based on the extent they referred to the characters' perspectives (see Figure H.1 for examples of each type of rationale). 'Social rules' referred to norms or conventions indicating what it is considered appropriate versus inappropriate in the social situations. 'Mentalistic' rationales referred to the secondary characters' expectations, emotions or thoughts. Responses could score for only one of the two categories; if both were met, then the best answer would be taken, and participants' rationales would score in the 'mentalistic' category. There was an inter-rater agreement of 90%; all disagreements were resolved through discussion. Scores for each category were added across scenarios and converted into percentages for each condition ('more familiar' and 'less familiar').

Figure H.1. Example scenario and questions from the Social Appropriateness Scenarios task

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Example scenario: (more/less familiar variants)
Sam pops round to a good friend's/his new neighbour's house to invite him for coffee and finds him on his doorstep. He tells Sam that he is on his way to meet someone for a date, and he is very excited about it. Sam notices that his neighbour has very bad breath.

Question 1: Should Sam tell his friend/neighbour that he has bad breath in this situation?
a) Yes
b) No

Question 2: If Sam decided to tell his friend/neighbour that he had bad breath, what should he say to him in this situation?

Examples of strategies:
- Blunt: *"Your breath stinks!"; "Your breath does not smell very good"; "You have terrible breath"*
- Socially sensitive: *"I don't mean to offend you, but as you are going on a date, maybe you should know that your breath doesn't smell too pleasant"; "Just a heads-up before your date, since you are very excited, maybe you should get back inside and clean your teeth"; "Please, don't take this the wrong way; I just want to help you to make the best possible impression with your date… I think that your breath does not smell very good right now"*

Question 3: Please tell me the most important reasons why it might not be appropriate for Sam to tell his friend/neighbour that he has bad breath in this situation.

Examples of rationales:
- Social rule: *"It's very rude"; "It's not acceptable to do that"; "You shouldn't comment on other people's breath"*
- Mentalistic: *"Sam's friend/neighbour may feel embarrassed"; "You don't want to ruin their mood just before their date"; "He might take it personally and feel upset"*

Question 4: On a scale from 1 to 10, where 1 represents "not at all awkward" and 10 represents "very awkward", how awkward do you think Sam would feel if he told his friend/neighbour that he had bad breath in this situation?

H.3 RESULTS

H.3.1 DATA ANALYSIS

Means and SDs for each measure are shown in Table H.1. Following the procedure described in chapter F, the variables of interest were initially examined for outliers and skewness. All variables were normally distributed, except for awkwardness ratings in the 'less familiar' condition, and the percentage of socially sensitive strategies used in the 'more familiar' condition, which were both positively skewed for the control group. Thus, square transformations were performed on the relevant measures to meet criteria for parametric analysis.

H.3.2 DECISIONS TO RAISE THE AWKWARD ISSUES

The two groups were compared on the percentage of times they decided to raise the awkward issues. A repeated-measure 2x2 ANOVA (group by condition: more familiar or less familiar) found a significant main effect of condition, $F(1,36)=166.17$, $p<.0001$, and a significant condition by group interaction, $F(1,36)=5.18$, $p=.029$. There was no significant main effect of group, $F(1,36)=3.14$, $p=.085$. Post-hoc t-tests using a corrected significance level ($p=0.5/2=0.025$) showed that the group with ASD was significantly less likely to raise the issues in the more familiar condition, $t(36)=3.65$, $p=.001$; there was no significant difference between groups in the less familiar condition, $t(36)=.00$, $p=1.000$.

H.3.3 STRATEGIES TO RAISE THE AWKWARD ISSUES

The two groups where compared on the percentage of socially sensitive versus blunt strategies they used to raise the awkward issues. A repeated-measure 2x2 ANOVA (group by condition) found a significant main effect of group, $F(1,36)=8.04$, $p=.007$. There was no significant main effect of condition, $F(1,36)=.11$, $p=.741$, or significant condition by group interaction, $F(1,36)=1.77$, $p=.191$. From inspection of the mean scores presented in Table H.1, it is clear that the group with ASD used fewer socially sensitive strategies overall compared to the control group.

H.3.4 RATIONALES

The two groups were compared on the types of rationales they used to explain why it might not be appropriate to raise the awkward issues. A repeated-measure 2x2 ANOVA (group by condition) found a significant main effect of condition, $F(1,36)=11.93$, $p=.001$, and a significant main effect of group, $F(1,36)=12.80$, $p=.001$. There was no significant condition by group interaction, $F(1,36)=.331$, $p=.568$. From inspection of the mean scores presented in Table H.1, it is clear that the group with ASD used fewer 'mentalistic' rationales overall compared to the control group.

H.3.5 AWKWARDNESS RATINGS

The two groups were compared on their ratings of perceived awkwardness in each condition. A repeated-measure 2x2 ANOVA (group by condition) found a significant main effect of condition, $F(1,36)=207.86$, $p<.0001$. There was no significant condition by group interaction, $F(1,36)=1.88$, $p=.179$, or main effect of group, $F(1,36)=.58$, $p=.453$. Inspection of the mean scores presented in Table H.1 indicates that all participants gave higher awkwardness ratings for less familiar characters compared to more familiar ones.

H.3.6 ANALYSES WITH GENDER AS A COVARIATE

Any effect of gender on the results was examined by repeating the analyses using this as a covariate; this did not alter the pattern of findings.

H.3.7 CORRELATIONS BETWEEN INTERVIEW SCORES AND PERFORMANCE ON THE TASK

Correlations between scores on the interview examining whether participants met current diagnostic criteria, and scores on each variable from the Social Appropriateness Scenario task were conducted for participants with ASD. There was a significant, positive correlation between participants' scores describing the extent to which their symptoms interfered with their everyday functioning ('Domain D'; see Table E.2 in chapter E) and the percentage of socially sensitive

strategies that they generated in the 'less familiar' condition, $r(17)=.66, p=.002$. None of the other

correlational analyses were significant, p>.05.

Table H.1. Mean scores, standard deviations, significance, and effect sizes for the Social Appropriateness Scenarios task

| | Group | | | |
| | Group with ASD (N=19) | Control group (N=19) | | |
Variables	Mean (SD)	Mean (SD)	Significance	Effect size
Decisions to raise the awkward issues (%)			Condition $\quad$ *** Gp $\quad$ NS Condition x Gp $\quad$ *	
More familiar	80.92 (14.05)	94.74 (8.66)	**	1.84
Less familiar	48.68 (17.63)	48.68 (18.58)	NS	0.00
Socially sensitive strategies (%)			Condition $\quad$ NS Gp $\quad$ ** Condition x Gp $\quad$ NS	
More familiar	63.16 (31.86)	83.55 (20.01)		0.77
Less familiar	61.18 (31.15)	86.84 (16.39)		1.03
Mentalistic rationales (%)			Condition $\quad$ ** Gp $\quad$ ** Condition x Gp $\quad$ NS	
More familiar	47.37 (25.20)	73.03 (19.66)		1.14
Less familiar	37.50 (28.57)	59.21 (16.58)		0.93
Awkwardness ratings (%)			Condition $\quad$ *** Gp $\quad$ NS Condition x Gp $\quad$ NS	
More familiar	45.33 (9.67)	40.39 (12.27)		0.45
Less familiar	66.32 (10.98)	65.79 (15.01)		0.40

* p<.05, ** p<.01, *** *p*<.001

H.4 DISCUSSION

The present study aimed to follow-up the findings of the Social Appropriateness questionnaire described in chapter G. Participants with and without ASD were presented with a revised version of the same questionnaire (now called the 'Social Appropriateness Scenarios task'), which this time involved a combination of more and less demanding questions. In the task, participants read a range of social scenarios, in which a main character had to decide whether to raise an awkward issue (e.g., bad breath) with a secondary character. The relationship between the characters was manipulated, so that they were either more or less familiar to one another (e.g., friends versus neighbours). It was hypothesised that the groups would not differ in their performance on the less

demanding questions of deciding whether to raise the awkward issues or not, and to rate how awkward the main character would feel if they decided to do that. These predictions were partly supported: the groups did not differ on their awkwardness ratings or in the number of times they chose to raise the issues with less familiar characters; however, those with ASD chose less frequently to raise the awkward issues with familiar characters compared to control participants. Our hypotheses that those with ASD would use fewer socially sensitive strategies to raise the awkward issues, and more rule-based and fewer mentalistic rationales to explain why raising the issues might be inappropriate overall compared to control participants were supported.

Before moving on to discuss the meaning of the present findings in more detail, it is probably important to consider the possibility of practice effects in facilitating performance, since a subset of participants in each group (twelve participants in the clinical group, nine in the control group) took part in both the studies described by chapters G and H, i.e. they performed both the Social Appropriateness questionnaire and the Social Appropriateness scenario task. However, the two studies were conducted during two separate experimental sessions, with a gap of at least three months between them. Moreover, although the task described in the present study was based on the same items of the Social Appropriateness questionnaire, the two studies involved different questions and demands, and thus were relatively different in nature. Finally, the components of performance that were preserved in the present experiment were in line with the findings of chapters F and G, whereby those with ASD gave similar responses to control participants on less demanding questions requiring rating or rank-ordering alternatives, but were still clearly impaired at generating appropriate strategies or rationales. It is therefore difficult to account for present performance in terms of cuing or facilitation because of prior completion of the Social Appropriateness questionnaire.

The finding that those with ASD were less skilled at raising the awkward issues supports and expands on the study described in chapter F, in which participants were asked how they would

respond to different types of awkward questions asked by a fictional character (the Social Strategy task; Channon et al., 2012). In that study, compared to control participants, those with ASD generated fewer sophisticated strategies that took into account the characters' feelings and perspectives, and used more often simple strategies consisting of acquiescing or outright refusing the questions. In the present experiment, when asked what they would say to raise the awkward issues, participants with ASD were once again found to generate fewer socially skilled responses compared to control participants. They raised the issues in a relatively upfront way (e.g., "You have bad breath"), without providing contextual information or trying to soften the blow in any way for the characters. This was in contrast with the types of strategies generated by the control participants; these tended to elaborate more on the reasons why they were raising the issues (e.g., "Since I know that you are going for a date, you might want to know that…"), and to acknowledge what the other person might think or how they might feel (e.g., "I don't mean to make you feel uncomfortable, but I think you should know that…"). The findings from chapter F and the present experiment extend previous evidence indicating that children with ASD are less skilled in their social communication, e.g. they are more likely to use an inappropriate intonation (Shriberg et al., 2001), to have difficulties in deciding what to say (Paul et al., 2009), and are impaired at initiating or maintaining conversations (Jones & Schwartz, 2009; see chapter C for a review of previous research).

Why did people with ASD struggle generating socially skilled strategies in the present study? As also outlined in chapter F when discussing why they generated more simple and fewer sophisticated strategies, this may potentially be explained in terms of an inability to consider the characters' perspectives. Due to their difficulties mentalising, participants with ASD may have been less able to anticipate or consider the negative impact that the use of blunter strategies would have on the character's thoughts or feelings, on their relationship, or on the characters' opinion of them. Limited appreciation of the characters' points of views may have meant that those with ASD

were less motivated to generate socially sensitive strategies, which acknowledged the sensitivity of the situations and what the characters might think or feel. By contrast, control participants may have been more able to take into account the characters' points of view when presented with the scenarios; in turn, may have encouraged them to come up with strategies that tried to protect their feelings and relationship.

The suggestion that participants with ASD were less likely to take the characters' perspectives when responding to the social scenarios is corroborated by the other key finding of the study concerning the types of rationales provided by the groups. When asked to justify why raising the awkward issues may be considered inappropriate, those with ASD gave more rationales based on explicit norms or conventions (e.g., "it is rude"), and fewer mentalistic justifications based on the characters' potential thoughts, emotions, and feelings (e.g., "the neighbour may feel uncomfortable") compared to control participants. This finding is consistent with previous evidence indicating that people with ASD may be relying more heavily on learnt norms and knowledge when reasoning about social situations compared to neurotypical people. For instance, in a previous scenario-based task used by Zalla and colleagues (2009), it was found that adults with ASD were able to recognise examples of faux pas in a comparable way to control participants. However, when asked to explain why the situations described were awkward, those with ASD referred more often to explicit rules or conventions that had been violated (e.g., "one should not lie") and more rarely to the characters' mental states compared to control participants. Similarly, in a study examining prosocial behaviour in the context of everyday situations, Jameel and colleagues (2015) showed that people with many autistic traits may be more likely to rely on learnt rules when asked to explain why it is appropriate to help a person in need compared to those with a low number of autistic traits. Taken together, these findings suggest that people with ASD may be relying more heavily on compensatory mechanisms such as learnt knowledge when reasoning about social situations and problems compared to neurotypical people. Reliance on rules and

norms alone is however unlikely to be a sufficient compensatory tool for generating appropriate free responses, and thus for supporting effective interactions. People may need to rely both on knowledge stores and also on more intuitive socio-emotional processes such as perspective-taking to be able to generate socially sensitive responses in their exchanges with others, and to reason about the nuances of social situations in a sophisticated manner.

Although reliance on norms and knowledge alone may not support the generation of skilled free responses, it might still be sufficient to aid participants with ASD to make appropriate social judgements and approximations, especially when task demands are low. Reliance on compensatory strategies such as drawing on previously acquired knowledge may have allowed those with ASD to make similar ratings in the Social Appropriateness questionnaire described in chapter G, and also similar estimates of awkwardness to control participants in the present study. As already outlined in the discussion of chapter G, providing ratings is likely to be a considerably less complex task compared to generating free responses. Contrasting different options in chapter G, and different variants of the same scenarios with different types of characters in the present study, may have further facilitated performance by those with ASD, by making the difference in contexts and characters more salient. This, in turn, may have prompted them to make their ratings in the expected directions.

Could reliance on social knowledge also explain the different decisions made by the groups with respect to whether to raise the awkward issues? In present task, it was found that, although the groups did not differ in their decisions with respect to less familiar characters, those with ASD chose less frequently to raise the awkward issues with more familiar individuals. It is possible that over-reliance on social norms may have led those with ASD to make stricter judgements with respect to more familiar characters. In everyday life, raising awkward issues such as bad breath with familiar people such as relatives or friends may not be necessarily be considered inappropriate, as long as it is done tactfully and with a reason. When people know each other well, it is easier to

predict whether the other person is going to be offended, or how they are going to react, compared to when interacting with a stranger or an acquaintance. Reduced reliance on perspective-taking and over-reliance on learnt norms (such as "it is not appropriate to tell someone that they have bad breath"), may have meant that those with ASD were less able to appreciate the difference in the dynamics characterising interactions between more versus less familiar individuals. This, in turn, may have made them less willing to raise the issues with more familiar characters compared to control participants.

Another possible explanation for reduced willingness in those with ASD to raise the awkward issues with familiar characters is also that they may have felt less confident than control participants that they would be able to do so in a sensitive manner. People with ASD often state in qualitative studies that they feel that they lack the appropriate social skills to engage in positive social interactions. They often report coming across as rude or offending people without meaning to do so. Unsuccessful attempts at social interactions can often lead to a sense of disappointment and frustration, and eventually reduce people's motivation to try to engage with others (e.g., Causton-Theoharis et al., 2009; Daniel & Billingsley, 2010). With respect to the present study, participants with ASD might have doubted that they would be able to raise the issues in way that would keep the characters' happy and not harm their feelings or sensitivity. This may have led them to be more 'cautious' in their choices and thus to be less willing to take the risk of potentially ruining their relationship with more familiar characters such as friends or relatives. Future replications of the present task might explore in more depth the reasoning behind participants' decisions by for example asking them to provide justifications for their judgements.

In summary, in the present study, participants with and without ASD read a series of social scenarios, where a main character had to decide whether to raise an awkward issue with a secondary character, who was either more or less familiar to them (e.g., a friend versus a neighbour). Participants answered both open- and closed-ended questions examining their ability to reason

and make judgements about the social scenarios, and also to raise the awkward issues in socially sensitive ways. Compared to neurotypical people, those with ASD were less socially skilled at raising the issues, and made more reference to explicit social norms rather than to the characters' perspectives when explaining why the interactions may not be appropriate. The groups did not differ in their ratings concerning how awkward the main character might feel, or in the number of times they decided to raise the issues with less familiar characters. However, those with ASD were less willing to raise the awkward issues with more familiar characters compared to neurotypical participants. Taken together, these findings expand on the previous two chapters, and suggest that people with ASD tend to rely on less socially skilled strategies to manage everyday social situations. Their understanding of these also appears to be less sophisticated compared to that of neurotypical people, although aspects of intact performance seem to emerge when tasks demands are low.

As outlined in chapter C and D, the next three experimental chapters (I, J, and K) will now move on to examine another aspect of everyday social functioning and performance in those with ASD, i.e. how they apply and reason about different types of moral and societal principles underpinning everyday interactions. chapter I will start this by investigating people's sensitivity to reciprocity in the context of their everyday social exchanges.

Chapter I: Reciprocity in social exchanges

I.1 INTRODUCTION

As reviewed in chapter D, research from the fields of experimental economics and social psychology has shown that in their social interactions, people often show a systematic concern for principles guiding behaviour towards others such as fairness or altruism. Theorists have identified several factors that consistently heighten or reduce people's inclination to donate, share or cooperate with others, with a central one being reciprocity. People are more likely to choose to help someone if this person also helped them in the past (e.g., Keysar et al., 2008). Positive reciprocity has important societal implications, in that it promotes cooperation between individuals and facilitates the development and maintenance of prosocial interactions (Cialdini, 2001).

Little empirical research has examined whether people with ASD show intact sensitivity to reciprocity in their exchanges with others. Whereas clinical reports indicate that children with ASD typically struggle engaging in reciprocal social behaviours such as turn-taking or pretend-play (e.g., Robertson, Tanguay, L'Ecuyer, Sims, & Waltrip, 1999), previous empirical research examining their choices in repeated trials of the Prisoner's Dilemma and Ultimatum Game has found no difference in performance between children with and without ASD: all participants, regardless of group membership, were more likely to share or cooperate with another player if he/she had previously done the same towards them (Downs & Smith, 2004; Sally & Hill, 2006).

However, as outlined in chapter D, the use of experimental economics tasks to examine social behaviour has a number of limitations. Firstly, they have a relatively abstract nature, which raises concerns about their ecological and external validity (Bardsley, 2008). Indeed, some previous studies have suggested that performance on these tasks does not often predict people's behaviour in naturally-occurring contexts (see Levitt & List, 2006, for a review). Secondly, it is likely that people's choices in these types of games may be predominantly driven by strategic considerations

concerning the final pay-off matrix, rather than by a genuine desire for reciprocation. For instance, qualitative studies examining participants' thought processes while playing the Prisoner's Dilemma have indicated that people usually base their decisions on a rational approach aiming to maximise their personal gain, rather than on considerations regarding what the other player may think or feel (Hill et al., 2004). In the context of everyday social relationships, however, reciprocal exchanges are unlikely to be driven only by deliberations concerning the gain or loss of practical resources; considerations regarding the social implications of reciprocating, such as the consequences or effect of this on the other person or on their relationship with them, are also likely to be involved. Indeed, previous research examining the mechanisms underpinning social reciprocity within everyday social interactions has suggested that this draws upon cognitive and emotional mechanisms such as perspective-taking or concern for others (e.g., Pelligra, 2011).

Another limitation of experimental economics games is that they do not often reflect the complexity of the real world. In these tasks, participants typically have the opportunity to reciprocate the other player's actions to the same exact extent (e.g., by donating back the same amount of money), leading to completely equal and fair exchanges from the perspective of both players. In the context of everyday social interactions, however, the picture is more complicated, since reciprocal exchanges in social situations are unlikely to be always perfectly symmetrical (Gernsbacher, 2006). Most of the time, it may be difficult to reciprocate one's actions to the same exact degree. For instance, two friends taking turns at paying for lunch may end up paying differing slightly amounts on each occasion, whereby one person pays more than the other.

Although unequal exchanges may be disadvantageous from the giver's perspective and unfair overall, within repeated social interactions a departure from equality may have some advantages. Under some circumstances, giving extra resources to others may be interpreted as a sign of generosity, interest or care. Typically, in the context of functional and healthy social relationships, in the long-run this may lead to further reciprocation from the other person. Appreciation of these

potential benefits is likely to rely on a relatively sophisticated understanding of the dynamics of social relationships, and of the positive effects that giving extra resources may have for them in the short- or long-term (Gernsbacher, 2006).

The present experiment was designed to examine reciprocity in adults with ASD with respect to unequal everyday exchanges with others, by adapting a task that has already been used to assess reciprocity in those with psychopathic traits (Social Exchange task; Vyas & Channon, in preparation). In the study described below, participants with and without ASD read a range of descriptions of social situations, in which a fictional character familiar to the participants (e.g., a friend) had previously done them a favour (e.g., paid for their sandwich). In these scenarios, participants were now presented with the opportunity to reciprocate the character's original action with either a smaller or a bigger favour (e.g., pay for coffee versus pay for a meal). Thus, from the participants' perspectives, reciprocating with a coffee would lead to a lower cost exchange in relation to the original favour, whereas reciprocating with a meal would lead to a higher cost exchange in relation to the original favour. After reading the scenarios, participants were asked what they would say in response to the situations. Both their degree of reciprocation and their reasoning for choosing that course of action were examined. The groups were then presented with different courses of action and asked to rate them in terms of how fair each one was, and how comfortable they would personally feel carrying out each of them.

I.1.1 HYPOTHESES

The issue of unequal social exchanges has not been examined in people with ASD. It seems likely that they might behave differently from neurotypical people in higher-cost exchanges, since they might not be sensitive to the social considerations that lead people to reciprocate in these types of circumstances. In the present study, it was therefore hypothesised that people with ASD would be less reciprocal in their responses, would rate reciprocal courses of action as less fair, and would feel less comfortable carrying these out compared to control participants

The prediction for lower-cost exchanges was less clear-cut, since it could be argued that those with ASD might again present difficulties appreciating the social expectation to reciprocate, and be less likely to do so. On the other hand, since children with ASD have been found to be sensitive to reciprocity in the context of equal exchanges (Downs & Smith, 2004; Sally & Hill, 2006), then people with ASD might also be expected to be able to recognise the expectation to reciprocate in lower-cost exchanges, which do not lead to an overall personal loss in the same way as higher-cost ones. If this is the case, those with ASD should differ from control participants in their degree of reciprocity for higher-cost but not for lower-cost exchanges.

I.2 METHODS

I.2.1 PARTICIPANTS AND PROCEDURE

Nineteen university students with ASD and 19 control participants (13 males, 6 females in each group) took part in the study. Participants were recruited and diagnosed using the same procedure, inclusion and exclusion criteria as those described in chapter E. There was no significant difference between groups in age (ASD group mean=22.21, SD=3.43, control group mean=21.47, SD=3.04), $t(36)=.70$, $p=.488$, or IQ (ASD group mean=111.05, SD=5.26, control group mean=108.37, SD=6.36), $t(36)=1.41$, $p=.165$.

I.2.2 THE SOCIAL EXCHANGE TASK

The Social Exchange task (Vyas and Channon, in preparation) was designed to assess how people respond to and reason about everyday social exchanges with another person. In the task, participants read ten descriptions of social interactions between themselves and a fictional character (see Appendix D for the full list of vignettes). In each story, the character had previously done the participants a favour (e.g., they had paid for their sandwich), and was now offering to do them a new one. There were two different variants for each scenario (lower-cost and higher-cost). In the lower-cost condition, the character offered to do participants a smaller favour than the original one, that involved less effort, time, or money (e.g., to pay for their coffee). In the higher-

cost condition, they offered to do them a bigger favour (e.g., to pay for their meal). Two different orders of presentation of the scenarios were used within each group of participants, to control for order effects. The gender of the characters, the degree of relationship with the participants (i.e., friend, colleague, schoolmate, or neighbour) and the type of social context (i.e., family, social, or workplace) were varied across scenarios. After reading the task instructions, participants worked through an example. For each scenario variant, they were asked what they would say in response to the character's offer (Figure I.1, question 1).

After responding to this question for all scenarios, participants completed a novel component of the Social Exchange task. They were presented with the same set of stories one more time, followed for each scenario by three options, representing different courses of action that participants might take in response to the character's offer: a 'nonreciprocal' course of action (e.g., allow the character to pay for both coffees/meals), a course of action based on 'compromise' (e.g., suggest to split the cost of the bill) and a 'reciprocal' course of action (e.g., offer to pay for both coffees/meals instead). They were asked to rate on a scale from 1 to 10 how fair each course of action was (Figure I.1, question 2), and how comfortable they would personally feel if they chose each of them (Figure I.1, question 3). The possible options were presented separately from the initial question (asking participants how they would respond to the characters' offers) in order to avoid an effect of spelling out the alternative courses of action on participants' responses. Each scenario was shown one at a time in printed form on a separate page of the same booklet, and remained on display when the question was presented to avoid potential confounding effects from memory load.

I.2.3 SCORING

I.2.3.1 Strategies

When asked what they would reply to the characters' questions, participants' responses were coded according to two different dimensions: a) course of action and b) justification of action.

I.2.3.1.1 Course of action

Participants' responses were classified into three different categories depending on the extent to which they reciprocated the character's original favour. These mapped onto the forced-choice alternatives subsequently provided to participants: 'non-reciprocal', 'compromise', and 'reciprocal'. Strategies were classified as 'non-reciprocal' when participants accepted the character's favour (e.g., they let their friend pay for both coffees/meals). They were categorised as 'compromise' when they offered to contribute or do something for the character later in the future (e.g., they suggested splitting the bill, or promised to take the friend out for another coffee/meal in the future). Finally, they were classified as 'reciprocal' when participants refused the character's offer and did them the favour instead (e.g., they offered to pay for both coffees/meals; see Figure I.1 for examples of each type of strategy). Participants' responses were scored by a rater blind to group membership and also by another independent, non-blind rater. There was an inter-rater agreement rate of 98%; all disagreements were resolved through discussion. Non-reciprocal responses were awarded a score of 1, compromises a score of 2 and reciprocal ones a score of 3. Composite scores reflecting participants' degree of reciprocity were created by adding the scores for each strategy and converting them into percentages for each condition (lower-cost and higher-cost).

I.2.3.1.2 Justification of action

This dimension relates to the nature of the reasoning given by participants in relation to their preferred course of action. Participants' responses were classified with respect to whether they contained practical or social reasoning. Practical reasoning involved simple responses that only specified the participants' preferred course of action without further elaboration, or which referred to practical reasons such as saving time or money. Social reasoning involved more sophisticated responses that referred to the reciprocal, turn-taking nature of the exchanges, to the character's positive attributes, or included empathic comments (see Figure I.1 for examples of each type of reasoning). Responses could score for only one of the two categories; if both were met, then the best answer would be taken, and participants' rationales would score as social reasoning. There

was an inter-rater agreement rate of 95%; all disagreements were resolved through discussion. Scores for each strategy were added across scenarios, and converted into percentages for each condition (lower-cost and higher-cost).

I.2.3.2 Ratings of fairness and discomfort

Participants' ratings of fairness and discomfort were individually added across scenarios, and converted into percentages for each condition (lower-cost and higher-cost).

Figure I.1. Example scenario and questions from the Social Exchange task

Example scenario:
Last week when you and a friend went out for lunch, she paid for her own sandwich and yours.

<u>Lower-cost condition:</u> Today, you go out for coffee. When the bill comes, she says she will pay for your coffee.

<u>Higher-cost condition:</u> Today, you go out for an evening meal in your local pub. When the bill comes, she says she will pay for your meal.

Question 1: What would you say in response?

Examples of responses for each dimension (course of action and justification of action):
- Non-reciprocal
    Practical reasoning: *"Yes, you can pay"; "Thanks, I don't have enough money on me"; "That'd be great, I am quite broke at the moment"*
    Social reasoning: *"You really don't have to pay for me again, but if you'd like, thanks very much"; "That's so kind of you, thank you"; "That's so generous of you, thanks very much"*

- Compromise
    Practical reasoning: *"Let's split the bill"; "I'll pay for my own thing, I have enough cash on me"; "Let's pay half and half"*
    Social reasoning: *"It's not fair on you to pay for me twice in a row, let's just split the bill between us" ; "I really appreciate your offering, but let's just split it this time"; "I really appreciate your offer, but we will split it this time"*

- Reciprocal
    Practical reasoning: *"I will pay for both of us"; "I will pay for both, I have enough cash"; "I can pay for both this time"*
    Social reasoning: *"Absolutely not, you paid last time, so I want to treat you this time"; "It's very generous of you to be offering again, but it is my turn to pay for both of us this time"; "You are really kind, but I want to pay for both of us this time"*

Question 2: On a scale from 1 to 10, where 1 represents 'not at all fair' and 10 'very fair', how fair would it be if people chose to:
   a) Thank the friend and let her pay for both coffees/meals
   b) Thank the friend but pay for their own coffee/meal
   c) Thank the friend but pay for both coffees/meals instead

Question 3: On a scale from 1 to 10, where 1 represents 'not at all comfortable' and 10 'very comfortable', how comfortable would you feel if you chose to:
   a) Thank the friend and let her pay for both coffees/meals
   b) Thank the friend but pay for your own coffee/meal
   c) Thank the friend but pay for both coffees/meals instead

I.3 RESULTS

I.3.1 DATA ANALYSIS

Means and SDs for each measure are shown in Table I.1. Following the procedure described in chapter F, the variables of interest were initially examined for outliers and skewness. All variables were normally distributed, except for (a) the fairness ratings provided by the control group for the non-reciprocal options in both conditions, and (b) the discomfort ratings provided by the control group for the non-reciprocal option in the higher-cost condition, which were both negatively skewed. Thus, logarithmic transformations were performed on the rating measures to meet criteria for parametric analysis.

I.3.2 STRATEGIES

I.3.2.1 Course of action

The two groups were compared on the degree of reciprocity they displayed when asked what they would say in response to the social scenarios. A repeated-measures 2x2 ANOVA (group by condition: lower-cost or higher-cost) found a significant main effect of condition, $F(1,36)=17.98$, $p<.0001$, and a significant main effect of group, $F(1,36)=6.26$, $p=.009$. There was no significant condition by group interaction, $F(1,36)=2.80$, $p=.103$. Inspection of the means revealed that all participants had higher reciprocity scores for the lower-cost condition compared to the higher-cost condition, and that participants with ASD had lower reciprocity scores compared to control participants overall. These differences can be seen in both the composite scores and the scores for frequency of use of each individual strategy contributing to the composite scores ('non-reciprocal', 'compromise', or 'reciprocal'), shown in Table I.1.

I.3.2.2 Justification of action

The two groups were compared on the percentage of times they relied on social versus practical reasoning in their responses to the social scenarios. A repeated-measures 2x2 ANOVA (group by

condition) found a significant main effect of group, $F(1,36)=7.57$, $p=.009$. There was no significant main effect of condition, $F(1,36)=3.44$, $p=.072$, or significant condition by group interaction, $F(1,36)=.049$, $p=.825$. Inspection of the means revealed that whilst those with ASD relied on social reasoning less than half the time, control participants referred to it for the majority of their responses.

I.3.3 FAIRNESS RATINGS

The two groups were compared on their fairness ratings for each course of action (non-reciprocal, compromise, reciprocal). A repeated-measures 3x2x2 ANOVA (course of action by group by condition) found a significant main effect of course of action, $F(2,35)=173.59$, $p<.0001$, a significant main effect of condition, $F(1,36)=45.32$, $p<.0001$, and a significant course of action by condition interaction, $F(2,35)=54.45$, $p<.0001$. There was no significant main effect of group, $F(1,36)=2.16$, $p=.150$, or significant course of action by group interaction, $F(2,35)=3.19$ $p=.053$, or condition by group interaction, $F(1,36)=.141$, $p=.709$, or course of action by condition by group interaction, $F(2,35)=.149$, $p=.862$. Inspection of the means revealed that both groups considered reciprocal courses of action the fairest, followed by compromise and non-reciprocal courses of action.

I.3.4 'HOW COMFORTABLE' RATINGS

The two groups were compared on their discomfort ratings for each course of action (non-reciprocal, compromise, reciprocal). A repeated-measures 3x2x2 ANOVA (course of action by condition by group) found a significant main effect of course of action, $F(2,35)=125.89$, $p<.0001$, a significant main effect of condition, $F(1,36)=11.93$, $p=.001$, a significant course of action by condition interaction, $F(2,35)=47.74$, $p<.0001$, and a significant course of action by group interaction, $F(2,35)=5.11$, $p=.011$. There was no significant main effect of group, $F(1,36)=2.87$, $p=.099$, or condition by group interaction, $F(1,36)=.287$, $p=.595$, or course of action by condition by group interaction, $F(2,35)=.715$, $p=.496$. Post-hoc t-tests were conducted to compare the

groups' ratings for each course of action across conditions using a corrected significance level (p=.05/3=0.017). Compared to the control group, participants with ASD indicated that they would feel significantly more comfortable choosing non-reciprocal courses of action, $t(36)$=2.73, p=.010, and significantly less comfortable choosing reciprocal courses of action, $t(36)$=2.56, p=.015. There was no significant difference between groups in their ratings for compromise, $t(36)$=.45, p=.659.

I.3.5 ANALYSES WITH GENDER AS A COVARIATE

Any effect of gender on the results was examined by repeating the analyses using this as a covariate; this did not alter the pattern of findings.

I.3.6 CORRELATIONS BETWEEN INTERVIEW SCORES AND PERFORMANCE ON THE TASK

Correlations between scores on the interview examining whether participants met current diagnostic criteria, and scores on each variable from the Social Exchange task were conducted for participants with ASD. There was a significant, positive correlation between participants' scores describing the extent of their social impairments ('Domain A'; see Table E.2 in chapter E) and the degree of reciprocity displayed when asked what they would say in response to the social scenarios in the higher-cost variant, $r(17)$=.58, p=.009. None of the other correlational analyses were significant, p>.05.

Table I.1. Mean scores, standard deviations, significance, and effect sizes for the Social Exchange task

| | **Group** | | | |
| | Group with ASD (N=19) | Control group (N=19) | | |
Variables	Mean (SD)	Mean (SD)	Significance	Effect size
Strategies				
Course of action : composite scores (%)			Condition *** Gp ** Condition x Gp NS	
Lower-cost	78.60 (13.11)	90.35 (10.48)		0.92
Higher-cost	74.56 (8.90)	81.05 (12.38)		0.60
Course of action : individual scores (%)				
Non-reciprocal				
Lower-cost	23.16 (18.87)	8.95 (14.49)		
Higher-cost	17.89 (13.57)	7.89 (13.98)		
Compromise				
Lower-cost	17.89 (12.73)	11.05 (8.75)		
Higher-cost	40.53 (16.15)	41.05 (23.78)		
Reciprocal				
Lower-cost	58.95 (22.33)	80.00 (17.95)		
Higher-cost	41.58 (17.40)	51.05 (27.87)		
Justification of action : social reasoning (%)			Condition NS Gp ** Condition x Gp NS	
Lower-cost	41.05 (35.26)	65.79 (27.95)		0.78
Higher-cost	46.84 (33.51)	73.16 (24.51)		0.90
Fairness ratings (%)			C. action *** Condition *** Gp NS C. action x condition *** C. action x Gp NS Condition x Gp NS C. action x condition x Gp NS	
Non-reciprocal				
Lower-cost	34.68 (12.07)	26.84 (14.97)		0.58
Higher-cost	26.05 (10.17)	20.00 (10.54)		0.54
Compromise				

Lower-cost	65.16 (10.93)	63.21 (13.39)			0.16
Higher-cost	71.68 (12.57)	68.79 (13.21)			0.22
Reciprocal					
Lower-cost	82.37 (11.81)	89.05 (7.54)			0.67
Higher-cost	73.53 (10.67)	80.00 (9.79)			0.63
'How comfortable' ratings (%)			C. action	***	
			Condition	**	
			Gp	NS	
			C. action x condition	***	
			C. action x Gp	**	
			Condition x Gp	NS	
			C. action x condition x Gp	NS	
Non-reciprocal				*	
Lower-cost	30.79 (15.78)	21.05 (12.67)			0.68
Higher-cost	39.05 (17.65)	26.26 (15.20)			0.78
Compromise					
Lower-cost	66.00 (15.46)	63.05 (15.17)			0.19
Higher-cost	70.74 (13.48)	69.95 (13.35)			0.59
Reciprocal				*	
Lower-cost	81.32 (11.48)	91.21 (8.20)			0.59
Higher-cost	73.63 (13.28)	80.32 (11.43)			0.54

* $p<.05$, ** $p<.01$, *** *$p<.001$*

I.4 DISCUSSION

The current study examined social reciprocity in people with and without ASD. Participants were presented with a series of scenarios in which a fictional character had previously done them a favour (e.g., paid for their sandwich). They now had the opportunity to reciprocate with either a smaller favour, leading to lower cost (e.g. pay for the character's coffee), or with a bigger favour, leading to a higher cost from their perspectives (e.g., pay for the character's meal). With respect to higher-cost exchanges, it was predicted that, compared to control participants, those with ASD would show reduced reciprocity, report feeling less comfortable carrying out reciprocal courses of action, and rate these as less fair. With respect to lower-cost exchanges, it was expected either that

(a) those with ASD would present the same pattern of performance as for higher-cost exchanges compared to control participants, or (b) that they might not differ from the control group at all.

The findings revealed a slightly different picture. Compared to control participants, when asked what they would say in the situations, the responses of those with ASD were scored as less reciprocal in their courses of action regardless of the personal cost of the exchanges. However, when the same responses were scored on the basis of the rationales given, those with ASD relied less frequently on social reasoning and more often on practical reasoning than control participants, regardless of the cost of the exchanges. When participants' ratings were examined, those with ASD reported feeling more comfortable carrying out non-reciprocal courses of action (e.g., letting the character pay for their own coffee/meal again) and less comfortable carrying out reciprocal courses of action (e.g., paying for the character's coffee/meal instead) in both conditions. However, there was no difference between groups in their fairness ratings for the different courses of action in either condition.

Previous research has examined reciprocity in children with ASD by examining their choices on repeated trials of experimental economics games, such as the Prisoner's Dilemma and the Ultimatum Game. In these experiments, children with ASD were found to be similarly reciprocal to their typically-developing counterparts: all participants, regardless of group membership, were more likely to collaborate or to share a resource with another player if he/she had previously done the same towards them (Downs & Smith, 2004; Sally & Hill, 2005). In the present task, however, participants with ASD were found to be systematically less reciprocal than control participants. This was observed not only for higher-cost exchanges, where reciprocating may lead participants to incur in a greater personal loss, but also for lower-cost exchanges, where reciprocating was relatively convenient from their perspectives.

Why did those with ASD show similar reciprocity to control participants in previous experimental economics tasks, but behaved less reciprocally in the present study? This may be due to the

different types of measures used. Experimental economics tasks such as the Prisoner's Dilemma or the Ultimatum Game have a relatively abstract nature, and thus may not effectively approximate the characteristics of everyday social situations (Bardsley, 2007). Indeed, previous evidence has suggested that reciprocity in experimental economics games may be a function of task demands, whereby participants make reciprocal choices only to maximise their own final win (e.g., the number of stickers received at the end) rather than on the basis of considerations regarding what the other player may want, think or feel (Hill et al., 2004). By contrast, it is likely that participants' choices on the Social Exchange task may have been driven not only by strategic reasoning, but also by social considerations concerning the implications for their relationship with the characters or their thoughts or feelings. It is thus possible that the present task might have been more effective at approximating the features and demands of real-life social exchanges, and be more reflective of the types of decisions that people with ASD would make in these types of contexts.

Moving now to the possible explanations for the present pattern of findings, there are a number of possible reasons that could account for the differences between the groups in their degree of reciprocity and levels of discomfort carrying out different courses of action. Firstly, these could be explained in terms of differential levels of interest or concern by the groups for their social relationships. It has been suggested that people engage in reciprocal or prosocial behaviour only when they value their social relationships and the positive effects that engaging in these types of actions may have for them (De Dreu & Van Lange, 1995; McClintock & Allison, 1989). It is possible that, compared to neurotypical people, those with ASD may value less the potential beneficial effects associated with reciprocation (e.g. the strengthening of a relationship with a friend), and thus find reciprocal behaviours less rewarding or satisfying. This, in turn, might lead them to be less willing to reciprocate, to feel more comfortable choosing non-reciprocal courses of action, and less at ease engaging in reciprocal behaviours. However, such an account is not entirely plausible given previous qualitative evidence suggesting that people with ASD are generally

interested in developing meaningful social bonds, and often long for friendships and closer relationships (see chapter C for a review of this).

In light of this, a reduced ability in people with ASD to comprehend fully the nature of give-and-take interactions may be a more likely account for the present findings. It has been suggested that reciprocal behaviour in the context of social relationships draws on mentalistic considerations. To be willing to reciprocate one's actions, people need to be able to anticipate how reciprocation is going to affect the other individual, e.g., how it is going to make them feel, the impact it may have on how they view them, and the potential positive consequences on their relationship in both the short- and long-term (Sally & Hill, 2005). The role of mentalising in the context of reciprocal interactions has been recently supported by neuroimaging evidence, showing activity in areas linked with cognitive empathy, such as the medial prefrontal cortex (e.g., Sakaiya et al., 2013; Van de Bos, van Dijk, Westenberg, Rombouts, & Crone, 2009). It is thus likely that, due to their difficulties mentalising, people with ASD may struggle appreciating the potential positive implications of reciprocating for forming and sustaining positive social interactions and relationships. This, in turn, may lead them to be less motivated to engage in reciprocal behaviour compared to neurotypical people, regardless of the personal cost of the exchanges. This explanation might also account for the difference between those with ASD and the control group in their discomfort ratings. Limited appreciation of the beneficial nature of reciprocal behaviour may have meant that those with ASD were less able to understand why people might want to refuse the character's offer, leading them to feel more content accepting the favour again compared to control participants. Similarly, those with ASD may have also found it difficult to understand why people may decide to engage in reciprocal courses of action; compared to neurotypical participants they may have found these less sensible and/or rewarding choices, leading to higher discomfort ratings for them.

Finally, another possible explanation for differences in reciprocity and levels of discomfort between groups is that people with ASD may have reduced knowledge or awareness of normative expectation to reciprocate in social exchanges. As reviewed in chapter C, people with ASD tend to have more limited experience with the social world, and thus may not be as aware as neurotypical people of the norms underpinning the types of situations presented in the task (e.g., the expectation to take turns paying when going out with friends). However, the similar ratings of fairness provided by the two groups appear to contradict this suggestion. Interestingly, in fact, all participants, regardless of group membership, considered reciprocal courses of action the fairest, followed by compromise and non-reciprocal courses of action, regardless of the personal cost of the exchanges.

Although people with ASD may have intact knowledge concerning the normative expectation to reciprocate in social exchanges, reliance on learnt principles may still not be sufficient to motivate them to engage in reciprocal behaviour without a more sophisticated understanding of its implications. Examination of the types of justifications provided by those with ASD for choosing their courses of action further corroborate this suggestion. Compared to neurotypical participants, those with ASD were considerably less likely to rely on social reasoning to justify their responses (e.g., to use rationales that referred to the social, turn-taking nature of their interactions, or that referred to positive social aspects such as kindness or generosity), and to make practical considerations more often (e.g., to use justifications that related to the division of practical resources such as time or money). Taken together, the present pattern of findings suggests that although people with ASD may have acquired, possibly through learning or experience, a normative theory of reciprocity, they may still be lacking a more sophisticated understanding of its social implications, most likely due to their difficulties taking others' perspectives. This in turn may lead them to be show reduced motivation to reciprocate in everyday social exchanges, to feel more comfortable carrying out non-reciprocal behaviours and less comfortable choosing reciprocal courses of action.

The findings of the present study lead to a number of potentially interesting areas for future research. Firstly, it should be noted that all participants, regardless of group membership, showed a bias towards reciprocal responses in their performance on the Social Exchange task, since they all favoured reciprocal strategies over non-reciprocal ones or compromise, regardless of the personal cost of the exchanges. They also consistently reported feeling the most comfortable carrying out reciprocal courses of action, and judged these as the fairest options overall. This indicates the potential presence of a ceiling effect. It is possible that the expectation to reciprocate in the scenarios may have been particularly obvious: since the characters explicitly offered to do participants a favour twice, they may have come across as strikingly generous. This, in turn, may have prompted most participants to offer to reciprocate, and made them less willing to accept the offer again or to suggest a compromise. Future replications of the Social Exchange task may present participants with more subtle opportunities to reciprocate. For example, participants may read scenarios where characters previously did them a favour (e.g., paid for their sandwich), but are now not offering again. In this type of situations, participants would have to make the first move if they were willing to engage in a reciprocal exchange. It is likely that the people with ASD may be even less likely to reciprocate in situations requiring them to take initiative.

Secondly, future research may examine participants' performance when given the opportunity to reciprocate the character's actions to the same exact extent (i.e., by doing the characters the same favour, such as paying for their sandwich, rather than a smaller or bigger one). Previous experiments have shown that people with ASD often show a tendency to be more 'black-and-white' in their choices and to rely more rigidly on norms (e.g., Channon et al., 2011). For example, Sally & Hill (2006) found that, although children with ASD did not differ from a typically-developing group in their mean allocations on the Ultimatum Game, they relied on slightly different strategies in the course of their performance, whereby they were either completely fair or not fair at all. It is thus possible that rigid reliance on norms may lead those with ASD to be reciprocal only in those situations in which exchanges are going to be completely symmetrical for

both parties. Future studies may address this possibility by adding a new set of scenarios to the Social Exchange task, where participants are given the opportunity to reciprocate the character's actions to the same degree.

Finally, as reviewed in chapter D, reciprocity is not the only factor influencing people's inclination to help each other. The nature of the social relationships between individuals has also been found to play a central role; for example, people are more willing to help individuals who they have a relationship with or who they like (Sally, 2000). In the present task, all characters were familiar to the participants, so it is not possible to determine whether or to what extent this may have affected their choices. Future replications of the Social Exchange task may manipulate this factor by examining people's choices when interacting with different characters. Since the effect of familiarity is also thought to be related to mentalistic considerations (Sally & Hill, 2006), people with ASD may be expected to be less sensitive to this aspect in their decisions compared to neurotypical individuals.

Thus, in summary, the present study found that, compared to neurotypical participants, those with ASD were less reciprocal in everyday social exchanges, regardless of whether these were more or less costly from their personal perspectives. They seemed to rely less often on social reasoning when justifying their choices, and reported feeling more and less comfortable engaging in non-reciprocal and reciprocal behaviours respectively. Their ratings of fairness for different courses of action varying in reciprocity did not differ from those of the control group, as all participants rated reciprocal responses as the fairest. It has been argued that, although people with ASD may be aware of the expectation to reciprocate in social exchanges, their understanding may be less sophisticated. People with ASD may not be fully able to grasp or anticipate the potential positive implications of reciprocation in the context of everyday social relationships, which in turn may lead them to be less willing to reciprocate and to find reciprocal courses of action less rewarding.

A number of ways in which these suggestions may be further investigated by future research were outlined.

The next study will follow up these findings by investigating reciprocity in different types of situations, i.e. when people are presented with the opportunity to respond to a negative, rather than positive act. People will be presented with descriptions of situations where a character acted to their own detriment, rather than to their advantage. Their responses to the situations and judgements for these types of situations will be examined.

Chapter J: Reacting to and reasoning about intentional and unintentional transgressions

J.1 INTRODUCTION

In chapter I, it was found that people with ASD were less reciprocal in their responses to both more and less advantageous positive social exchanges. This study is now going to examine 'negative' reciprocity, i.e. how people evaluate and respond to situations in which someone acted in a harmful way towards them.

Previous research has shown that, whereas people tend to respond in prosocial ways to positive acts, this does not usually occur when they think that they have been treated unfavorably. Experiments from the field of experimental economics, for example, have found that participants act more selfishly towards another player if they believe that he/she had previously acted to their detriment (Keysar et al., 2008). Within interpersonal social relationships, people can present a wide range of responses to damaging acts, varying for example from doing nothing (and thus deciding to 'let it go'), to responding in kind or cutting bridges with the other person (McCullough, 2008).

People's reactions to harmful acts depend on many factors, including how negatively they feel towards the agent (e.g., Falk & Fischbacher, 2006). A central role in this respect is played by intention. As reviewed in chapter D, people tend to judge individuals more harshly for pursuing a detrimental course of action (e.g., physically harming someone) if they believe that they carried it out on purpose rather than by accident (Lagnado & Channon, 2008). It has been proposed that unintentional harmful acts elicit more sympathy in the observers, which in turn increases their propensity to choose more lenient punishments and/or to forgive them for what they did (e.g., Metts & Cupach, 2007). Neuroimaging research has supported this by showing activation in areas associated with emotional empathy and sympathetic responses when people witness an agent accidentally harming a victim (e.g., Jankowski & Takahashi, 2014).

As outlined in chapter D, previous research examining how those with ASD judge and respond to harmful acts is limited. Some previous experiments have found that children and adolescents with ASD are able to recognise moral transgressions and differentiate these from socio-conventional ones, although the reasoning behind their judgements is less sophisticated (e.g., Shulman et al. 2011). It is less clear whether people with ASD judge intentional and unintentional transgressions in a similar fashion to neurotypical people. Some previous experiments (e.g., Buon et al., 2013; Moran et al., 2011) have shown that people with ASD may tend to over-attribute intent to accidental wrong-doings, and thus to judge these more harshly compared to neurotypical people. Other studies, however, have contradicted this, and found no differences between children with and without ASD (e.g., Grant et al., 2005). It has been suggested that inconsistencies in previous findings might be due to differences in the task at hand, so that people with ASD can differentiate between intentional and unintentional actions when the agent's mental states are made explicit (see D.3.2 for a review of this). Indeed, a recent study by Channon and colleagues (2012) indicated that under these circumstances adults with ASD differentiate even more strongly between intentional and unintentional actions, since they judged intentional wrong-doings more harshly and accidental ones more leniently compared to control participants.

There are a number of limitations with previous experiments examining the ability of those with ASD to judge and reason about moral transgressions. Firstly, these have been usually conducted on children and adolescents, meaning that it is unclear to what extent their findings also extend to the performance of adults with ASD. Secondly, previous tasks have predominantly involved the presentation of serious, emotionally-salient transgressions (e.g. an agent poisoning, hitting, or killing someone). No previous work has examined participants' judgements with respect to more common, everyday types of wrong-doings; it is possible that more subtle differences between groups might emerge when presented with less serious and emotionally-charged situations. Understanding how people with ASD judge these has relevant implications for improving current knowledge regarding how they judge and reason about everyday moral problems and dilemmas.

Finally, previous studies have only focused on the examination of participants' judgements; no work so far has investigated their behavioural responses to harmful acts, e.g. what they would do to respond to them. Understanding this has potential important implications: in everyday life, it is not uncommon to have to manage unpleasant interactions or events; our ability to deal with them in skilled ways is likely to have important consequences for our capacity to navigate our everyday social environment successfully.

The present study thus aimed to examine how people judged and responded to different types of everyday intentional and unintentional transgressions. Participants with and without ASD read a range of descriptions of social situations, in which a fictional character acted to the detriment of the participants, e.g., they revealed an embarrassing personal secret about them to others. The character's intent was manipulated systematically, so that they acted either deliberately, or accidentally. For each scenario variant, participants were asked to say what they would do in response, to rate how acceptable the character's action was, and also to rank-order the different courses of actions they might take after the character had apologised to them.

J.1.1 HYPOTHESES

As reviewed in chapter D, when the distinction between intentional and unintentional actions is made salient, people with ASD appear to be able to differentiate between them in their moral judgements. In the present study, such difference was made clear by presenting participants with written scenarios and by contrasting different variants (intentional and unintentional) of the same set of stories. Thus, a main effect of intentionality was expected in this study, so that, in the intentional condition, all participants, regardless of group membership, would generate harsher strategies to respond to the scenarios, rate the characters' actions as less acceptable, and prefer harsher courses of action in their rank-ordering compared to the unintentional condition.

Moreover, on the basis of previous evidence that adults with ASD may differentiate even more strongly between intentional and unintentional actions in their moral judgements (Channon et al.,

2012), an interaction between intentionality and group was also expected. Specifically, it was predicted that, compared to control participants, those with ASD would generate and prefer harsher responses, and rate the characters' actions as less acceptable in the intentional condition. The opposite pattern of performance was predicted for the unintentional condition, so that participants with ASD would generate and prefer less harsh responses, and rate the actions as more acceptable compared to the control group.

J.2 METHODS

J.2.1 PARTICIPANTS AND PROCEDURE

Twenty university students with ASD and 20 control participants (12 males, 8 females in each group) took part in the study. Participants were recruited and diagnosed using the same procedure, inclusion and exclusion criteria as those described in chapter E. There was no significant difference between groups in age (ASD group mean=22.65, SD=3.56, control group mean=21.70, SD=3.36), $t(38)=.87$, $p=.381$, or IQ (ASD group mean=110.75, SD=5.32, control group mean=106.80, SD=7.56), $t(36)=1.55$, $p=.063$.

J.2.2 THE SOCIAL INTENTIONALITY TASK

The Social Intentionality task was designed to assess how people respond to and reason about everyday social situations in which someone does something unpleasant to them. It also examined their sensitivity to intentionality when producing their judgements and responses. In the task, participants read 8 descriptions of social interactions between themselves and a fictional character (see Appendix E for the full list of vignettes). In each scenario, the characters acted to the detriment of the participants, e.g. they revealed an embarrassing personal secret about them to others. There were two different variants for each scenario, so that characters acted either intentionally or unintentionally (see Figure J.1). Two different orders of presentation of the scenarios were used within each group of participants, to control for order effects. The gender of the characters, the degree of relationship with the participants (i.e., friend, colleague, schoolmate,

or neighbour) and the type of social context (i.e., family, social, or workplace) were varied across scenarios. After reading the task instructions, participants worked through an example.

For each scenario variant, they were asked what they would do to respond to the situations, and then to rate on a scale from 1 to 10 how acceptable the characters' actions were. They were then told that the characters apologised to them for what they did, and were presented with four different courses of action. These varied in how harsh they were towards the characters, and always involved: a) remaining friends with the characters as usual; b) remaining friends with the characters, but acting slightly differently towards them (e.g., putting less trust in them, or relying on them less); c) responding in kind to the characters; d) ending their friendship with the characters. Participants were asked to rank-order the four options to say how they would behave towards the characters, from the most to the least likely (see Figure J.1). Each scenario was shown one at a time in printed form on a separate page of the same booklet, and remained on display when the question was presented to avoid potential confounding effects from memory load.

J.2.3 SCORING

J.2.3.1 Strategies

Participants' responses when asked how they would respond immediately to the situations were classified as three different types of strategies, depending on how harsh these were towards the characters: 'no response', 'moderate' and 'extreme'. Strategies were categorised as 'No response' when participants said they would not do or say anything to the characters. They were classified as 'moderate' responses when participants stated that they would raise the issues with the characters (e.g., go to discuss the situation with them) or act slightly differently towards them (e.g., put less trust in them, or rely on them less). They were categorised as 'extreme' when participants said they would choose very harsh courses of actions such as responding in kind to the characters, or ending their friendship with them (see Figure J.1 for examples of each type of strategy). Participants' responses were scored by a rater blind to group membership and by another

independent, non-blind rater. There was an inter-rater agreement rate of 96%; all disagreements were resolved through discussion. Strategies that were classified as 'no response' were awarded a score of 1, whereas 'moderate' and 'extreme' strategies were awarded a score of 2 and 3 respectively. Composite scores reflecting the degree of harshness of participants' response strategies were created by adding the scores for each strategy across scenarios and converting them into percentages for each condition (intentional and unintentional).

J.2.3.2 Acceptability ratings

Participants' ratings of the acceptability of the characters' actions were added across scenarios, and converted into percentages for each condition (intentional and unintentional).

J.2.3.3 Strategies rank-ordering

The response options ranked by participants as the 'most likely' were considered. Composite scores reflecting the level of harshness of participants' preferred courses of actions were created. Participants received a score of 1 when they chose a) as their most likely option, 2 when they chose b), and 3 when they chose c) or d). Options c) and d) scored the same because they were both harsher responses compared to a) and b), and because people may have different perceptions concerning which option between them is more severe. Composite scores reflecting the degree of harshness of participants' preferred course of action were created by adding the scores across scenarios and converting them into percentages for each condition (intentional and unintentional).

Figure J.1. Example scenario and questions from the Social Intentionality task

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Example scenario:
You tell your course mate in confidence about an embarrassing thing that happened to you. Later on, a mutual friend asks you about it.

<u>Intentional variant:</u> You find out that your course mate revealed it to them, thinking that it was too funny a story not to share it.

<u>Unintentional variant:</u> You find out that your course mate let it slip after having too much to drink.

Question 1: What would you do in this situation?

Examples of strategies:

- No response: *"I would accept the situation, and move on"; "I wouldn't do anything at all"; Nothing; I'd let it go"*
- Moderate response: *"I would approach the course mate, and tell them I was unhappy with what they did"; "I would be more cautious in revealing personal information to them"; "I would explain the course mate how I felt, and stop sharing secrets with them"*
- Extreme response: *"I would also reveal one of my course mate's secrets to someone else"; "I would stop being friends with the course mate"; "I would stop any contact with the course mate"*

Question 2: On a scale from 1 to 10, how acceptable is what your course mate did?

Question 3: You mentioned it to your course mate, who apologised. Please rank-order the following options to say how you would behave towards your course mate from the MOST likely to the LEAST likely:
    a) Continue being friendly to her as usual
    b) Continue being friendly to her, but do not confide in her anymore
    c) Spread a rumour about her too
    d) Stop being friendly to her

J.3 RESULTS

J.3.1 DATA ANALYSIS

Means and SDs for each measure are shown in Table J.1. Following the procedure described in chapter F, the variables of interest were initially examined for outliers and skewness. All variables were normally distributed; thus the parametric analyses were reported.

J.3.2 STRATEGIES

The two groups were compared on the degree of harshness they displayed in responding to the social scenarios. A repeated-measures 2x2 ANOVA (group by condition: intentional or unintentional) found a significant main effect of condition, $F(1,38)=92.18$, $p<.0001$, and a significant main effect of group, $F(1,38)=6.26$, $p=.017$. There was no significant condition by group interaction, $F(1,38)=.79$, $p=.380$. Observation of the means revealed that all participants had higher harshness scores for the intentional condition compared to the unintentional condition, and that participants with ASD had higher harshness scores compared to control participants overall. These differences can be seen in both the composite scores and the scores for frequency of use of each individual strategy contributing to the composite scores (no response, moderate, and extreme), shown in Table J.1.

J.3.3 ACCEPTABILITY RATINGS

The two groups were compared on their ratings of acceptability of the characters' actions. A repeated-measure 2x2 ANOVA (group by condition) found a significant main effect of condition, $F(1,38)=294.94$, $p<.0001$, and a significant main effect of group, $F(1,38)=12.88$, $p=.001$. There was no significant condition by group interaction, $F(1,38)=.573$, $p=.454$. Inspection of the means revealed that all participants rated the characters' actions as less acceptable in the intentional condition compared to the unintentional condition. Those with ASD also tended to give lower acceptability ratings overall compared to the control group.

J.3.4 STRATEGIES RANK-ORDERING

The two groups were compared on their composite scores reflecting how harsh their preferred response option was. A repeated-measure 2x2 ANOVA (group by condition) found a significant main effect of condition, $F(1,38)=124.63$, $p<.0001$, and a significant main effect of group, $F(1,38)=7.29$, $p=.010$. There was no significant condition by group interaction, $F(1,38)=.373$, $p=.545$. Inspection of the means revealed that all participants had higher scores for the intentional condition compared to the unintentional condition, and that participants with ASD had higher scores compared to control participants overall.

J.3.5 ANALYSES WITH GENDER AS A COVARIATE

Any effect of gender on the results was examined by repeating the analyses using this as a covariate; this did not alter the pattern of findings.

J.3.6 CORRELATIONS BETWEEN INTERVIEW SCORES AND PERFORMANCE ON THE TASK

Correlations between scores on the interview examining whether participants met current diagnostic criteria, and scores on each variable from the Social Intentionality task were conducted for participants with ASD. None of these correlational analyses were statistically significant, p>.05.

Table J.1. Mean scores, standard deviations, significance, and effect sizes for the Social Intentionality task

	Group			
	Group with ASD (N=20)	Control group (N=20)		
Variables	Mean (SD)	Mean (SD)	Significance	Effect size
Strategies : composite scores (%)			Condition *** Gp ** Condition x Gp NS	
Intentional	67.19 (9.79)	63.96 (5.78)		0.40
Unintentional	55.63 (4.93)	52.71 (4.33)		0.63
Strategies : individual scores (%)				
No response				
Intentional	11.88 (12.48)	13.75 (12.76)		
Unintentional	36.88 (15.95)	41.88 (13.00)		
Moderate				
Intentional	68.75 (24.16)	80.63 (13.13)		
Unintentional	59.38 (19.82)	58.13 (13.00)		
Extreme				
Intentional	19.38 (23.81)	5.63 (8.58)		
Unintentional	3.75 (7.14)	.00 (.00)		
Acceptability ratings (%)			Condition *** Gp ** Condition x Gp NS	
Intentional	24.81 (7.61)	34.13 (11.03)		0.98
Unintentional	56.00 (12.15)	68.19 (13.27)		0.96
Strategies rank-ordering: composite scores (%)			Condition *** Gp * Condition x Gp NS	
Intentional	52.03 (13.15)	45.00 (7.75)		0.65
Unintentional	35.47 (6.35)	30.16 (3.83)		1.01

* $p<.05$, ** $p<.01$, *** $p<.001$

J.4 DISCUSSION

This study examined how people with and without ASD evaluate and respond to everyday situations in which a fictional character did something detrimental to them. Intent was systematically manipulated across the scenarios, so that the characters acted either on purpose or

unintentionally. There were two different but related hypotheses in the study; firstly, it was expected that both groups would be affected by intentionality, so that all participants would judge and react more harshly to intentional actions than to unintentional ones. This prediction was supported: compared to their responses in the unintentional condition, all participants rated intentional actions as less acceptable, generated harsher strategies to respond to them, and preferred harsher response options when rank-ordering different courses of actions that they might take after the characters had apologised. Secondly, it was hypothesised that those with ASD would show heightened sensitivity to intentionality, so that, compared to the control group, they would generate and prefer harsher response strategies, and rate the characters' actions as less acceptable in the intentional condition; the opposite pattern of performance was expected in the unintentional condition. This prediction was not supported, since there was no interaction between condition and group. Interestingly, however, a main effect of group was found, so that, compared to control participants, those with ASD rated the characters' actions as less acceptable, generated harsher strategies, and preferred harsher response options in their rank-ordering overall.

The finding that the performance of both groups was similarly affected by condition, so that all participants judged and responded to intentional actions more severely than to unintentional ones, is consistent with previous literature indicating that people with ASD can differentiate between intentional and accidental actions in their moral judgements when the agent's intent is made explicit to them. In the present study, this was done by using written scenarios which spelt out the characters' motivations for their actions, and by contrasting different variants (intentional and unintentional) of the same set of stories. Consistent with this, another previous experiment by Grant and colleagues (2005) also showed that when children with ASD were presented with different variants of the same stories, they were as likely as their typically-developing counterparts to rate intentional actions more harshly than unintentional ones.

It should be noted that on the basis of the present findings it is not possible to know whether people with ASD would still present a similar pattern of performance if the difference in the character's intent was not as salient. It is possible that, if participants were required to work out the characters' intentions from scratch, they might struggle differentiating between intentional and unintentional actions. Indeed previous experiments in which the difference between characters' intentions were not as clear-cut as in this study found that participants with ASD had a tendency to over-interpret unintentional actions as intended, and thus to judge these more negatively compared to neurotypical people (see chapter D for a review of the evidence). For example, Moran and colleagues (2011) presented participants with and without ASD with completely different sets of scenarios depicting intentional and unintentional transgressions, and found that people with ASD blamed the agents carrying out the unintentional actions more severely than control participants. Since they did not contrast different variants of the same scenarios as in the present study, the difference between intentional and unintentional actions may have been less obvious for participants, and thus hindered the ability of those with ASD to use information about intent in their judgements in comparable ways to neurotypical people. Similarly, in another experiment by Buon and colleagues (2013), participants saw non-verbal cartoons that depicted intentional and unintentional transgressions. Since no verbal information was provided, participants were required to identify the differences in the agents' intentions by themselves. Also in this case, it was found that those with ASD tended to attribute more blame to the agents in the unintentional condition, and to judge them more harshly compared to control participants.

It is likely that tasks in which the difference between intentional and unintentional actions is not explicit posit higher demand on the ability of those with ASD to infer the characters' mental states; a capacity that has already been shown to be potentially impaired in people with ASD (see chapter B for a review of the evidence). On the other hand, tasks such as the one used in the current study are more likely to keep mentalistic demands to a minimum by providing those with ASD with clearer information about the agents' motives and reducing their need to work this out by

themselves. This in turn may have allowed them to differentiate between intentional and unintentional actions in similar ways to neurotypical people. It might be interesting for future studies to examine the validity of this suggestion by presenting people with and without ASD with a modified version of the present task, where the characters' intentions are less clearly spelt out. If, under these circumstances, participants with ASD were found to differ in their evaluations from neurotypical participants, then it may mean that, when appropriate cues are provided, people with ASD can use information about intentionality in similar ways to neurotypical individuals; on the other hand, when the difference in intentionality is not made clear, their judgements may be contaminated by their mentalising difficulties, and thus not necessarily mirror their actual evaluations of the transgressions (i.e., the ones they would make if they had been able to infer correctly the characters' intentions).

Moving now to discussing the second important finding of the present study, it was also shown that, compared to control participants, those with ASD were harsher in their judgements and reactions to the situations, regardless of the character's intent. This was true for all types of responses: participants with ASD judged the characters' actions as less acceptable, and preferred harsher strategies both to respond immediately to the scenarios, and also when rank-ordering different courses of actions that they might carry out after the character had apologised to them. For instance, compared to neurotypical participants, those with ASD were more likely to choose to end their friendship with the characters or to respond in kind to their actions (e.g., to reveal one of the character's personal secrets to others as well). This finding suggests that people with ASD judge more harshly and potentially react in more vindictive ways to unpleasant social interactions, both in the immediate situation and after an apology.

The finding that those with ASD were harsher overall in their responses disconfirms our hypothesis that, compared to control participants, they would be harsher only towards intentional actions and more lenient towards unintentional ones. This expectation was based on the findings

of a previous experiment by Channon and collaborators (2012), who presented adults with and without ASD with stories where an agent harmed a victim either on purpose or by accident. They found that those with ASD differentiated more strongly in their judgements of blame between intentional and unintentional actions, so that they evaluated intentional actions more harshly and unintentional ones more leniently compared to neurotypical participants. In the present study, however, those with ASD were always harsher in their responses compared to neurotypical participants, irrespectively of whether the characters' actions were intentional or accidental.

What could be the possible reasons of this inconsistency between the finding by Channon et al. (2012) and the present experiment? There are two main differences between the studies. Firstly, in the experiment by Channon et al. participants were presented with serious transgressions, where an agent physically harmed someone. By contrast, in the current experiment the transgressions used did not involve physical harm and thus may have been less emotionally salient. Secondly, whereas in the study by Channon et al. the situations involved dyadic interactions between two characters, in the present experiment participants were always the victim of the characters' actions. It is possible that these factors (i.e., the nature of the transgression and the identity of the victim) may influence the degree of sympathy experienced by those with ASD towards the agents in different ways compared to neurotypical people. Sympathy is thought to influence both people's reactions to unpleasant events and also their propensity to forgive (Worthington & Scherer, 2004). For example, people are more likely to choose more lenient punishments if they feel they can sympathise with the person who carried a harmful action (Channon et al., 2010). As reviewed in chapter B, sympathy is closely linked to emotional empathy; it is currently unclear whether these capacities are intact or impaired in those with ASD. It is plausible that sympathy may be intact in those with ASD, but differentially influenced by situational factors compared to neurotypical individuals.

In particular, it may be that, when transgressions have high emotional valence, people with ASD are more sensitive to intentionality compared to neurotypical people, so that they feel more sympathetic towards the agents of unintentional actions, and less sympathetic towards those of intentional ones, leading to more 'black-and-white' judgements. Future research may explore this further by examining participants' performance when presented with a combination of more and less emotionally-salient transgressions. Moreover, it is also possible that when someone's actions have a personal, detrimental effect on them, those with ASD may generally feel less inclined to forgive the agents, regardless of their intent. Their general tendency to be more self-focussed and prioritise their personal perspective more compared to neurotypical people may lead them to feel less understanding or tolerant towards harmful actions that damage their personal interests. It would be interesting for future studies to examine the validity of this speculation by manipulating systematically the identity of the victims of different transgressions. If those with ASD have a bias for harsher judgements with respect to actions detrimental to the self, then they should be expected to differentiate more strongly between transgressions harming themselves versus someone else.

It is of course also possible that sympathy may actually be fully impaired in people with ASD; differences in sympathy would therefore no longer be a likely explanation for the present pattern of findings. Another possibility is that those with ASD may have relied more rigidly on learnt rules and norms in their performance on the task. As reviewed in chapter D, moral reasoning is thought to be based on both reliance on learnt, explicit principles and norms, and on socio-emotional, intuitive processes such as empathy (e.g., Haidt, 2001, 2003). Over-reliance on explicit norms in those with ASD may have meant that those with ASD were less tolerant of the characters' actions regardless of intent, and thus may have led them to be more rigid and stricter in their judgements and responses. By contrast, the judgements and decisions of control participants may have been more tempered by socio-emotional processes. This in turn may have encouraged them be more understanding and forgiving overall towards the agents, and thus to generate more lenient responses.

In summary, the present study was designed to examine how people with ASD evaluate and respond to a range of everyday social interactions, in which a fictional character did something detrimental to them, either intentionally or unintentionally. Participants were asked to rate the acceptability of the characters' actions, to say what they would do to respond to the situations, and to rank-order different response options that they might take after the characters apologised to them, from the most to the least likely. The performance of both groups was affected to the same extent by intentionality, so that all participants judged and responded in harsher ways to intentional actions compared to unintentional ones. However, those with ASD tended to be harsher compared to control participants overall. These results corroborate our previous findings suggesting that, although people with ASD can often show intact sensitivity to important situational factors in their judgements and responses, there are still subtle differences in their performance compared to neurotypical individuals.

The next chapter will continue investigating everyday moral reasoning in those with ASD by examining their decision-making and judgements in relation to different types of situations. Participants will be presented with a new set of transgressions, leading to a personal, positive (rather than detrimental) outcome for them. Their reasoning underpinning their judgements and decision-making will also be explored this time, by asking them to provide justifications for their judgements.

Chapter K: Reasoning about transgressions that may lead to a personal advantage

K.1 INTRODUCTION

The previous chapter investigated how people with ASD evaluated and responded to everyday transgressions that had detrimental effects on them. This study will now examine how they evaluate transgressions that may instead lead them to gain a personal advantage.

Previous research has identified several factors that motivate people to transgress in everyday life. For instance, rule breaking can be driven and/or exacerbated by feelings of injustice (Vardi & Weitz, 2004), emotional factors (e.g., the 'cheater high'; Ruedy, Moore, Gino, & Schweitzer, 2013), or peer pressure (Santor, Messervey, & Kusumakar, 2000). One powerful motivator for unethical behavior is self-interest: people are significantly more likely to break a norm if they think that doing so could help them to satisfy a personal wish or to obtain something that they value (e.g., Bersoff, 1999; Hegarty & Sims, 1978; Loe, Ferrell, & Mansfield, 2000). Self-interest also influences people's moral judgements, by leading them to see transgressions as more permissible. For instance, a series of recent studies has shown that, although people usually judge others' transgressions (e.g., cheating for money) as immoral, their evaluations shift when the behaviour in question benefits themselves, so that they see it as more acceptable (the 'self-interest' bias; Bocian & Wojciszke, 2014).

People with ASD are often described as self-focused, and to be living in a 'self-centred' world (e.g., de Vignemont, 2007). The findings of the present studies so far support this notion, by showing a tendency in participants with ASD to prioritise their personal wishes and needs more often compared to neurotypical individuals. For instance, in chapter F, when responding to awkward social interactions, those with ASD generated more strategies that considered only their preferences and neglected the other person's point of view. In chapter I, they were less reciprocal

in their social exchanges overall, and in chapter J they were found to judge and react more harshly to transgressions that damaged their personal interests.

On the basis of this evidence, one interesting question is how people with ASD judge transgressions that may lead them to gain a personal advantage, and whether they may be more likely than neurotypical individuals to engage in rule-breaking in these circumstances. Previous evidence indicates that children and adolescents with ASD are able to recognise moral transgressions, although their understanding of these appears to be less sophisticated (e.g., Shulman et al., 2012); thus, on the basis of this, it may be expected that they should not differ from neurotypical participants in their moral judgements. However, given their tendency to be more self-focused, it is also possible that differences between the groups might emerge when rules violations may potentially lead to a personal profit, and that people with ASD may consider these more permissible.

The present chapter examined this comparing the judgements and decision-making of people with and without ASD when presented with different types of everyday transgressions. Participants read a series of scenarios, in which a character wanted to achieve something (e.g., to be considered for a job they wanted), but could obtain this only by breaching a norm (e.g., by lying about their skills in the job application form). They were firstly asked whether they would personally choose to carry out the transgression (e.g., whether they would lie in the form) if they were the main character, to explore what they would personally choose to do if they were in those types of situations. They were then required to rate how acceptable it would be to carry out the transgressions, and to explain why people may think it was wrong.

K.1.1 HYPOTHESES

Previous studies have indicated that people with ASD typically show preserved ability to identify and judge moral transgressions. However, other experiments of a different nature have also indicated that they may also often show a tendency to prioritise their own interests and wishes

when approaching and reasoning about everyday situations and problems. On the basis of this, it was expected that, compared to control participants, those with ASD would be more likely to choose to carry out the transgressions, and that they would rate these as more acceptable compared to control participants.

Moreover, on the basis of previous research suggesting that people with ASD tend to generate simpler rationales when asked to justify their moral judgements (e.g., Grant et al., 2005; Shulman et al., 2012; see chapter D for a review), it was hypothesised they would provide fewer elaborated justifications than control participants when asked to explain why the transgressions described in the scenarios were wrong.

K.2 METHODS

K.2.1 PARTICIPANTS AND PROCEDURE

Twenty university students with ASD and 20 control participants (12 males, 8 females in each group) took part in the study. Participants were recruited and diagnosed using the same procedure, inclusion and exclusion criteria as those described in chapter E. There was no significant difference between groups in age (ASD group mean=22.65, SD=3.56, control group mean=21.70, SD=3.36), $t(38)=.87$, $p=.381$, or IQ (ASD group mean=110.75, SD=5.32, control group mean=106.80, SD=7.56), $t(36)=1.55$, $p=.063$.

K.2.2 THE RULE TRANSGRESSIONS TASK

The Rule Transgressions task was designed to assess how people respond to and reason about situations in which violating a rule may help them to gain a personal advantage. In the task, participants read 10 descriptions of everyday situations (see Appendix F for the full list of vignettes). In each scenario, a main character wanted or needed to achieve or obtain something (e.g., to be considered for a job), but could do so only by breaching a rule (e.g., by lying on the job application form). Two different orders of presentation of the scenarios were used within each

group of participants, to control for order effects. The gender of the characters and the type of context were varied across scenarios. After reading the task instructions, participants worked through an example. For each scenario, participants were asked to say whether they would personally choose to carry out the transgression if they were the story character; to rate on a scale from 1 to 10 how acceptable it would be to carry out the transgression; and to explain why people may think it is wrong for someone to do that (see Figure K.1). Each scenario was shown one at a time in printed form on a separate page of the same booklet, and remained on display when the question was presented to avoid potential confounding effects from memory load.

K.2.3 SCORING

K.2.3.1 Decisions to carry out the transgressions and acceptability ratings

The number of times participants said that they would carry out the transgressions if they were the story characters and their ratings of acceptability were individually added across scenarios, and converted into percentages.

K.2.3.2 Rationales

Participants' responses when asked why people might think that it is wrong for someone to carry out the transgressions were classified into two categories, 'simple' or 'sophisticated'. Rationales were categorised as simple when participants reiterated elements of the scenarios, provided nonspecific condemnations of characters' actions, or cited simple rules that prohibited them without further explication. They were classified as sophisticated when participants showed a higher-level understanding of the transgressions, for example by referring to abstract or more elaborate principles, or by recognising the possible damaging effects of the characters' actions on other people's opportunities or rights (see Figure K.1 for examples of each type of strategy). Responses could score for only one of the two categories; if both were met, then the best answer would be taken, and participants' rationales would score in the sophisticated category. Participants' responses were scored by a rater blind to group membership, and also by an independent, non-

blind rater. There was an inter-rater agreement rate of 96%; all disagreements were resolved through discussion. Scores for each strategy were added across scenarios, and converted into percentages.

Figure K.1. Example scenario and questions from the Rule Transgressions task

Example scenario:
Alan is unhappy with his current job, and finds an opening to work for the company of his dreams. He meets all the job criteria except for one, since he does not have much knowledge about computer programming. He has the opportunity to lie about his skills in the application form.

Question 1: If you were Alan, would you lie about your skills in this situation? a) Yes; b) No

Question 2: On a scale from 1 to 10, where 1 represents 'not at all acceptable' and 10 represents 'very acceptable', how acceptable is it to do that in this situation?

Question 3: Why might people think that it is wrong for someone to do that in this situation?

Examples of rationales:

- Simple: *"Alan does not have experience with computer programming"; "It's lying"; "It would involve cheating"*
- Sophisticated: *"He is taking advantage of a system based on supplying truthful information"; "It is unfair towards other candidates, who may be better qualified for the job"; "His actions will have a detrimental effect on the company's best interests and on other, more deserving candidates"*

K.3 RESULTS

K.3.1 DATA ANALYSIS

Means and SDs for each measure are shown in Table K.1. Following the procedure described in chapter F, the variables of interest were initially examined for outliers and skewness. All variables were normally distributed, except for the acceptability ratings provided by the group with ASD, which were negatively skewed. Thus, logarithmic transformations were performed on this measure to meet criteria for parametric analysis.

K.3.2 DECISIONS TO CARRY OUT THE TRANSGRESSIONS

The two groups were compared on the number of times that they said they would personally choose to carry out the transgressions if they were the story characters. There was no significant difference between groups, $t(38)=1.42$, $p=.164$. Both groups stated that they would choose to carry out the transgressions about half the time.

K.3.3 ACCEPTABILITY RATINGS

The two groups were compared on their acceptability ratings. There was no significant difference between groups, $t(38)=1.29$, $p=.204$.

K.3.4 RATIONALES

The two groups were compared on the types of verbal rationales they generated to explain why carrying out the transgressions may be considered wrong. There was a significant difference between groups in the proportion of sophisticated rationales used, $t(38)=3.62$, $p=.001$. Inspection of the means revealed that whilst those with ASD generated sophisticated rationales less than half the time, the control group relied on these for the majority of their responses.

K.3.5 ANALYSES WITH GENDER AS A COVARIATE

Any effect of gender on the results was examined by repeating the analyses using this as a covariate; this did not alter the pattern of findings.

K.3.6 CORRELATIONS BETWEEN INTERVIEW SCORES AND PERFORMANCE ON THE TASK

Correlations between scores on the interview examining whether participants met current diagnostic criteria, and scores on each variable from the Rule Transgressions task were conducted for participants with ASD. There was a significant, positive correlation between participants' scores describing the extent of their non-social impairments ('Domain B'; see Table E.2 in chapter E) and the percentage of simple versus sophisticated rationales that they generated in the task, $r(17)=.72$, p<.001. None of the other correlational analyses were significant, p>.05.

Table K.1. Mean scores, standard deviations, significance, and effect sizes for the Rule Transgressions task

	Group			
	Group with ASD (N=20)	Control group (N=20)		
Variables	Mean (SD)	Mean (SD)	Significance	Effect size
Decisions to carry out the transgressions (%)	50.00 (21.03)	58.50 (16.63)	NS	0.45
Acceptability ratings (%)	33.65 (14.43)	39.55 (14.42)	NS	0.41
Sophisticated rationales (%)	35.00 (20.39)	59.50 (22.35)	**	1.15

* p<.05, ** p<.01, *** *p*<.001

K.4 DISCUSSION

The present study was designed to examine the judgements and decision-making of people with and without ASD when presented with everyday situations in which transgressing a rule (e.g., 'do not lie in a job application form') may help them to gain a personal advantage (e.g., be considered for the job of their dreams).

Previous research on moral reasoning in the neurotypical population has shown that people are typically more lenient when judging the acceptability of transgressions that may help them to

obtain something that they want (e.g., cheating to earn more money; the 'self-interest bias'). Since people with ASD have been found to be more self-oriented, i.e. to prioritise their own wishes and preferences more often compared to neurotypical individuals in social situations, it was hypothesised in the present experiment that they would also be more likely to prioritise their personal interests in these scenarios compared to neurotypical participants. In particular, it was hypothesised that (a) they would choose more often to carry out the transgressions if they were the story characters, and (b) that they would rate the transgressions as more acceptable. Neither of these two predictions was confirmed, since the two groups did not differ in their responses to either question. Nevertheless, those with ASD generated significantly fewer sophisticated rationales to explain why the transgressions were wrong.

Why did those with ASD not differ in their ratings and decisions compared to neurotypical participants? As reviewed in chapter D, moral reasoning is thought to be based on both reliance on learnt, explicit principles and norms, and on socio-emotional processes such as empathy (e.g., Haidt, 2001, 2003). One likely explanation for the present findings is that people with ASD may have developed a normative theory that allows them to recognise moral transgressions. Indeed, although the difference between groups for their ratings and decisions did not reach significance, the direction of the means was the opposite of that expected, suggesting that if anything, people with ASD might be even more rule-based and stricter in their judgements of the transgressions than neurotypical individuals. It is thus possible that over-reliance on norms may lead those with ASD to be even less affected than neurotypical people by the self-interest bias in moral reasoning. This suggestion could be explored further in future studies comparing people's judgements for transgressions that benefit themselves versus someone else. If those with ASD are more strongly driven by explicit principles in their reasoning than neurotypical people, it is possible that they may differentiate less in their judgements concerning transgressions that benefit themselves compared to someone else.

Moving now to the difference in the rationales generated by the two groups, this was in line with expectations, and confirms previous studies on moral reasoning in children and adolescents with ASD (e.g., Grant et al., 2005). For example, Shulman and colleagues (2012) found that, when asked to explain why different types of moral transgressions (e.g., a boy hitting another child) were unacceptable, children and adolescents with ASD were more likely to reiterate elements of the stories and/or to refer to simple rules that prohibited the character's actions (e.g. "it is forbidden to hit others"). Consistent with this, in the present study those with ASD also showed a tendency to reiterate information (e.g., 'he lied') and to mention simple rules ("lying is not correct") in their justifications. This was in contrast with control participants, who provided more elaborate rationales based on abstract principles and/or on the effect that rule-breaking might have on other individuals (e.g., "it would compromise the opportunities of other, more prepared candidates").

It is possible that, although reliance on norms and rules may have allowed participants with ASD to make similar judgements and decisions to neurotypical participants, generation of sophisticated rationales may depend on more complex social and cognitive processes. It has been proposed that both emotional and cognitive empathy are necessary for moral reasoning (e.g., Blair, 1999; Hoffman, 1994) and that their relative contributions may depend on the task and stimuli at hand (Greene et al., 2004). With respect to the current experiment, an involvement of emotional empathy seems less likely. Emotional empathy is thought to be implicated predominantly in situations evoking strong emotional responses, such as for example witnessing someone in distress, where people's moral judgements are driven by their 'gut feelings', i.e. their immediate affective reactions (e.g., Blair, 1999). In the present study, however, the transgressions presented had a relatively low emotional valence, as they were not going to cause explicit harm or distress any specific individual. Thus, compared to previous experiments the present scenarios were less likely to elicit aversive affective responses.

A contribution of cognitive empathy seems more likely with respect to performance in the present task; it is in fact possible that, compared to the other task questions, the requirement to generate rationales may have drawn more heavily on participants' mentalistic abilities. Although the transgressions described in the scenarios were not going to impact immediately on any other specific individual, they were still going to have unpleasant, indirect consequences on others in the long-term. For example, in the job application scenario, lying on the form would reduce the chances of other, more skilled candidates of being considered for the job; if participants were eventually hired, their lack of experience might impact negatively on the company in the long-run; their employer might also eventually find out about their lie, and lose trust in them or feel disappointed. Difficulties mentalising may have hindered the ability of those with ASD to consider or anticipate all these possible implications, and thus to reach a more comprehensive and sophisticated understanding of the scenarios. By contrast, through reliance on both norms and cognitive abilities, neurotypical participants may have been more skilled at appreciating the potential consequences of the transgressions, both with respect to the opportunities, rights, or welfare of other individuals and also to societal living in a wider sense. This suggests that, although reliance on norms and deliberate reasoning may still allow individuals to make correct moral judgements, cognitive empathy is still likely to be an essential skill for higher-level understanding of everyday moral problems.

In summary, the present study examined the decisions and judgements made by people with and without ASD in relation to a series of situations where carrying out a transgressions may help them to gain a personal advantage. There was no difference between groups in the number of times they decided to carry out the transgressions and in their acceptability ratings of them. However, when asked to explain why the transgressions were wrong, those with ASD generated significantly fewer sophisticated rationales compared to the control group. The findings of all the studies presented

up until this point will now be all brought together and discussed in the next chapter, the general discussion.

PART 3: GENERAL DISCUSSION AND

BIBLIOGRAPHY

Chapter L: General discussion

The findings of the studies described in the thesis will now be discussed together. Firstly, their potential contribution to advancing current understanding of everyday social functioning in people with ASD will be examined. Models and factors that might explain or contribute to participants' performance across tasks will then be discussed. Finally, the clinical implications of the findings and areas of interest for future research will be outlined.

L.1 CONTRIBUTIONS OF THE PRESENT RESEARCH

L.1.1 SUMMARY OF THE STUDIES AND OF THEIR NOVEL ELEMENTS IN THE DESIGN

Previous qualitative and clinical evidence suggests that one of the main struggles of higher-functioning individuals with ASD is to be able to develop and maintain positive and meaningful social relationships (e.g., Locke et al., 2010). People with ASD often report that, although they would be interested in befriending others, they feel that they lack the appropriate skills to do so. For instance, they frequently claim to have difficulties understanding what is expected of them in social situations, and to do or say socially inappropriate things without meaning to do so (e.g., Carrington et al., 2003; Stokes et al., 2007). Unsuccessful attempts at social interactions can in turn lead those with ASD to avoid social situations and to feelings of isolation and loneliness (e.g., Causton- Theoharis et al., 2009; Daniel & Billingsley, 2010; see chapter C of this thesis for a review of previous literature on this).

Despite this evidence, there is a paucity of empirical work examining the nature or severity of the impairments presented by people with ASD in their everyday social performance. Previous empirical studies have predominantly involved lower-functioning children or adolescents, and the usage of relatively abstract laboratory tasks. As a consequence, little is known about the specific problems experienced by higher-functioning adults. A more fine-grained understanding of these

might contribute to gain more insight as to why they have difficulties engaging in successful interactions and relationships, and also inform and guide the development of tailored interventions and strategies. The present thesis thus aimed to examine everyday social performance in higher-functioning adults with ASD. This was done through the use of novel or adapted versions of previous scenario-based tasks that recreated some of the features and demands of common social situations and interactions.

The first three experimental chapters of the thesis focused on exploring the types of strategies that individuals with ASD use to manage everyday social situations, and also their ability to judge and reason about these in a sophisticated manner. In the tasks, participants were presented with challenging but common types of social situations, i.e. awkward social scenarios. Specifically, *chapter F* investigated the strategies people used to respond to awkward questions (e.g., an unwelcome relative asking to be their guest for the weekend), and how they evaluated these (using the 'Social Strategy task'). *Chapter G* examined their ability to adapt their social judgements flexibly across different types of circumstances, by asking them to rate the appropriateness of raising different types of awkward issues (e.g., bad breath) with different individuals varying in the degree of familiarity, and in different settings varying in the degree of formality (the 'Social Appropriateness questionnaire'). *Chapter H* expanded on the findings from *chapter G*, by examining participants' capacity to raise the same awkward issues in a socially sensitive manner, and also to reason about these in a skilled way (the 'Social Appropriateness Scenario task').

The last three experimental chapters focused on another important aspect of everyday social performance, i.e. the ability to apply and reason effectively about important moral and societal principles underpinning everyday exchanges and interactions. In particular, *chapter I* explored participants' sensitivity to reciprocity in everyday social exchanges (e.g., how they would interact with a friend who had previously treated them to lunch; the 'Social Exchange task'). *Chapter J* investigated how they judged and reacted to intentional and unintentional transgressions that had

a detrimental effect on them (e.g., a friend revealing one of the participants' personal secrets to others; the 'Social Intentionality task'). Finally, *chapter K* examined participants' decisions and reasoning when confronted with situations where they had the opportunity to transgress norms to gain a personal advantage (e.g., to lie in an application form in order to be considered for an important job; 'the Rule Transgressions task').

The designs of the present tasks incorporated a number of novel elements compared to previous research. Firstly, they examined both the types of strategies used by people to engage in social situations, and also their ability to judge and reason about these. These aspects of performance are both crucial to successful social functioning (Spence, 2003), but have been rarely examined in concert in those with ASD. Doing this should help to illuminate the extent to which practical impairments in social interactions are associated with impaired versus preserved aspects of understanding. Secondly, the tasks included a combination of more and less demanding questions throughout, such as open- versus closed-ended response formats. As reviewed in chapter C, previous studies have found that children and adolescents with ASD can sometimes perform in similar ways to neurotypical people on social cognition measures (e.g., Callenmark et al., 2013); some authors have proposed that this could be attributable to differences in the complexity of the task at hand, whereby performance of those with ASD is enhanced by the usage of less demanding question formats, involving for example the requirement to give ratings or to select from alternatives. Since this suggestion had not been systematically investigated, especially in higher functioning adults with ASD, the present research presented participants with both more and less demanding types of questions to examine the impact of this on group differences.

L.1.2 CONTRIBUTIONS OF THE FINDINGS TO UNDERSTAND EVERYDAY SOCIAL FUNCTIONING IN ASD

Throughout the experimental chapters, a number of interesting findings systematically emerged in relation to the social performance of those with ASD. These will now be outlined and discussed.

L.1.2.1 Social strategies in everyday performance

One of the key findings of this thesis was that, compared to neurotypical individuals, those with ASD systematically generated strategies that were less socially sensitive to respond to the social situations presented. Overall in their interactions they relied on briefer, less elaborate responses with emotional tones that were less polite. Moreover, they appeared to take into account mostly their own points of view, preferences or interests, and to neglect how other people might think or feel. For instance, compared to neurotypical people, those with ASD were less likely to generate sophisticated responses that considered the characters' expectations and wishes to respond to everyday awkward questions. Consistent with this, in chapter H, they used blunter strategies to raise different types of awkward issues with other people (e.g., "your breath stinks!"). They were also less reciprocal when presented with the opportunity to return someone else's favour in chapter I, and in chapter J they responded more harshly to unpleasant interactions between themselves and a fictional character, for example by responding in kind or ending their friendships with them.

Overall, these findings suggest that higher-functioning adults with ASD might be less competent compared to neurotypical people at both approaching and responding to other people in everyday social situations. The types of strategies that they use seem less likely to make a positive impression, and to have the potential to harm others' feelings and their relationships with them, in both the short- and long-term. They thus seem ineffective at supporting successful social interactions, and this might account in practice for at least some of the difficulties experienced by individuals with ASD at both forming and sustaining positive social relations.

L.1.2.2 Awareness of social and moral principles underpinning everyday performance

One interesting question is whether practical difficulties with the generation of socially skilled strategies in those with ASD are also associated with a more limited understanding of the nuances characterising social situations. Social understanding in people with ASD was examined in the present thesis by asking participants to answer different types of questions. Many of these involved

making a series of judgements about the social situations, such as for example rating the awkwardness of the situations, or rank-ordering different courses of action on the basis of their appropriateness or fairness. Interestingly, the groups did not typically differ in their performance on these, suggesting that higher-functioning adults with ASD might be able to demonstrate at least partially intact awareness of many social and moral principles underpinning everyday situations in these types of circumstances. For example, in chapter F and I, those with ASD rank-ordered sophisticated strategies and reciprocal courses of actions respectively as the most appropriate and fairest responses to the social situations, in similar ways to neurotypical people. All participants also consistently showed similar sensitivity in their ratings to the types of experimental manipulations used across studies. For instance, in chapters G and H, participants with ASD were able to adapt their judgements concerning the appropriateness of different social behaviours flexibly to various types of situations, and in chapter K they also rated intentional transgressions as less permissible than accidental ones in similar ways to neurotypical people.

It is possible, however, that preserved aspects of performance shown by those with ASD under these types of circumstances might have been facilitated, at least to an extent, by the usage of relatively low task demands. The requirement to provide ratings or to rank-order alternatives is likely to be a less complex task compared to the generation of free verbal responses; it might thus be easier for those with ASD to provide accurate approximations or estimates under these conditions. Moreover, it is possible that contrasting different options (e.g., familiar versus unfamiliar characters) or variants of the same scenarios (e.g., intentional versus unintentional) might have made the difference between these more salient or explicit for those with ASD, and thus 'cued' them to make their judgements in the expected direction. Thus, in summary, it may be that the use of less complex questions or the provision of implicit cues might 'mask' the presence of more subtle impairments in social understanding in individuals with ASD. This possibility was explored further in the thesis through inspection of participants' performance on more complex

questions, which examined their rationales and the reasoning behind their judgements in more depth.

L.1.2.3 Understanding and reasoning about everyday performance

Obtaining participants' justifications to examine the reasoning behind their judgements through the usage of more demanding, open-ended question formats systematically revealed the presence of some key differences between people with ASD and neurotypical individuals. Although, as discussed in the paragraph above, those with ASD could often show relatively preserved awareness of the normative expectations underpinning the social situations, their understanding of these appeared to be overall considerably more limited compared to that of neurotypical people. When asked to justify their judgements, people with ASD were consistently more likely to concentrate on practical aspects of the situations, such as for example practical or monetary resources, and/or on explicit and simple rules and norms of behaviour.

For example, compared to neurotypical individuals, people with ASD provided more practical rationales (e.g., "it saves time or money" or "it is more convenient to do that") to explain why people might use simple strategies to respond to awkward questions, or to justify their chosen courses of action in social exchanges in chapters F and I respectively. When required to explain why it might not be appropriate in some circumstances to raise awkward issues such as 'advising someone to lose weight', or to engage in transgressions such as 'cheating in an exam' in chapters G and K respectively, those with ASD tended to rely on explicit norms or non-specific condemnations of the behaviours, such as "because it's rude" or "it is forbidden to do that". The nature of the rationales provided by those with ASD thus differed systematically from those generated by neurotypical participants, who instead relied more often on social considerations. These tended to refer for example to the impact that different types of behaviours or responses might have on other people's thoughts or feelings, on their opinion of them or of the relationship (e.g., "it will keep them happy" or "it might damage their friendship with them"). Reduced ability

to consider and appreciate important social factors and aspects of the situations in their reasoning might explain, at least to an extent, why those with ASD generated fewer socially sensitive strategies to manage the social situations (i.e., the finding described in L.1.2.1). Limited capacity to appreciate the nuances of the social interactions presented, and a tendency to focus on practical aspects or on simple rules might have meant that those with ASD were not sufficiently motivated to generate socially sensitive responses that took into account other people's thoughts, feelings or potential reactions.

Interestingly, it should be noted that the findings from one of the studies presented in the thesis hinted that it might be possible in some circumstances to encourage those with ASD to rely more effectively on social considerations by prompting them to do so. This possibility was discussed in more detail in chapter F. In this study, when asked to explain why people might use simple strategies (involving acquiescing or outright refusing) to respond to awkward questions, those with ASD gave more rationales based on practical resources such as effort or money, and fewer justifications relating to the character's preferences and wishes compared to neurotypical people. However, all participants regardless of group membership were more likely to rely on character-based rationales when asked to explain why people might use sophisticated strategies (involving suggesting a compromise or providing a justification); no difference between groups was found in this case. To explain this finding, it was suggested that, although practical justifications might be overall be easier to access for those with ASD, the requirement to reflect on why people might choose sophisticated strategies might have prompted them to take the characters' perspectives into consideration in their reasoning. Since it might be hard to imagine why someone would make the effort to compromise or give a justification on the basis of the practical aspects of the situation alone, this might have helped those with ASD to appreciate the inadequacy of these types of rationales, and to put more effort into thinking about alternative explanations. It is thus possible that when people with ASD are prompted by task or situational requirements to consider social implications of different courses of actions, then they might be able to do so.

Thus, taken together, all these findings suggest that the level of complexity of situational demands at hand and the provision and availability of relevant cues or prompts might play a strong influence on social performance in higher-functioning adults with ASD. When asked to produce free verbal responses, people with ASD seem to struggle considerably providing sophisticated responses such as socially sensitive strategies or rationales. However, when situational demands are relatively low and/or the intensity of the social signal is increased, then performance may appear to be preserved.

L.1.2.4 Limitations of the studies

It is of course important to consider that the sample sizes used in the present thesis might have not been large enough to detect differences in performance between groups under these circumstances. Sample sizes were determined using the guidelines and table provided by Cohen (Psychological Bulletin, 1992, 112, 115-119), which indicate that 20 participants per group are necessary to detect a difference likely to be of clinical significance, setting power at 80% and alpha at 10%. Samples in the present study were around this size, and other studies reporting significant effects in high-functioning adults with ASD have also used similar or even smaller number of participants (e.g. Zalla et al., 2008, with respect to faux pas recognition; Shulman et al., 2012 with respect to moral reasoning). Nevertheless, it is acknowledged that the present sample sizes are relatively small and might not be large enough to detect more subtle differences between groups. Increasing statistical power through the use of larger sample sizes in future studies might therefore lead to the emergence of additional or stronger group differences.

It should also be noted that the majority of participants in both the clinical and control groups took part in more than one study (see chapter E for details). This raises several issues. Firstly, it brings into question the generalisability of the findings to the wider population of those with ASD. Secondly, the possibility cannot be ruled out that one or more of the participants might have been atypical in their responses to the tasks, and therefore that performance across studies might have been systematically influenced by individual differences specific to subsets of participants who

took part in more than one experiment. Thirdly, overlap of participants across studies raises a question about the potential presence of practice effects. However, the types of scenarios presented differed across tasks, and participants were explicitly told on each occasion that there were no 'right or wrong' ways to perform on them. Moreover, the studies were carried out in pairs (i.e., chapter F and G, H and I, J and K), and these pairs were performed in counterbalanced order and on separate occasions. Finally, differences remained between the groups even on the later experiments, where any practice effects might have been expected to be maximal, suggesting that any such effects were not sufficient to eradicate these group differences. For these reasons, any substantial influence of practice effects on the present pattern of findings seems unlikely. Future replications of the tasks might overcome these limitations and improve the generalizability of the findings through the use of larger sample sizes with different samples of participants.

It is also important to consider that, although the groups were matched with respect to gender, the majority of participants were male. As reviewed in chapter A, ASD is more commonly diagnosed in males rather than females (Fombonne, 2009). On the basis of this, it could be argued that the present pattern of finding is more representative of the general population of those with ASD than it would have been if the studies included an even gender ratio. Interestingly, clinical reports have suggested that females with ASD might have better social skills than males with a diagnosis, and have a greater ability to 'mask' or compensate for their everyday impairments (Halladay et al., 2015). One important question is thus whether gender might have played an influence on the pattern of performance shown by participants. This possibility was examined in each study by including gender as a covariate in the statistical analyses. It was found that this factor could not explain or account for differences in performance across the tasks, suggesting that the findings of the present thesis are unlikely to have been influenced by gender, and that they should thus apply to both males and females with ASD.

Finally, a potential limitation of the present studies concerns the validity and sensitivity of the use of scenario-based measures. These have many different strengths; for instance, they allow performance to be examined in relation to real-life-type materials or situations, and thus have higher ecological validity compared to more abstract, traditional laboratory measures. Moreover, they facilitate insight into participants' thought and reasoning processes in a more rigorous way compared to observational or qualitative experiments. Nonetheless, they still lack the high degree of experimental control available when using traditional laboratory measures. There are also possible limitations with respect to their external validity, since naturally-occurring situations are likely to be more complex and interpersonally stimulating compared to vignettes. Some authors have proposed that the use of virtual reality paradigms or role-plays might be a useful way to increase ecological validity (e.g. Parsons & Cobb, 2011); this is however debatable, at least with respect to the current research. It could be in fact be argued that, whereas vignettes allow participants to imagine or visualise in their minds familiar characters (e.g., a close friend) or environments (e.g., one's home or workplace), role-plays or virtual reality paradigms do not typically provide people with the same opportunities. These are in fact likely to require participants to interact with unfamiliar people (e.g., an actor pretending to be a friend) or in contexts with different physical features to their everyday ones to; for these reasons, they might be even less effective than vignettes at simulating the characteristics of the situations encountered by participants in their everyday lives. Thus, although it would be interesting to examine whether the use of different methodologies such as role-plays generated a similar pattern of findings to the present thesis, it is unclear whether these would actually increase ecological validity.

L.1.2.5 Inter-participants variability

Special consideration should also be given to the potential issue of inter-participants variability within the clinical sample with respect to their core symptoms and also scores on the experimental tasks. As mentioned in chapter A, there is evidence of a high level of heterogeneity in the

expression, severity and nature of the symptoms associated with ASD (APA, 2013). With respect to social impairments, for example, these may vary from complete refusal or inability to communicate with others, to more subtle deficits in managing complex interactions that require a sophisticated understanding of other people's goals or intentions. Similarly, patterns of rigid and repetitive interests and behaviours might range from simple motor stereotypies to more complex and elaborated rituals, accompanied by differing levels of distress when these are interrupted (Pelphrey, Shultz, Hudac, & Vander Wyk, 2011). Great variability has also been observed with respect to people's levels of intellectual functioning, from profoundly impaired to intact or even above average abilities (Fombonne, 2003, 2005). Current rates of comorbid problems, such as stress, depression, or anxiety, also seem to vary across studies; for instance, prevalence of depressive symptoms has been found to be in the range of 4% to 57% (Ghaziuddin et al., 2002; Lainhart, 1999), whereas anxiety has been found to be in the range of 7% to 84% (e.g. Lainhart, 1999; White et al., 2009). Comorbid mental health issues can exacerbate the impairments associated with ASD, compromising quality of life and overall functioning level to a greater degree (Matson & Nebel-Schwalm, 2007).

This evidence on heterogeneity in the presentation of ASD raises the important question of the range of core features and symptoms in participants with ASD who took part in the present studies, and whether this might have impacted on the findings in any way. Examination of their performance on the tasks reveals in fact that their scores tended to have relatively large standard deviations, suggesting potentially marked variability among participants in their responses. To what extent did the participants in the clinical group differ from one another in terms of important features? As described in chapter E, all participants in the clinical group were university students at a UK leading university, and were thus all relatively high-functioning. They were also all of similar age, and, as shown by their WTAR-predicted full-scale IQ scores, they all had average levels of intellectual abilities. Thus, the participants were relatively homogeneous with respect to their

expected level of cognitive functioning and skills. Moreover, screening for comorbid mental health issues at the time of the study revealed that none of the participants included in the research met the threshold required to be diagnosed with a major mental health disorder. This indicates that the sample might have overall been relatively homogeneous with respect to important features such as age, cognitive functioning, and presence of comorbid problems.

Another source of information with regards to inter-participants variability in those with ASD is the range of scores obtained on the semi-structured interview. As described in chapter E, diagnosis of ASD was confirmed (or excluded) in all participants who took part in the research through the use of a semi-structured interview, which closely related to the current DSM-5 criteria for ASD. Examination of participants' responses to the interviews revealed that all individuals in the clinical group who met inclusion criteria presented social and non-social difficulties in line with diagnostic criteria, although the specific nature of these differed across them (see chapter E). For instance, with regards to social impairments, there was variability in the extent to which people said that they enjoyed talking to other people, with some of them reporting that they did not like it at all, and others reporting that they did enjoy talking with others about topics in which they had a special interest. People also differed with respect to the nature of their obsessional interests, varying, for example, from collecting objects, to reading, playing instruments, or cooking. However, although the specific pattern and presentation of symptoms appeared to be unique to each individual, inspection of participants' scores on the diagnostic interview suggests that participants did not in fact differ a great deal in the number or severity of their symptoms, or in the extent to which these impacted on their everyday functioning (see chapter E, table E.2).

Although participants in the ASD group appeared to be relatively homogeneous with respect to their scores on the diagnostic interview, the potential presence of a relationship between these and performance on the tasks was examined for each experiment, through the use of correlational analyses for each study. The majority of these analyses did not reach significance, suggesting that

differences in presentation were unlikely to explain why participants' scores on the tasks were relatively widely distributed. What other factors could explain this? One possible reason may be that high standard deviations reflect natural variability among individuals with respect to their preferences and responses to different types of everyday social situations. As explained in chapter E, the scenarios used in the experimental chapters were developed for the purpose of recreating a variety of common social interactions and problems. For this reason, it is probably unsurprising that people may tend to vary considerably from one another with respect to their reactions and preferred responses to each of these. Indeed, a similar pattern of performance to the group with ASD can be observed in the neurotypical group, since control participants also presented a high degree of variability, with similar standard deviation scores to the group with ASD on each of the tasks. It is thus plausible that wide variation in performance might be a natural consequence of the type of materials used and represent individual differences in the population in their attitudes and responses to different types of problems.

Thus, overall, the findings suggest that heterogeneity in the clinical group might not have been a fundamental issue with respect to the present research, since participants presented similar core characteristics and levels of functioning. Nonetheless, it is important to acknowledge that exploration of heterogeneity in ASD is a key issue, since this has implications with respect to the generalisability of the findings, and also of the applicability of the tools developed for use with other individuals on the autistic spectrum. It will thus be important for future research to examine this in more detail where possible. Replication of the current studies might do this for example by including additional standardised measures such as questionnaires, examining in more depth how participants vary on important dimensions in everyday functioning, such as for example levels of perceived stress, social isolation, mood, and so on. The relationship between these and performance could then also be examined.

L.1.2.6 Summary of contributions of the present research

In summary, the findings from the present thesis have shown that people with ASD tend to rely on less socially sensitive strategies to communicate and interact with others. This also seems to be associated with differences between those with ASD and neurotypical individuals with respect to their ability to understand and interpret the nuances of social situations. In fact, although people with ASD appear able to appreciate many of the conventions underpinning everyday performance, their understanding of these is less sophisticated. In reasoning about social situations, people with ASD tend to pay reduced attention to important social factors, such as what other people might think or how they could feel, and to focus rather more heavily on practical considerations and/or on explicit and basic rules.

These findings from the present research extend and advance previous literature in a number of ways. They provide a rich source of information about the nature of the difficulties of higher-functioning adults with ASD and the types of factors that facilitate or impinge on their performance. They expand on previous qualitative and clinical reports concerning the everyday challenges of individuals with ASD (e.g., Carrington et al., 2003; Muller et al., 2008), by providing empirical evidence of 'what may be going wrong' in their attempts at social interactions, and of what aspects of their performance might be contributing to their difficulties forming and sustaining positive social relationships with others.

Furthermore, the findings indicate that situational demands may contribute strongly to differences in social performance when comparing higher-functioning adults with ASD to neurotypical people. This finding might help to explain previous discrepancies in the literature, where higher-functioning participants have sometimes been found to be able to pass social cognition tasks (e.g., Ponnet et al., 2005; Scheeren et al., 2013). It is possible that in previous studies preserved performance might have resulted from the usage of less demanding question formats, such as closed-ended questions, or from the effect of cuing. This evidence indicates that more complex

demands, such as for example the requirement to generate free verbal responses, might be more effective at detecting subtle group differences in social performance, and thus highlights the potential utility of using a combination of more and less demanding questions.

The present studies have a number of potential implications for use in clinical settings, which will be outlined in greater detail in L.3. For instance, the tasks described in the thesis could be used to aid with the diagnostic assessment of ASD in adults, or to guide the development of tailored interventions to ameliorate their deficits. Before examining these, the possible theoretical mechanisms that might explain the pattern of findings shown by the present thesis will be discussed.

L.2 MODELS POTENTIALLY EXPLAINING PERFORMANCE ACROSS TASKS

The possible role of previous theoretical models of ASD to explaining the pattern of performance shown by participants across the tasks will now be discussed. Firstly, the possible contribution of non-social models of ASD such as weak central coherence and impaired executive functions will be outlined. Then, the potential influence of social accounts of ASD such as alexithymia, impaired empathy, and reliance on compensatory social knowledge will be examined.

L.2.1 NON-SOCIAL MODELS: WEAK CENTRAL COHERENCE AND EXECUTIVE FUNCTION

As previously reviewed in chapter B, some previous research has proposed that the deficits of those with ASD might be explained in terms of weak central coherence, i.e. a cognitive style whereby they focus excessively on details and local information, and struggle to see the 'bigger picture' (Frith, 1989). Other studies have suggested that ASD might instead be explained by the presence of impairments in people's executive function (e.g., Steel et al., 1984). The empirical support for both accounts is mixed. Whereas some previous experiments have found evidence of weak central coherence and of impairments in executive skills such as inhibition, cognitive

flexibility and working memory, other experiments have contradicted this (see Happé & Frith, 2006, and Hill, 2004 for reviews). Mixed findings have led most researchers to agree that weak central coherence is probably a secondary outcome of ASD rather than a primary problem, and that it should be interpreted as an information processing bias instead of a discrete deficit (Booth & Happé, 2010; Happé, 2013). Whilst there is currently no consensus concerning the presence of executive deficits in people with ASD, these seem to be largely affected by their levels of intellectual abilities, since they manifest more frequently in those with lower IQ scores (Hill, 2004). Both weak central coherence and impaired executive function have been put forward to account predominantly for the non-social symptoms of ASD, such as for example their insistence on sameness and their patterns of rigid and narrow behaviours and interests (Frith, 1989; South et al., 2007). Nonetheless, a possible contribution of these models to the present pattern of findings cannot be excluded, since performance on the present tasks might have arisen from a combination of many different skills and resources.

Starting with the possible contribution of weak central coherence, this might have influenced the ability of those with ASD to integrate all relevant social information described in the situations. By focusing on details of the scenarios or failing to integrate relevant social cues, the group with ASD might have been unable to form a comprehensive understanding of the situations presented. For example, participants with ASD might have concentrated predominantly on details of the scenarios that were only relevant to their own points of view or preferences, leading to the generation of responses that did not consider others' perspectives or that referred to irrelevant aspects of the situations.

Moving now to the potential influence of impaired executive function on the present pattern of findings, many different executive skills might have been implicated in performance across the tasks. Although it would be difficult to try to disentangle the specific contribution of each different executive skill, taken together these might have influenced participants' ability to identify, keep in

mind and retrieve relevant social information, whilst ignoring distracting or inappropriate cues or information; to modify their responses flexibly across different types of contexts or circumstances; to identify appropriate goals, or predict the consequences and implications of different courses of actions; and to generate novel ideas, concepts and information.

Weak central coherence and impaired executive function might thus have accounted for or at least exacerbated the impairments in social performance of those with ASD with respect to the generation of both socially skilled strategies to respond to the scenarios, and also the generation of sophisticated rationales that took into account relevant social aspects of the situations. However, neither model can account for areas of preserved performance shown by participants with ASD, such as intact awareness of the conventions and norms underpinning the scenarios. Other possible accounts might provide a more comprehensive explanation for the present pattern of findings, and will thus be considered next.

L.2.2 SOCIAL MODELS

This section will now review the possible contributions of the social models of ASD to explain the present pattern of findings. It will start by examining the potential role of alexithymia, and will then move on to discuss the influence of impaired empathy and of reliance on compensatory social knowledge.

L.2.2.1 Alexithymia

As reviewed in chapter B, previous evidence suggests that between 40% and 65% of people with ASD might suffer from alexithymia, a condition characterised by deficits in identifying one's own feelings and internal experiences (Berthoz & Hill, 2005; Hill et al., 2004). Alexithymia has been associated with failure to recognise and express self-reflective, complex emotions such as embarrassment or guilt (Capps et al., 1992). Some theorists have recently argued that alexithymia might potentially explain the emotional and social impairments typical of ASD ('the alexithymia hypothesis'; Bird & Cook, 2013). The evidence in support of this is still limited though, especially

since this condition only seems to affect only a subset of those with a diagnosis of ASD, and is also presented by people with other psychiatric disorders (e.g., schizophrenia; Taylor et al., 1999).

With respect to the potential role of alexithymia in the present pattern of findings, the studies described in the thesis did not require participants to reflect on or to respond to questions concerning their own internal experiences or feelings; it is thus difficult to imagine how alexithymia might have contributed to their performance. Nonetheless, the possibility cannot be excluded that difficulties in those with ASD with respect to appraising their own emotions or feelings towards the characters or situations presented may have further hindered their ability to appreciate the overall social contexts or situations, including the characters' points of views or the social implications of different responses or courses of actions. This is especially the case since alexithymia has been associated with difficulties discerning other people's mental states and interpreting relevant social cues (e.g., Guttman & Laporte, 2002).

However, alexithymia still fails to explain why those with ASD showed intact aspects of performance on many of the tasks, e.g. why those with ASD could often give similar perceived awkwardness ratings, or recognise what courses of actions were the most appropriate or the fairest across situations. Disentangling the possible contribution of alexithymia is not possible in the present set of studies since they did not assess the presence of this in the participants, meaning that it is unknown whether or how many of the participants had this condition. Further replications of the tasks might investigate the possible contribution of alexithymia to social performance in more detail, using validated questionnaires or by adding new questions to the tasks.

L.2.2.2 Impaired empathy

As reviewed in chapter B, empathy is thought to comprise two separate but related components: emotional and cognitive (e.g., Blair, 2005). Both aspects of empathy are said to contribute to positive social functioning (Blair, 2008; Rogers, et al., 2007). The potential relative contributions of each type of empathy to the present pattern of findings will now be examined one at a time.

L.2.2.2.1 Emotional empathy

Emotional empathy has been typically defined as the capacity to resonate emotionally with other people's mental states ('I feel what you feel'; e.g., Eisenberg & Miller, 1987). It allows people to sense or share others' internal experiences, and to respond to these with appropriate emotions (e.g., with joy at someone else's happiness, or pity at their sadness; Rankin et al., 2005). Resonating emotionally with others can lead to feelings of concern, compassion or sympathy, especially in the context of negative or distressing situations; these in turn motivate people to act pro-socially and to try to provide others with the support that they need (e.g., Batson et al., 1987).

The evidence for an impairment in emotional empathy in those with ASD is currently mixed, with some studies in support of this and others contradicting it (see Blair, 2008 for a review). To reconcile these findings, it has been proposed that emotional empathy might in fact be intact in people with ASD, but that they might be able to resonate emotionally with people's mental states only when it is made explicit to them what others might be thinking or feeling (e.g., Jameel et al., 2015). Either way, since whether emotional empathy is intact or not in ASD is still under debate, a possible contribution of impairments in this resource to the present pattern of findings cannot be dismissed.

It is possible that reduced capacity to resonate emotionally with the characters' points of views might have led those with ASD to be less motivated to generate responses that met their expectations or wishes; by this means, impaired emotional empathy might thus account for their decreased propensity to generate socially skilled strategies. Since impaired emotional empathy should not affect people's ability to reason about others (Blair, 2008), a selective impairment in this domain might also hypothetically explain the preservation of aspects of performance in those with ASD, such as intact awareness of the rules and normative expectations underpinning the scenarios. However, such an explanation seems implausible in light of previous literature arguing for the opposite pattern of abilities in ASD, i.e. impaired cognitive empathy in the presence of

preserved emotional empathy (Blair, 2008; Singer et al., 2004). Moreover, it would still fail to explain why those with ASD struggled to show sophisticated understanding of social situations. Impaired cognitive empathy and reliance on social knowledge might provide a more likely and comprehensive explanation for the present pattern of findings.

L.2.2.2.2 Cognitive empathy

Cognitive empathy consists of the ability to take others' perspectives and infer their thoughts, intentions, or emotions ('I understand what you feel'; Frith et al., 1991; Whiten, 1991), and has many important implications for social functioning. For example, it allows people to anticipate or predict how others would like them to act or how they might be likely to react, and thus to adjust their own behaviours accordingly. People with higher levels of cognitive empathy have been typically found to have better social skills and to be more satisfied with their relationships (e.g., Selman et al., 1977). Cognitive empathy also has important implications for moral reasoning: for instance, it has been proposed that by taking others' perspectives people can understand what 'it is like' to be a victim, and can simulate in their minds what they would like or would not like to happen if they were in the same situation (Gibbs et al., 2007).

Many previous studies have supported the existence of a deficit in cognitive empathy in those with ASD (see chapter B for a review). This has been demonstrated initially through the use of first-order and second-order false belief tasks (e.g., Wimmer & Perner, 1983), and more recently through the adoption of more sensitive and advanced measures involving more ecological social stimuli such as scenarios (e.g., the 'Strange Stories test'; Happé, 1994), pictures (e.g., the 'Eyes in the Mind test', Baron-Cohen et al., 1991) or videos (e.g., the 'Empathic Accuracy task'; Roeyers et al., 2001). These examined participants' ability to infer or predict the mental states of different characters, and found that both children and adults with ASD were often less skilled at this compared to neurotypical individuals (e.g., Jolliffe & Baron-Cohen, 1999; Kaland et al., 2005; Spek et al., 2010).

How could an impairment in cognitive empathy account for the present pattern of findings? Firstly, reduced ability to take others' perspectives in those with ASD might explain why they generated fewer socially sensitive strategies to manage the social situations compared to neurotypical people. People with ASD might have struggled to anticipate or appreciate the negative impact that less skilled strategies, such as for example simpler or blunter ones, might have on the other person's thoughts or feelings, or how these might damage their relationship with them. Reduced ability to consider the social implications of using inappropriate strategies might have thus translated into decreased motivation to generate more sophisticated responses that considered both their own and the characters' perspectives. By contrast, neurotypical participants might have been more aware of the characters' thoughts, wishes, or feelings which in turn might have encouraged them to generate responses that would help to keep the characters happy and protect their relationship with them. Impaired cognitive empathy might also explain why those with ASD showed a less sophisticated understanding of the social situations, such as why they were less prone to consider important social factors in their reasoning. Due to difficulties taking others' perspectives, people with ASD might have found it difficult to consider or anticipate the social implications of the different behaviours or courses of actions presented in the studies, such as how these might affect other people or their relationship with them in the short- or long-term.

Recent evidence has suggested that impairments in cognitive empathy might also be linked to diminished motivation to protect one's own social reputation. People need to be able to represent what others might think of them to be motivated to influence their opinions (Amodio & Frith, 2006). Some recent studies have indicated that individuals with ASD tend to be less concerned about their image (Frith & Frith, 2011). For instance, it has been shown that, in contrast with neurotypical people, individuals with ASD are not more likely to behave altruistically (e.g. to donate to a charity) in the presence of an audience compared to when they are on their own (Izuma et al., 2011; Lin et al., 2012). Reduced concern with protecting their social reputations in those with ASD might have influenced the present pattern of findings in at least two ways. Firstly, it might have

meant that participants with ASD were less bothered about what the scenario characters might think of them. This might account both for a decreased propensity to generate socially appropriate strategies, and also for a reduced tendency to consider important social implications in their reasoning. Secondly, it is also possible that those with ASD might have worried less about what the experimenter would think of them, and thus generated more 'honest' responses overall. By contrast, neurotypical participants might have been more concerned with protecting their image in front of the eyes of the researcher, and thus given more socially desirable answers to the task questions. Future research might examine the influence of motivation to protect one's reputation on performance on the present tasks, for example by replicating these with and without the presence of an observer, or by manipulating the anonymity of participants' responses.

Although impaired cognitive empathy provides a plausible explanation for many of the difficulties shown by those with ASD throughout the experimental chapters, it still cannot explain why they could perform similarly to controls in some other aspects of performance. Reliance on social knowledge might provide a possible explanation for this.

L.2.2.3 Social knowledge

As reviewed in chapter B, previous work suggests that, although people with ASD seem to struggle with intuitive socio-emotional processes such as perspective-taking, they might still have an intact ability to learn social rules underpinning social situations, through experience and exposure to the social environment. It has been proposed that reliance on social knowledge might help them to compensate at least to an extent for some of their social impairments and to find solutions to social problems (e.g., Bowler, 1992). Support for this comes from previous evidence that people with ASD can sometimes perform similarly to control participants even on particularly sensitive measures of cognitive empathy (e.g., Begeer et al., 2010; Ponnet et al., 2005), and from previous clinical and qualitative reports examining their everyday problems. These indicate that people with ASD often spend time observing how neurotypical people act across different situations to

improve their social understanding and increase their ability to 'mask' their difficulties. For instance, small group interactions have been described by those with ASD as natural "laboratories" for learning about how to master social dynamics. This approach seems to be instrumental in helping them to extrapolate the rules underlying appropriate social conduct (Carrington et al., 2003; Müller et al. 2008). It has thus been postulated that social performance in ASD might be based on the use of static rules and logical reasoning, rather than on intuitive awareness and understanding of others' mental states (Dewey, 1991; Frith & Happé, 2003).

With respect to the current pattern of findings, reliance on compensatory social knowledge could account for preserved aspects of performance shown by those with ASD across the studies, and in particular for intact awareness of the conventions and normative expectations underpinning the social situations. Overall, reliance on social knowledge might have been sufficient for the group with ASD to detect awkward or inappropriate interactions, to recognise what types of behaviours might be appropriate depending on different circumstances, or to select or rank-order courses of actions on the basis of their acceptability or fairness. This is especially plausible considering that both ratings and rank-ordering are probably less demanding tasks than generating free verbal responses. These types of questions might circumvent at least to an extent the need for participants to take others' perspectives, and thus might rely less heavily on intuitive socio-emotional processes such as perspective-taking. Application of learnt knowledge and rules might therefore be sufficient for higher-functioning individuals with ASD to provide appropriate answers and approximations in these types of circumstances.

However, it is likely that reliance on social knowledge alone is not a sufficient compensatory tool for successful performance under more demanding conditions requiring the generation of free verbal responses. More sophisticated skills such as perspective-taking might be necessary for people to be able to generate socially skilled strategies or rationales that take into account others' feelings, thoughts or wishes. Reliance on non-intuitive knowledge alone without the ability to

consider and empathise with others might thus explain why those with ASD still struggled in these aspects of performance across the tasks. Thus, taking together the findings of past work and the present studies, it appears that people with ASD might be able to learn social rules and norms, but struggle to put them into practice and to reason about these in a sophisticated manner without the provision of cues.

It is also noteworthy that individuals with ASD tend to have reduced exposure to social situations compared to neurotypical individuals (e.g., Orsmond, Krauss, & Seltzer, 2004; Rowley et al., 2012), can find social situations stressful (White, Ollendick, & Bray, 2011), and may encounter negative responses to their attempts at social interaction, leading to potential social isolation (Trembath, Germano, Johanson, & Dissanayake, 2012). People with ASD might thus have less experience with everyday social interactions and situations, and might find these more anxiety-provoking compared to neurotypical individuals. This might have further exacerbated their difficulties in generating appropriate strategies and rationales.

Thus, in summary, impaired cognitive empathy combined with over-reliance on learnt social knowledge seems to be the most plausible and comprehensive account to explain the present pattern of findings. It is possible that people with ASD might have struggled taking others' perspectives in their social performance, and relied on learnt rules and conventions to compensate for their deficits. However, reliance on social knowledge in the absence of intuitive awareness and understanding of others' mental states is unlikely to be sufficient to support effective social interactions, and may lead to rigid and awkward patterns of social responses. The possible contribution of perspective-taking and reliance on compensatory knowledge to performance on the tasks described in these thesis might be examined in more depth by future replications of the studies, by for example adding additional components or questions to them. For instance, participants might be required to provide more detailed information about their perceptions of the characters' thoughts or feelings, to explore more directly their capacity to take their perspectives.

They might also be asked to illustrate their thought processes while performing the tasks, or to explain why they decided to provide certain responses.

Regardless of the specific nature of the theoretical mechanisms that may underlie group differences in performance, the present findings provide rich information about areas of preserved versus impaired functioning in those with ASD with respect to their capacity to navigate the everyday social environment. They highlight the potential utility of scenario-based tasks to improve current understanding of the nature and severity of the social deficits presented by those with ASD in their performance in the real world. They thus have relevant clinical implications for informing and guiding the development of better tools for both diagnosis and intervention; these will be outlined in the next paragraph.

L.3 IMPLICATIONS OF THE CURRENT RESEARCH AND FUTURE DIRECTIONS

Impaired social skills in people ASD have been associated with problems in virtually all areas of functioning, including emotional, social, academic, and occupational (Church, Alisanski, & Amanullah, 2000; Gillot & Standen, 2007; Howlin, Goode, Hutton, & Rutter, 2004; Mazurek, 2013). Difficulties appear in childhood and tend to persist into adulthood, leading to poor overall adjustment (Szatmari, Bartolucci, & Bremner, 1989; Van Hees, Moyson, & Roeyers, 2014). Although ASD is thought to appear early in development, typically within the first 3 years, diagnosis is not made until later in life in a high proportion of people. This seems to be especially the case for higher-functioning individuals, whose symptoms and difficulties may be particularly subtle, and thus harder to notice or interpret (Howlin, 2006). Despite this evidence, there are currently a number of issues with respect to both diagnostic and intervention tools for higher-functioning people with ASD.

As reviewed in chapter A, assessing ASD in adults is currently considered a particularly complex challenge for professionals (Seltzer et al., 2004). Diagnosis of ASD is typically based on

examination of people's developmental history and on the use of standardised tools of assessment such as the ADOS (Lord et al., 1984) or the ADI-R (Lord et al., 1994). However, adults seeking a diagnosis do not possess or frequently struggle recalling sufficient information concerning their early patterns of impairments. Informants (e.g., parents) may not always be available, and, even when they are, they might also be unable to remember specific information regarding early difficulties in development or the timeline of the emergence of these. Moreover, since most diagnostic tools were designed for children, many of their material and activities (e.g., playing with dolls in the ADOS) are unsuitable for use with older individuals.

Current intervention programmes to ameliorate the deficits of those with ASD have also been predominantly designed for lower-functioning children or adolescents, meaning that little is known about effective interventions for higher-functioning adults (Bishop-Fitzpatrick et al., 2012; see chapter C for a review). Many intervention programmes focus on teaching either specific cognitive skills, such as how to take other people's perspectives (e.g., Fisher & Happé, 2005; Turner-Brown et al., 2008), or broad pragmatic abilities, such as turn-taking or how to maintain eye contact (e.g., Barry et al., 2003; Rao et al., 2008). Although these types of intervention may often prove effective within the laboratory context, it has been shown that the skills acquired within the training sessions may be difficult to apply and generalise in real life situations (Begeer, et al., 2011; Howlin & Yates, 1999), and may lead to no actual practical improvements in how people with ASD navigate the social world (e.g., Hadwin et al., 1997; Locke et al., 2014).

The current findings suggest that everyday life-type tasks such as those described in the thesis might prove to be useful tools for identifying both impaired and preserved social abilities in those with ASD, with respect to both the types of strategies they use to respond to everyday situations, and their understanding of and ability to reason about these. They provide a means of profiling individuals' strengths and weaknesses with respect to both spontaneous processing and generation of social information through open-ended responses, and also the capacity to rate or rank-order

the quality of alternative options or responses when the need to generate novel ideas is removed. The present tasks and findings could thus represent potentially useful tools for use in clinical settings, where they could contribute both to the identification and assessment of people's specific deficits, and could also inform and guide the development of intervention strategies to ameliorate these. In particular, the findings from the thesis indicate that the tasks could be used in the following ways:

(1) To target generation of socially skilled strategies

The scenarios presented in the studies could be used to train people's skills in generating socially appropriate responses that consider both their own points of view but also the feelings, preferences and wishes of other people. People could be educated about the principles that can be applied to produce sophisticated, skilled responses (e.g., compromises, or more sensitive strategies), and on how to select and generate these across different types of interactions and exchanges. In combination with this, people might also be trained on anticipating the social implications of using different types of responses, such as for example the most likely reactions of potential recipients. Educating people on this might contribute to highlighting the likely benefits of using more socially sensitive strategies compared to responses that only take into account their own perspectives. Moreover, as outlined above, generalisability of skills training to a range of situations has been found difficult to achieve by previous work (Howlin & Yates, 1999). Teaching the principles underpinning generation and appreciation of socially skilled responses, and practising these using a range of different examples scenarios, might thus contribute to enhancing the generalisability of the improvements shown by people within clinical settings to real-life environments.

(2) To target the discrepancy between awareness and understanding, and the generation of flexible social responses

The findings from the present thesis have systematically highlighted the presence of a discrepancy in higher-functioning adults with ASD between awareness of the rules underpinning everyday performance and a more sophisticated understanding of these. For instance, people with ASD

were often able to recognise a situation as conventionally appropriate or inappropriate, but lacked adequate comprehension of the reasons behind it. In a clinical setting, the present tasks could be refined to identify such discrepancies in higher-functioning individuals and guide intervention strategies. These could either focus on expanding people's awareness of rules and norms underpinning everyday interactions, or on advancing their understanding of the underlying reasons and implications of these, depending on the specific difficulties presented by individuals. As argued throughout the thesis, both components appear to be necessary for successful social performance; although reliance on rules alone might help those with ASD to disguise their social impairments to an extent, this is unlikely to be always a sufficient compensatory tool on its own, and risks leading to inflexible and rigid patterns of behaviour. Improving both people's awareness of rules and also their understanding of these rules, such as their implications and possible caveats, might support the generation of more flexible and socially appropriate responses, especially in complex and unpredictable social situations (Channon et al., 2010; Howlin et al., 2004).

(3) To target performance through cuing

Finally, the findings from this thesis have provided some tentative evidence that the provision of cues is likely to enhance social performance in people with ASD. The potential effectiveness of the use of cues to facilitate social skills learning has also been supported by previous clinical studies and reports on children and adolescents with ASD. In the context of clinical settings, cues are usually defined as 'instructions, gestures, demonstrations, touches, or other things that we arrange or do to increase the likelihood that children will make correct responses' (McClannahan & Krantz, 1999). The ones used most frequently by training programmes are verbal, and involve either providing children with specific instructions about what they are expected to do (e.g., 'you should wash your hands before eating'), or tend to be more subtle and indirect (e.g., 'What are you supposed to do before you eat?'), depending on whether children have already shown some skill acquisition on the task at hand (Alberto & Troutman, 2005). Other types of prompts that can be used in conjunction with or independently of verbal ones involve 'modeling' the action, i.e.

demonstrating individuals how to perform the behaviour or guiding them through it step-by-step; gesture prompts such as pointing or nodding; and visual cues, such as pictures or photographs (MacDuff, Krantz, & McClannahan, 2001). The number of cues provided usually decreases over time to reach the point where children can perform the responses independently. Prompts have been found within clinical settings to increase the likelihood that children will engage in socially appropriate responses and to reduce the number of social errors made (Neitzel & Wolery, 2009; Smith, 2001).

One main limitation of previous evidence is that cues have been predominantly used in the context of interventions for lower-functioning children, with the aim of teaching them basic skills. Little is known about the effectiveness of these with respect to teaching more sophisticated social skills in higher-functioning individuals. Thus, the present tasks could be refined to exploit the effect of cuing and prompting to help higher-functioning people with ASD to gradually improve their social skills. For instance, in order to target generation of socially skilled strategies, people might be systematically encouraged to evaluate different types of response options (e.g., descriptions of simple and sophisticated strategies) before generating their own free responses. The same procedure could be applied to enhance people's social understanding: before explaining why certain interactions might or might not be conventionally appropriate, they might be asked to consider different alternative rationales focusing on practical versus social considerations. Training people to consider and evaluate different alternative responses before generating their own ones might eventually improve their ability to select and generate free responses that take into account other people's points of views and other important social factors. The intensity or availability of cues or prompts provided could be gradually decreased during training, to reach the point where people no longer need these and can generate sophisticated responses spontaneously.

Although the present tasks were designed for adults with ASD, they could also be modified and refined to assess and target impairments in children and adolescents. It has been proposed that

early diagnosis and intervention can have an important positive influence on long-term outcomes, and that they might potentially lead to better levels of adjustment and functioning in individuals with ASD (e.g., Estes et al., 2015). The scenarios used in the present tasks could be revised to depict situations that are more relevant to a younger population; for instance, they could describe interactions with schoolmates or teachers, or problems commonly arising when playing with others. Pictures rather than written vignettes could be used or added to the tasks to facilitate comprehension of the materials in younger children who are still learning how to read. Targeting the difficulties experienced by those with ASD early in development might be instrumental in equipping them with some of the skills necessary to navigate the rest of childhood, adolescence and adulthood more successfully.

Another interesting area that might be explored by future studies is the role of social motivation to enhance performance. Although, as discussed above, teaching compensatory strategies can be useful in face of reduced capacity to access intuitive socio-emotional processes such as perspective-taking, people still need to feel motivated to use these; otherwise, they may be aware of rules but still fail to apply them in practice. Social motivation is an interesting area of research, but one which has been relatively under-explored in ASD so far. Some recent evidence has suggested that individuals with ASD might lack motivation to engage in socially appropriate behavior and activities (e.g., joint attention or eye gaze) because they find these less intrinsically rewarding than neurotypical people (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). This has been supported by neuroimaging studies showing reduced activation in the brain reward centres of those with ASD following the presentation of social rewards and stimuli such as faces (e.g., Kohls et al., 2012). However, it is currently unclear whether reward deficits are specific to social stimuli or reflect a general reward processing deficit in ASD (Dichter et al., 2012). It might be interesting for future work to study in more detail how people with ASD process social stimuli and rewards in the context of everyday situations, and the potential presence of differences in the extent to which they seek and take pleasure from social interactions. In particular, it might be useful for guiding

and improving current intervention strategies to find out whether enhancing social motivation might also contribute to facilitate socially appropriate responses, in addition to other methods and techniques such as cuing.

In summary, taken together the present findings provide a basis for the development of tools to teach those with ASD to think and reason about social situations and problems more flexibly, especially in situations where mere application of rules and abstract cognitive skills is insufficient to generate socially appropriate responses, and a more advanced appreciation of the complexity of human behaviour is required. Real-life type measures such as the ones described in this thesis, which present participants with a range of realistic everyday scenarios involving different types of characters and contexts, could therefore be instrumental in bridging the gap between training cognitive skills and successfully dealing with real-life situations, including their caveats and exceptions. These could in turn help people with ASD to improve their communication and interpersonal skills.

L.4 CONCLUDING COMMENTS

The present thesis aimed to examine the types of difficulties that higher-functioning adults with ASD present in their everyday social performance. Overall, the findings showed that, compared to neurotypical people, individuals with ASD tended to rely on less socially skilled strategies in their interactions with other people. Although they often showed relatively intact awareness of many social and normative expectations underpinning everyday situations, their understanding of these appeared to be more limited. The present findings highlighted the potential utility of scenario-based tasks to identify the nature and severity of the impairments presented by higher-functioning adults with ASD in their everyday social interactions and functioning. These could be used to inform and guide the development of diagnostic and intervention tools to identify and ameliorate the deficits associated with ASD.

Appendix A

List of scenarios from the Social Strategy task (chapter F)

1. You have just moved house. A new neighbour offers to assemble some shelves for you. He does not do a very good job, as he scratches the new paintwork. He asks: "Would you like me to assemble your desk now?"

2. Your cousin likes to come and stay with you. She is good company, but when she visits she expects you to pay to take her out to expensive places. She asks: "Can I come and visit they next weekend?"

3. Your colleague is being considered for an important promotion, and gives a talk to the company. It is too long, and he makes some bad jokes where nobody laughs. He asks: "Do you think my talk went well?"

4. You friend knits you a jumper for Christmas. The shape is rather uneven and the style is not flattering. She asks: "Will you wear the jumper when we go carol singing later?"

5. On the train home after a long day, you bump into an old schoolmate. She always only talks about herself and moans a lot. She asks: "Would you like to come over for dinner next week?"

6. You meet up with your brother. You saw him recently with his new girlfriend. Each time you or your friends tried to talk to her, she ignored you and talked only to your brother. He asks: "Did you get on well with my girlfriend?"

7. You are taking an evening course in French. A woman who is on the same course struggles with the material. She often asks you for extra help. Now she asks: "Will you help me with my essay?"

8. A friend who recently took art classes has painted a series of self-portraits. They are very poorly painted. He asks: "Would you like a painting for your living room?"

9. Your brother decides to organise a big party for your parents' golden wedding anniversary. You are very busy at work, with important deadlines to meet. He asks: "Will you send out all the invitations?"

10. Your friend wants to become a singer, and she takes part in a singing competition. Her singing is badly out of tune. She asks: "Do you think I sang well?"

Appendix B

List of scenarios from the Social Appropriateness questionnaire (chapter G)

1. Tell someone that you do not agree with their opinion

2. Ask someone if you can try a bite of their meal

3. Ask someone if you can borrow their phone to make a quick call

4. Correct someone's grammar while you are talking with them

5. Interrupt someone while they are talking

6. Mention to someone that their hairstyle does not suit them

7. Suggest to someone that they should lose weight

8. Tell someone that they often have bad breath

Appendix C

List of scenarios from the Social Appropriateness Scenarios task (chapter H) (more/less familiar variants)

1. Alex is listening to a presentation given by a good friend/new colleague who has a similar role in the company. His friend is presenting a set of ideas for the team's future strategic planning. Alex strongly disagrees with what his friend is saying.

2. Alicia is dining in a restaurant with a group of good friends/ Alicia is dining in a restaurant at a school reunion. She did not order a dessert. However, when her friend/someone she used to know from school is served the chocolate mousse, Alicia is tempted by the sight of the pudding and would like to try it.

3. Paul is standing at the train station next to his flatmate/a man he just met, waiting for his train to go to work. The trains are delayed by bad weather, and Paul is not going to make it on time for an important work meeting. He takes his phone out his pocket to inform his office, and realises that it is out of battery.

4. Helena is queuing up to enrol for university, and gets chatting to an old friend/girl she has just met who has just moved to England from Spain to study. She tells Helena that she is nervous about studying in the UK, but has been working hard to improve her English. While they are talking, Helena notices that she keeps making the same grammatical mistake.

5. Emma is at home having a chat with her mother/ Emma is in the office having a chat with her colleague. Her mother/colleague starts telling Emma about some unpleasant events that recently happened in the news, and becomes emotional. Emma glances at her watch and realises that she will be late for an appointment if she lets her mother carry on talking.

6. Jenna has been invited to her flatmate's/colleague's wedding. Jenna's flatmate shows her a picture of the hairstyle she is planning to have on the day. Jenna thinks that this hairstyle would not suit her flatmate at all.

7. Jeff goes to visit his father/neighbour, who has just come out of hospital. The doctor told him that he would improve faster if he changed his lifestyle and lost a few pounds. However, Jeff thinks that his father is not taking the advice seriously, as he finds him eating fish and chips.

8. Sam pops round to a good friend's/ new neighbour's house to invite him for coffee and finds him on his doorstep. He tells Sam that he is on his way to meet someone for a date, and he is very excited about it. Sam notices that his friend has very bad breath.

Appendix D

List of scenarios from the Social Exchange task (chapter I) (lower-cost/higher-cost)

1. Last week when you and a friend went out for lunch, she paid for her own sandwich and yours.

    Lower-cost variant: Today, you go out for coffee. When the bill comes, she says she will pay for your coffee.

    Higher-cost variant: Today, you go out for an evening meal in your local pub. When the bill comes, she says she will pay for your meal.

2. Last week, your brother took the day off to take your mother to a hospital appointment, even though you are both busy at work.

    Lower-cost variant: Today, your mother phones and asks if one of you will bring over her prescription. Your brother says he will do it.

    Higher-cost variant: Today, your mother phones and asks if one of you could take a few days off and look after her. Your brother says he will do it.

3. Last week, a colleague you work closely with gave up a Saturday to work on a project that was behind schedule.

    Lower-cost variant: Today, one of you needs to stay after work for another project. She says she will stay late.

    Higher-cost variant: Now, one of you needs to give up a weekend for another project. She says she will give up her weekend.

4. Last week, your flatmate cleaned the kitchen and bathroom.

    Lower-cost variant: Today, you are both at home for the afternoon and he says he is going to clean the kitchen again.

    Higher-cost variant: Today, you are both at home for the afternoon and he says he is going to clean the kitchen, bathroom and living room.

5. A mutual friend is visiting the city where you and your cousin live. Although you both have deadlines to meet, last week your cousin took her out for the day to see museums.

   Lower-cost variant: Today, she wants one of you to take her sightseeing for a few hours. Your cousin says she will take the friend out

   Higher-cost variant: Today, she wants one of you to take her sightseeing for the whole weekend. Your cousin says she will take the friend out.

6. You and your brother share a car. Last week, you both wanted to use the car to go away for the weekend, and your brother let you have it.

   Lower-cost variant: Today, you both want to use the car for the day. Your brother says you can take it.

   Higher-cost variant: Today, you both want to use the car to go away for a week. Your brother says you can take it.

7. The nearest grocery store is a long walk from your flat. Last week, your flatmate went to the shop to get a few ingredients for dinner.

   Lower-cost variant: Today, you go to make coffee and find that your milk has run out. She says she will make the journey to the shop

   Higher-cost variant: Today, you need a long list of groceries. She says she will make the journey to the shop.

8. Last week, your colleague spent an hour sorting out expense claims for both of you.

   Lower-cost variant: This week, you both have some urgent mail to post. He says he will go down to the post office during his half-hour lunch break to post the mail for both of you.

   Higher-cost variant: This week, an urgent report on a joint project is due. He says he will spend a couple of hours in the morning writing the report for both of you.

9. Last week, your sister spent the day helping your father move boxes into his new house.

   Lower-cost variant: This week your father needs someone to spend a few hours unpacking boxes for him. Your sister says she will do it.

Higher-cost variant: This week your father needs someone to spend the weekend redecorating for him. Your sister says she will do it.

10. Last week, your cousin paid £20 for the two of you to see a comedy show.

    Lower-cost variant: This week he suggests going to see a local play, and tickets for both of you cost £10. He says he will pay for the tickets.

    Higher-cost variant: This week he suggests going to see a West End musical, and tickets for both of you cost £30. He says he will pay for the tickets.

Appendix E

List of scenarios from the Social Intentionality task (chapter J) (intentional/unintentional variant)

1. You tell your course mate in confidence about an embarrassing thing that happened to you.

   Intentional variant: Later on, a mutual friend asks you about it. You find out that your course mate revealed it to them, thinking that it was too funny a story not to share it.

   Unintentional variant: Later on, a mutual friend asks you about it. You find out that your course mate let it slip after having too much to drink.

2. You go out for lunch with a friend. When the bill arrives, neither of you has enough cash.

   Intentional variant: You offer to pay the whole bill with your card, and suggest that he repays you his share later. He agrees, but never pays you back. You find out that he is saving up for a big holiday, and hoped that you would forget that he owed you money.

   Unintentional variant: You offer to pay the whole bill with your card, and suggest that he repays you his share later. He agrees, but never pays you back. You find out that he is dealing with a lot of pressure at work, and forgot that he owed you money.

3. You and your friend plan to spend an evening together. As he has a very busy schedule, you rearrange your plans to be able to meet him.

   Intentional variant: At the last minute, he texts you that he cannot make it. You then find out that he had chosen to go to a friend's party instead.

   Unintentional variant: At the last minute, he texts you that he cannot make it. You then find out that he is quite depressed.

4. You agree to baby-sit your brother's children for one night, although you have an exam the morning after.

   Intentional variant: Your brother and his wife come home several hours later than you agreed. They decided to stay out longer to enjoy their night out, and so they were late.

Unintentional variant: Your brother and his wife come home several hours later than you agreed. Their car broke down, and so they were late.

5. Your sister's laptop broke down. You agree to share your computer with her for a few days, while she waits for hers to be repaired.

    Intentional variant: You find her looking at one of your emails in your personal account. You had left your account logged in, and she was curious.

    Unintentional variant: You find her looking at one of your emails in your personal account. You had left your account logged in, but she thought that she was logged into her own.

6. You are walking down the street with your new partner when you bump into your cousin. You stop for a few minutes for a chat.

    Intentional variant: That evening at a family event, you ask your cousin what she thought. She makes a joke about his appearance, despite knowing that he was your partner.

    Unintentional variant: That evening at a family event, you ask your cousin what she thought. She makes a joke about his appearance, as she had not understood that he was your partner.

7. You are walking down the street when you spot an old friend on the other side of the road.

    Intentional variant: You wave to him and call out his name, but he carries on walking. You find out that he was not in the mood, and pretended not to see you.

    Unintentional variant: You wave to him and call out his name, but he carries on walking. You find out that he was lost in thought, and did not hear or see you.

8. You lend your friend a special book.

    Intentional variant: He does not return it to you. You find out that he really liked it, and kept it for himself.

    Unintentional variant: He does not return it to you. You find out that he has been busy moving home, and forgot that he had it.

Appendix F

List of scenarios from the Rule Transgressions task (chapter K)

1. Mark is taking an exam that is going to influence his overall university degree grade. He cannot remember some information that will help him to answer many of the questions. The exam room supervisor has to leave for an emergency for about 15 minutes. He has the opportunity to check the notes in his bag without anyone noticing.

2. Diana borrows her grandfather's car to go to an important work meeting. She cannot find a parking spot, and it is getting late. She spots a free space for disabled people. She is not disabled, but notices that her grandfather left his disabled badge in the car. She has the opportunity to use it to park, and get to the meeting on time.

3. After a night out, Laura rushes to catch a late train home. If she stops to buy a ticket, she will miss it and will have to wait two hours. She knows that at that time of night nobody ever checks train tickets, and that turnstiles are left unattended. She has the opportunity to travel home without buying a ticket.

4. Paul rents a car for his holiday abroad, but unintentionally scratches it on one side. When he returns it to the rental company, the assistant does not notice the damage. He has the opportunity to avoid reporting the scratch, and not pay for it.

5. Kate is in a very long queue to enter a festival. She notices that one of her friends is also in queue, and has almost made it to the entrance. She has the opportunity to join the friend in the queue and skip most of it.

6. Steve is walking down the street when he urgently needs the toilet. He goes into a coffee shop, but realises that he forgot his wallet and cannot order anything. The staff have not noticed him yet. He has the opportunity to use the coffee shop toilet without ordering anything.

7. Alan is unhappy with his current job, and finds an opening to work for the company of his dreams. He meets all the job criteria except for one, since he does not have much knowledge

about computer programming. He has the opportunity to lie about his skills in the application form.

8. Emily has been struggling to come up with ideas for a new project proposal. The day before the deadline, she overhears a colleague discussing an interesting idea that he had. She thinks that the colleague's idea would fit her project well, and would help her to make a good impression on her boss. She has the opportunity to use it for the project proposal and pass it off as her own.

9. Spencer has been asked to attend a meeting at work, where everyone will vote on a series of competing ideas for the company's future. Spencer thinks that the idea suggested by his team leader is not very strong. However, he promises Spencer in confidence that he will get him a pay rise if he votes for him. He has the opportunity to vote for his team leader's idea and get a pay rise.

10. There is an exhibition that James would really like to see, but he cannot afford the standard ticket price. Students can get a good discount, but he is no longer one. Someone working at the exhibition tells him that the staff only rarely checks if students have their cards with them. He has the opportunity to lie about his student status and go to the exhibition.

Chapter M: References

Adolphs, R. (2009). The social brain: neural basis of social knowledge. *Annual review of psychology*, *60*, 693.

Adolphs, R., Baron-Cohen, S., & Tranel, D. (2002). Impaired recognition of social emotions following amygdala damage. *Journal of cognitive neuroscience*, *14*(8), 1264-1274.

Agam, Y., Joseph, R. M., Barton, J. J., & Manoach, D. S. (2010). Reduced cognitive control of response inhibition by the anterior cingulate cortex in autism spectrum disorders. *Neuroimage*, *52*(1), 336-347.

Alberto, P. A. & Troutman, A. C. (2005). *Applied behavior analysis for teachers* (7th ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Amaral, D. G., Schumann, C. M., & Nordahl, C. W. (2008). Neuroanatomy of autism. *Trends in neurosciences*, *31*(3), 137-145.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders, Fifth Edition*. Arlington, VA: American Psychiatric Publishing.

Amodio, D. M. & Frith, C. D. (2006). Meeting of minds: the medial frontal cortex and social cognition. *Nature reviews neuroscience*, *7*(4), 268-277.

Anagnostou, E. & Taylor, M. J. (2011). Review of neuroimaging in autism spectrum disorders: what have we learned and where we go from here. *Molecular autism*, *2*, 4.

Anderson H.H. & Anderson G.L. (1951) *An introduction to projective techniques and other devices for understanding human behaviour*. NJ, USA: Prentice Hall, Englewood Cliffs.

Argyle, M., Furnham, A., & Graham, J. A. (1981). *Social situations*. Cambridge, UK: Cambridge University Press.

Argyle, M., Henderson, M., & Furnham, A. (1985). The rules of social relationships. *British journal of social psychology*, *24*(2), 125-139.

Aylward, E. H., Minshew, N. J., Goldstein, G., Honeycutt, N. A., Augustine, A. M., Yates, K. O.,Barta, P.E., & Pearlson, G. D. (1999). MRI volumes of amygdala and hippocampus in non–mentally retarded autistic adolescents and adults. *Neurology*, *53*(9), 2145-2145.

Baas, D., Aleman, A., & Kahn, R. S. (2004). Lateralization of amygdala activation: a systematic review of functional neuroimaging studies. *Brain research reviews*, *45*(2), 96-103.

Bacon, A. L., Fein, D., Morris, R., Waterhouse, L., & Allen, D. (1998). The responses of autistic children to the distress of others. *Journal of autism and developmental disorders*, *28*(2), 129-142.

Baddeley, A. (1992). Working memory. *Science*, *255*(5044), 556-559.

Baddeley, A. (1996). Exploring the central executive. *The quarterly journal of experimental psychology: section A*, *49*(1), 5-28.

Baddeley, A. (2012). Working memory: theories, models, and controversies. *Annual review of psychology*, *63*, 1-29.

Baird, J. A. & Astington, J. W. (2004). The role of mental state understanding in the development of moral cognition and moral action. *New directions for child and adolescent development*, *2004*(103), 37-49.

Baird, G., Simonoff, E., Pickles, A., Chandler, S., Loucas, T., Meldrum, D., & Charman, T. (2006). Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: the Special Needs and Autism Project (SNAP). *The lancet*, *368*(9531), 210-215.

Bardsley, N. (2008). Dictator game giving: altruism or artefact? *Experimental economics*, *11*(2), 122-133.

Barnett, M. A. (1982). *Empathy and prosocial behaviour in children. Review of human development.* New York: Wiley.

Baron‑Cohen, S., Jolliffe, T., Mortimore, C., & Robertson, M. (1997). Another advanced test of theory of mind: Evidence from very high functioning adults with autism or Asperger syndrome. *Journal of child psychology and psychiatry*, *38*(7), 813-822.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition*, *21*(1), 37-46.

Baron-Cohen, S., O'Riordan, M., Stone, V., Jones, R., & Plaisted, K. (1999). Recognition of faux pas by normally developing children and children with Asperger syndrome or high-functioning autism. *Journal of autism and developmental disorders*, *29*(5), 407-418.

Baron-Cohen, S., Ring, H. A., Bullmore, E. T., Wheelwright, S., Ashwin, C., & Williams, S. C. R. (2000). The amygdala theory of autism. *Neuroscience & biobehavioral reviews*, *24*(3), 355-364.

Baron‑Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" test revised version: A study with normal adults, and adults with Asperger syndrome or high‑functioning autism. *Journal of child psychology and psychiatry*, *42*(2), 241-251.

Barry, T. D., Klinger, L. G., Lee, J. M., Palardy, N., Gilmore, T., & Bodin, S. D. (2003). Examining the effectiveness of an outpatient clinic–based social skills group for high-functioning children with autism. *Journal of autism and developmental disorders*, *33*(6), 685-701.

Batson, C. D. (1991). *The altruism question.* Hillsdale, NJ: Erlbaum.

Batson, C. D., Fultz, J., & Schoenrade, P. A. (1987). Distress and empathy: Two qualitatively distinct vicarious emotions with different motivational consequences. *Journal of personality*, *55*(1), 19-39.

Baumeister, R. F. & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological bulletin*, *117*(3), 497.

Bauminger, N. (2004). The expression and understanding of jealousy in children with autism. *Development and psychopathology*, *16*(01), 157-177.

Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioning children with autism. *Child development*, *71*(2), 447-456.

Bauminger, N., & Shulman, C. (2003). The development and maintenance of friendship in high-functioning children with autism maternal perceptions. *Autism*, *7*(1), 81-97.

Bauminger, N., Shulman, C., & Agam, G. (2004). The link between perceptions of self and of social relationships in high-functioning children with autism. *Journal of developmental and physical disabilities*, *16*(2), 193-214.

Begeer, S., Gevers, C., Clifford, P., Verhoeve, M., Kat, K., Hoddenbach, E., & Boer, F. (2011). Theory of mind training in children with autism: A randomized controlled trial. *Journal of autism and developmental disorders*, *41*(8), 997-1006.

Begeer, S., Malle, B. F., Nieuwland, M. S., & Keysar, B. (2010). Using theory of mind to represent and take part in social interactions: Comparing individuals with high-functioning autism and typically developing controls. *European journal of developmental psychology*, *7*(1), 104-122.

Bennetto, L., Pennington, B. F., & Rogers, S. J. (1996). Intact and impaired memory functions in autism. *Child development*, *67*(4), 1816-1835.

Bernier, R. & Gerdts, J. (2014). *Autism spectrum disorders: a reference handbook*. Santa Barbara, CA: Greenwood Publishing Group.

Bersoff, D. M. (1999). Why good people sometimes do bad things: Motivated reasoning and unethical behavior. *Personality and social psychology bulletin*, *25*(1), 28-39.

Berthoz, S., & Hill, E. L. (2005). The validity of using self-reports to assess emotion regulation abilities in adults with autism spectrum disorder. *European psychiatry*, *20*(3), 291-298.

Bzdok, D., Schilbach, L., Vogeley, K., Schneider, K., Laird, A. R., Langner, R., & Eickhoff, S. B. (2012). Parsing the neural correlates of moral cognition: ALE meta-analysis on morality, theory of mind, and empathy. *Brain structure and function*, *217*(4), 783-796.

Bicchieri, C. (2005). *The grammar of society: The nature and dynamics of social norms*. Cambridge, UK: Cambridge University Press.

Bickart, K. C., Dickerson, B. C., & Barrett, L. F. (2014). The amygdala as a hub in brain networks that support social life. *Neuropsychologia*, *63*, 235-248.

Bird, G. & Cook, R. (2013). Mixed emotions: the contribution of alexithymia to the emotional symptoms of autism. *Translational psychiatry*, *3*(7), e285.

Birmingham, E., Cerf, M., & Adolphs, R. (2011). Comparing social attention in autism and amygdala lesions: effects of stimulus and task condition. *Social neuroscience*, *6*(5-6), 420-435.

Bíró, S. & Russell, J. (2001). The execution of arbitrary procedures by children with autism. *Development and psychopathology*, *13*(1), 97-110.

Bischof-Köhler, D. (1991). The development of empathy in infants. In M.E. Lamb & H. Keller (Eds.), *Infant Development. Perspectives from German speaking countries* (pp. 245-273). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Bishop, D. V. M. (1997). Cognitive neuropsychology and developmental disorders: Uncomfortable bedfellows. *Quarterly Journal of Experimental Psychology, 50A*, 899–923.

Bishop-Fitzpatrick, L., Minshew, N.J., & Eack, S.M. (2012). A systematic review of psychosocial interventions for adults with Autism Spectrum Disorders. *Journal of autism and developmental disorders*, 43(3), 687–694.

Blair, R. J. R. (1999). Psychophysiological responsiveness to the distress of others in children with autism. *Personality and Individual Differences*, *26*(3), 477-485.

Blair, R. J. R. (2005). Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. *Consciousness and cognition*, *14*(4), 698-718.

Blair, R. J. R. (2008). Fine cuts of empathy and the amygdala: dissociable deficits in psychopathy and autism. *The quarterly journal of experimental psychology*, *61*(1), 157-170.

Blumberg, S. J., Bramlett, M. D., Kogan, M. D., Schieve, L. A., Jones, J. R., & Lu, M. C. (2013). Changes in prevalence of parent-reported autism spectrum disorder in school-aged US children: 2007 to 2011–2012. *National health statistics reports*, *65*(20), 1-7.

Blumer, D. & Benson, D. F. (1975). Personality changes with frontal and temporal lobe lesions. *Psychiatric aspects of neurologic disease*, *1*, 151-170.

Bocian, K. & Wojciszke, B. (2014). Self-interest bias in moral judgments of others' actions. *Personality and social psychology bulletin*, doi: 10.1177/0146167214529800.

Booth, R., & Happé, F. (2010). "Hunting with a knife and… fork": Examining central coherence in autism, attention deficit/hyperactivity disorder, and typical development with a linguistic task. *Journal of experimental child psychology*, *107*(4), 377-393.

Boucher, J. (1988). Word fluency in high-functioning autistic children. *Journal of autism and developmental disorders*, *18*(4), 637-645.

Bowler, D. M. (1992). "Theory of mind" in Asperger's syndrome. *Child psychology & psychiatry & allied disciplines, 33*(5), 877-893.

Brady, S. S., Dolcini, M. M., Harper, G. W., & Pollack, L. M. (2009). Supportive friendships moderate the association between stressful life events and sexual risk taking among African American adolescents. *Health psychology*, *28*(2), 238.

Brian, J. A. & Bryson, S. E. (1996). Disembedding performance and recognition memory in autism/PDD. *Journal of child psychology and psychiatry*, 37(7), 865-872.

Brothers, L. (1990). The neural basis of primate social communication. *Motivation and emotion*, *14*(2), 81-91.

Brothers, L., Ring, B., & Kling, A. (1990). Response of neurons in the macaque amygdala to complex social stimuli. *Behavioural brain research*, *41*(3), 199-213.

Buon, M., Dupoux, E., Jacob, P., Chaste, P., Leboyer, M., & Zalla, T. (2013). The role of causal and intentional judgments in moral reasoning in individuals with high functioning autism. *Journal of autism and developmental disorders*, *43*(2), 458-470.

Burger, J. M., Sanchez, J., Imberi, J. E., & Grande, L. R. (2009). The norm of reciprocity as an internalized social norm: Returning favours even when no one finds out. *Social influence*, *4*(1), 11-17.

Burgess, P.W (1997) Theory and methodology in executive function research. In: Rabbitt, P., (ed.) *Theory and Methodology of Frontal and Executive Function* (pp. 81-116). East Sussex, UK : Psychology Press.

Burgess, P. W. & Shallice, T. (1997). *The Hayling and Brixton Tests. Test Manual.* Bury St Edmunds: Thames Valley Test Company.

Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkley, L. C., & Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses. *Psychology and aging*, *21*(1), 140.

Callenmark, B., Kjellin, L., Rönnqvist, L., & Bölte, S. (2013). Explicit versus implicit social cognition testing in autism spectrum disorder. *Autism*, doi: 10.1177/1362361313492393.

Camerer, C. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton, N.J: Princeton University Press.

Camerer, C. & Thaler, R. H. (1995). Anomalies: Ultimatums, dictators and manners. *The Journal of Economic Perspectives*, *9*(2), 209-219.

Capps, L., Kehres, J., & Sigman, M. (1998). Conversational abilities among children with autism and children with developmental delays. *Autism*, *2*(4), 325-344.

Capps, L., Yirmiya, N., & Sigman, M. (1992). Understanding of simple and complex emotions in non-retarded children with autism. *Journal of child psychology and psychiatry*, *33*(7), 1169–1182.

Carmichael, S. T. & Price, J. L. (1995). Limbic connections of the orbital and medial prefrontal cortex in macaque monkeys. *Journal of comparative neurology*, *363*(4), 615-641.

Carrington, S., Templeton, E., & Papinczak, T. (2003). Adolescents with Asperger syndrome and perceptions of friendship. *Focus on autism and other developmental disabilities*, *18*(4), 211-218.

Cassidy, S., Ropar, D., Mitchell, P., & Chapman, P. (2014). Can adults with autism spectrum disorders infer what happened to someone from their emotional response? *Autism research*, *7*(1), 112-123.

Castelli, F., Happé, F., Frith, U., & Frith, C. (2000). Movement and mind: a functional imaging study of perception and interpretation of complex intentional movement patterns. *Neuroimage*, *12*(3), 314-325.

Castelli, I., Massaro, D., Bicchieri, C., Chavez, A., & Marchetti, A. (2014) Fairness Norms and Theory of Mind in an Ultimatum Game: Judgments, Offers, and Decisions in School-Aged Children. *PLoS ONE 9*(8): e105024.

Causton-Theoharis, J., Ashby, C., & Cosier, M. (2009). Islands of loneliness: Exploring social interaction through the autobiographies of individuals with autism. *Journal information*, *47*(2), 84-96.

Cavanna, A. E., & Trimble, M. R. (2006). The precuneus: a review of its functional anatomy and behavioural correlates. *Brain*, *129*(3), 564-583.

Chandler, M. J. (1973). Egocentrism and antisocial behaviour: The assessment and training of social perspective-taking skills. *Developmental psychology*, *9*(3), 326.

Channon, S. (2004). Frontal lobe dysfunction and everyday problem-solving: Social and non-social contributions. *Acta psychologica*, *115*(2), 235-254.

Channon, S., Charman, T., Heap, J., Crawford, S., & Rios, P. (2001). Real-life-type problem-solving in Asperger's syndrome. *Journal of autism and developmental disorders*, *31*(5), 461-469.

Channon, S., Collins, R., Swain, E., Young, M. B., & Fitzpatrick, S. (2012). The use of skilled strategies in social interactions by groups high and low in self-reported social skill. *Journal of autism and developmental disorders*, *42*(7), 1425-1434.

Channon, S. & Crawford, S. (1999). Problem-solving in real-life-type situations: The effects of anterior and posterior lesions on performance. *Neuropsychologia*, *37*(7), 757-770.

Channon, S., Crawford, S., Orlowska, D., Parikh, N., & Thoma, P. (2014). Mentalising and social problem solving in adults with Asperger's syndrome. *Cognitive neuropsychiatry*, *19*(2), 149-163.

Channon, S., Fitzpatrick, S., Drury, H., Taylor, I., & Lagnado, D. (2010). Punishment and Sympathy Judgments: Is the Quality of Mercy Strained in Asperger's Syndrome? *Journal of autism and developmental disorders*, *40*(10), 1219-1226.

Channon, S., Lagnado, D., Fitzpatrick, S., Drury, H., & Taylor, I. (2011). Judgments of cause and blame: Sensitivity to intentionality in Asperger's Syndrome. *Journal of autism and developmental disorders*, *41*(11), 1534-1542.

Channon, S., Pellijeff, A., & Rule, A. (2005). Social cognition after head injury: Sarcasm and theory of mind. *Brain and language*, *93*(2), 123-134.

Channon, S., Rule, A., Maudgil, D., Martinos, M., Pellijeff, A., Frankl, J.,Drury, H., & Shieff, C. (2007). Interpretation of mentalistic actions and sarcastic remarks: Effects of frontal and posterior lesions on mentalising. *Neuropsychologia*, *45*(8), 1725-1734.

Chevallier, C., Kohls, G., Troiani, V., Brodkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in cognitive sciences*, *16*(4), 231-239.

Chin, H. Y. & Bernard-Opitz, V. (2000). Teaching conversational skills to children with autism: Effect on the development of a theory of mind. *Journal of autism and developmental disorders*, *30*(6), 569-583.

Church, C., Alisanski, S., & Amanullah, S. (2000). The social, behavioral, and academic experiences of children with Asperger syndrome. *Focus on autism and other developmental disabilities*, *15*(1), 12-20.

Cialdini, R. B. (2001). Harnessing the science of persuasion. *Harvard Business Review*, *79*(9), 72-81.

Cialdini, R. B., Vincent, J. E., Lewis, S. K., Catalan, J., Wheeler, D., & Darby, B. L. (1975). Reciprocal concessions procedure for inducing compliance: The door-in-the-face technique. *Journal of personality and social psychology*, *31*(2), 206.

Cohen, S., Doyle, W. J., Skoner, D. P., Rabin, B. S., & Gwaltney, J. M. (1997). Social ties and susceptibility to the common cold. *Journal of the American Medical Association*, *277*(24), 1940-1944.

Coke, J. S., Batson, C. D., & McDavis, K. (1978). Empathic mediation of helping: A two-stage model. *Journal of personality and social psychology*, *36*(7), 752.

Colombi, C., Liebal, K., Tomasello, M., Young, G., Warneken, F., & Rogers, S. J. (2009). Examining correlates of cooperation in autism Imitation, joint attention, and understanding intentions. *Autism*, *13*(2), 143-163.

Craig, A. D. (2009). How do you feel—now? The anterior insula and human awareness. *Nature reviews neuroscience*, *10*(1).

Critchley, H. D., Daly, E. M., Bullmore, E. T., Williams, S. C., Van Amelsvoort, T., Robertson, D. M., Rowe, A., Phillips, M., McAlonanon, G., Howlin, P., & Murphy, D. G. (2000). The functional neuroanatomy of social behaviour. *Brain*, *123*(11), 2203-2212.

Cudworth, R. (1996). *A treatise concerning eternal and immutable morality.* Ed. Sarah Hutton. Cambridge: Cambridge UP.

Cushman, F., Young, L., & Greene, J. D. (2010). Our multi-system moral psychology: Towards a consensus view. In J. Doris, G. Harman, S. Nichols, J. Prinz, W. Sinnott-Armstrong, & S. Stich (Eds.), *The Oxford handbook of moral psychology* (pp. 47-71).

Dahlgren, S. O. & Trillingsgaard, A. (1996). Theory of mind in non‐retarded children with autism and Asperger's syndrome. A research note. *Journal of Child Psychology and Psychiatry*, *37*(6), 759-763.

Damasio, A. R., Tranel, D., & Damasio, H. (1990). Individuals with sociopathic behaviour caused by frontal damage fail to respond autonomically to social stimuli. *Behavioural brain research*, *41*(2), 81-94.

Daniel, L. S., & Billingsley, B. S. (2010). What boys with an autism spectrum disorder say about establishing and maintaining friendships. *Focus on autism and other developmental disabilities*, *25*(4), 220-229.

Dawson, G., & Fernald, M. (1987). Perspective-taking ability and its relationship to the social behaviour of autistic children. *Journal of autism and developmental disorders*, *17*(4), 487-498.

Decety, J. & Michalska, K. J. (2010). Neurodevelopmental changes in the circuits underlying empathy and sympathy from childhood to adulthood. *Developmental science*, *13*(6), 886-899.

De Dreu, C. K., & Van Lange, P. A. (1995). The impact of social value orientations on negotiator cognition and behaviour. *Personality and social psychology bulletin*, *21*(11), 1178-1188.

Delis, D., Kaplan, E., & Kramer, J. (2001*). Delis–Kaplan executive function system technical manual.* San Antonio, TX: Psychological Corporation.

Deschamps, P. K., Been, M., & Matthys, W. (2014). Empathy and empathy induced prosocial behavior in 6-and 7-year-olds with autism spectrum disorder. *Journal of autism and developmental disorders*, *44*(7), 1749-1758.

De Vignemont, F. (2007). Autism, morality and empathy. In W. Sinnott-Armstrong, *Moral Psychology volume 3: The Neuroscience of Morality* (pp. 273-280). Mass.: MIT Press.

Dewey, M. (1991). Living with Asperger's syndrome. In U. Frith (Ed), *Autism and Asperger syndrom*e (pp. 184-206). New York, NY, US: Cambridge University Press.

Diamond, A. (2013). Executive functions. *Annual review of psychology*, *64*, 135.

Dichter, G. S., Felder, J. N., Green, S. R., Rittenberg, A. M., Sasson, N. J., & Bodfish, J. W. (2012). Reward circuitry function in autism spectrum disorders. *Social cognitive and affective neuroscience*, *7*(2), 160-172.

Dindia, K., Fitzpatrick, M. A., & Kenny, D. A. (1997). Self-disclosure in spouse and stranger interaction a social relations analysis. *Human communication research*, *23*(3), 388-412.

Di Martino, A., Ross, K., Uddin, L. Q., Sklar, A. B., Castellanos, F. X., & Milham, M. P. (2009). Functional brain correlates of social and nonsocial processes in autism spectrum disorders: an activation likelihood estimation meta-analysis. *Biological psychiatry*, *65*(1), 63-74.

Dodd, S.M. (2015). Understanding autism. Marrickville: Elsevier Australia.

Downs, A. & Smith, T. (2004). Emotional understanding, cooperation, and social behaviour in high-functioning children with autism. *Journal of autism and developmental disorders*, *34*(6), 625-635.

Dziobek, I., Rogers, K., Fleck, S., Bahnemann, M., Heekeren, H. R., Wolf, O. T., & Convit, A. (2008). Dissociation of cognitive and emotional empathy in adults with Asperger syndrome using the Multifaceted Empathy Test (MET). *Journal of autism and developmental disorders*, *38*(3), 464-473.

Edgin, J. O. & Pennington, B. F. (2005). Spatial cognition in autism spectrum disorders: Superior, impaired, or just intact? *Journal of autism and developmental disorders*, *35*(6), 729-745.

Eisenberg, N., Fabes, R. A., Miller, P. A., Fultz, J., Shell, R., Mathy, R. M., & Reno, R. R. (1989). Relation of sympathy and personal distress to prosocial behaviour: a multimethod study. *Journal of personality and social psychology*, *57*(1), 55.

Eisenberg, N., & Miller, P. A. (1987). The relation of empathy to prosocial and related behaviours. *Psychological bulletin*, *101*(1), 91.

Eldevik, S., Eikeseth, S., Jahr, E., & Smith, T. (2006). Effects of low-intensity behavioural treatment for children with autism and mental retardation. *Journal of autism and developmental disorders*, *36*(2), 211-224.

Erwin, R., Gur, R., Gur, R., Skolnick, B., Mawhinney-Hee, M., & Smailis, J. (1992). Facial emotion discrimination: I. Task construction and behavioural findings in normal subjects. *Psychiatry Research, 42*, 231–240.

Eslinger, P. J. & Damasio, A. R. (1985). Severe disturbance of higher cognition after bilateral frontal lobe ablation patient EVR. *Neurology*, *35*(12), 1731-1731.

Estes, A., Munson, J., Rogers, S. J., Greenson, J., Winter, J., & Dawson, G. (2015). Long-Term Outcomes of Early Intervention in 6-Year-Old Children With Autism Spectrum Disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 54, 580–587.

Evans, S. H., & Anastasio, E. J. (1968). Misuse of analysis of covariance when treatment effect and covariate are confounded. *Psychological Bulletin*,*69*(4), 225.

Falk, A. & Fischbacher, U. (2006). A theory of reciprocity. *Games and economic behaviour*, *54*(2), 293-315.

Fanselow, M. S., & Dong, H. W. (2010). Are the dorsal and ventral hippocampus functionally distinct structures? *Neuron*, *65*(1), 7-19.

Farrell, P., Trigonaki, N., & Webster, D. (2005). An exploratory evaluation of two early intervention programmes for young children with autism. *Educational and child psychology*, *22*(4), 29.

Fehr, E. & Fischbacher, U. (2003). The nature of human altruism. *Nature*, *425*(6960), 785-791.

Fehr, E., Goette, L., & Zehnder, C. (2008). A behavioural account of the labour market: The role of fairness concerns. Institute for Empirical Research in Economics, University of Zurich, Working Paper No. 394. Available at SSRN: http://ssrn.com/abstract=1361658 or http://dx.doi.org/10.2139/ssrn.1361658

Field, S., & Hoffman, A. (1999). The importance of family involvement for promoting self-determination in adolescents with autism and other developmental disabilities. *Focus on Autism and Other Developmental Disabilities*, *14*(1), 36-41.

First, M. B., Spitzer, R. L., Gibbon M., & Williams, J. B. W. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Non-patient Edition. (SCID-I/NP)* .New York: Biometrics Research, New York State Psychiatric Institute.

Fisher, N. & Happé, F. (2005). A training study of theory of mind and executive function in children with autistic spectrum disorders. *Journal of autism and developmental disorders*, *35*(6), 757-771.

Fletcher, P. C., Happe, F., Frith, U., Baker, S. C., Dolan, R. J., Frackowiak, R. S., & Frith, C. D. (1995). Other minds in the brain: a functional imaging study of "theory of mind" in story comprehension. *Cognition*, *57*(2), 109-128.

Fletcher, P. C. & Henson, R. N. A. (2001). Frontal lobes and human memory. *Brain*, *124*(5), 849-881.

Folstein, S. E. & Rosen-Sheidley, B. (2001). Genetics of autism: complex aetiology for a heterogeneous disorder. *Nature reviews genetics*, *2*(12), 943-955.

Fombonne, E. (2003). Epidemiological surveys of autism and other pervasive developmental disorders: an update. *Journal of autism and developmental disorders*, *33*(4), 365-382.

Fombonne, E. (2005). The changing epidemiology of autism. *Journal of applied research in intellectual disabilities*, *18*(4), 281-294.

Fombonne, E. (2009). Epidemiology of pervasive developmental disorders. *Pediatric research*, *65*(6), 591-598.

Frith, U. (1989). *Autism: Explaining the enigma.* Oxford: Blackwell.

Frith, U. (2001). Mind blindness and the brain in autism. *Neuron*, *32*(6), 969-979.

Frith, U. (2004). Emanuel Miller lecture: Confusions and controversies about Asperger syndrome. *Journal of child psychology and psychiatry*, *45*(4), 672-686.

Frith, C. D. (2007). The social brain? *Philosophical transactions of the Royal Society of London B: Biological sciences*, *362*(1480), 671-678.

Frith, U. & De Vignemont, F. (2005). Egocentrism, allocentrism, and Asperger syndrome. *Consciousness and cognition*, *14*(4), 719-738.

Frith, C. D. & Frith, U. (2006). The neural basis of mentalising. *Neuron*, *50*(4), 531-534.

Frith, C. D., & Frith, U. (2007). Social cognition in humans. *Current Biology*, *17*(16), R724-R732.

Frith, U. & Frith, C. (2011). Reputation management: In autism, generosity is its own reward. *Current biology*, *21*(24), R994-R995.

Frith, U. & Happé, F. (1994). Autism: Beyond "theory of mind". *Cognition*, *50*(1), 115-132.

Frith, U. & Happé, F. (1999). Theory of mind and self-consciousness: what is it like to be autistic? *Mind & language*, *14*(1), 82-89.

Frith, U., Happé, F., & Siddons, F. (1994). Autism and theory of mind in everyday life. *Social development, 2*, 108-124.

Frith, U., Morton, J., & Leslie, A. M. (1991). The cognitive basis of a biological disorder: Autism. *Trends in neurosciences*, *14*(10), 433-438.

Gaigg, S. B. (2012). The interplay between emotion and cognition in Autism Spectrum Disorder: implications for developmental theory. *Frontiers in Integrative Neuroscience*, *6*, 113.

Gallagher, H. L. & Frith, C. D. (2003). Functional imaging of 'theory of mind'. *Trends in cognitive sciences*, *7*(2), 77-83.

Gantman, A., Kapp, S. K., Orenski, K., & Laugeson, E. A. (2012). Social skills training for young adults with high-functioning autism spectrum disorders: A randomized controlled pilot study. *Journal of autism and developmental disorders*, *42*(6), 1094-1103.

Gazzola, V., Spezio, M. L., Etzel, J. A., Castelli, F., Adolphs, R., & Keysers, C. (2012). Primary somatosensory cortex discriminates affective significance in social touch. *Proceedings of the National Academy of Sciences*, *109*(25), E1657-E1666.

Gehlbach, H. (2004). A new perspective on perspective taking: A multidimensional approach to conceptualizing an aptitude. *Educational psychology review*, *16*(3), 207-234.

Gerland, G. (2003). *A real person: Life on the outside*. Translated from the Swedish by J. Tate]. Souvenir Press.

Gernsbacher, M. A. (2006). Toward a behaviour of reciprocity. *The journal of developmental processes*, *1*(1), 139.

Geurts, H. M., Verté, S., Oosterlaan, J., Roeyers, H., & Sergeant, J. A. (2004). How specific are executive functioning deficits in attention deficit hyperactivity disorder and autism? *Journal of child psychology and psychiatry*, *45*(4), 836-854.

Ghaziuddin, M., Ghaziuddin, N., & Greden, J. (2002). Depression in persons with autism: Implications for research and clinical care. *Journal of autism and developmental disorders*, *32*(4), 299-306.

Gibbs, J. C., Basinger, K. S., Grime, R. L., & Snarey, J. R. (2007). Moral judgment development across cultures: Revisiting Kohlberg's universality claims. *Developmental review*, *27*(4), 443-500.

Gillott, A. & Standen, P. J. (2007). Levels of anxiety and sources of stress in adults with autism. *Journal of intellectual disabilities*, *11*(4), 359-370.

Gneezy, U., Haruvy, E., & Yafe, H. (2004). The inefficiency of splitting the bill. *The economic journal*, *114*(495), 265-280.

Goel, V., Grafman, J., Sadato, N., & Hallett, M. (1995). Modeling other minds. *Neuroreport*, *6*(13), 1741-1746.

Goin-Kochel, R. P., Abbacchi, A., Constantino, J. N., & Autism Genetic Resource Exchange Consortium. (2007). Lack of evidence for increased genetic loading for autism among families of affected females A replication from family history data in two large samples. *Autism*, *11*(3), 279-286.

Golan, O. & Baron-Cohen, S. (2006). Systemizing empathy: Teaching adults with Asperger syndrome or high-functioning autism to recognize complex emotions using interactive multimedia. *Development and psychopathology*, *18*(2), 591-617.

Golan, O., Baron-Cohen, S., & Hill, J. (2006). The Cambridge mindreading (CAM) face-voice battery: Testing complex emotion recognition in adults with and without Asperger syndrome. *Journal of autism and developmental disorders*, *36*(2), 169-183.

Golan, O., Baron-Cohen, S., Hill, J. J., & Rutherford, M. D. (2007). The 'Reading the Mind in the Voice' test-revised: a study of complex emotion recognition in adults with and without autism spectrum conditions. *Journal of autism and developmental disorders*, *37*(6), 1096-1106.

Goldberg, M. C., Mostofsky, S. H., Cutting, L. E., Mahone, E. M., Astor, B. C., Denckla, M. B., & Landa, R. J. (2005). Subtle executive impairment in children with autism and children with ADHD. *Journal of autism and developmental disorders*, *35*(3), 279-293.

Goldman, S. (2013). Opinion: Sex, gender and the diagnosis of autism—A biosocial view of the male preponderance. *Research in autism spectrum disorders*, *7*(6), 675-679.

Goodwin, R., Cook, O., & Yung, Y. (2001). Loneliness and life satisfaction among three cultural groups. *Personal relationships*, *8*(2), 225-230.

Gotts, S. J., Simmons, W. K., Milbury, L. A., Wallace, G. L., Cox, R. W., & Martin, A. (2012). Fractionation of social brain circuits in autism spectrum disorders. *Brain*, *135*(9), 2711-2725.

Grandin, T., & Barron, S. (2005). *Unwritten rules of social relationships: decoding social mysteries through the unique perspectives of autism.* Arlington, TX: Future Horizons.

Grant, C. M., Boucher, J., Riggs, K. J., & Grayson, A. (2005). Moral understanding in children with autism. *Autism*, *9*(3), 317-331.

Gray, C. A. (1995). Teaching children with autism to "read" social situations. In K. A. Quill (Ed.), *Teaching children with autism: strategies to enhance communication and socialisation* (pp. 214–219). Delmar, NY: Albany.

Greene, J. D., Nystrom, L. E., Engell, A. D., Darley, J. M., & Cohen, J. D. (2004). The neural bases of cognitive conflict and control in moral judgment. *Neuron*, *44*(2), 389-400.

Greene, J. D., Sommerville, R. B., Nystrom, L. E., Darley, J. M., & Cohen, J. D. (2001). An fMRI investigation of emotional engagement in moral judgment. *Science*, *293*(5537), 2105-2108.

Grossman, J. B., Klin, A., Carter, A. S., & Volkmar, F. R. (2000). Verbal bias in recognition of facial emotions in children with Asperger syndrome. *Journal of child psychology and psychiatry*, *41*(03), 369-379.

Güth, W. & Tietz, R. (1990). Ultimatum bargaining behaviour: A survey and comparison of experimental results. *Journal of economic psychology*, *11*(3), 417-449.

Guttman, H. & Laporte, L. (2002). Alexithymia, empathy, and psychological symptoms in a family context. *Comprehensive psychiatry*, *43*(6), 448-455.

Haar, S., Berman, S., Behrmann, M., & Dinstein, I. (2014). Anatomical abnormalities in autism? *Cerebral cortex*, doi: 10.1093/cercor/bhu242

Hadjikhani, N., Zürcher, N. R., Rogier, O., Hippolyte, L., Lemonnier, E., Ruest, T., Ward, N., Lassalle, A., Gillberg, N., Billstedt, E., Helles, A., Gillberg, C., Solomon, P., & Prkachin, K. M. (2014). Emotional contagion for pain is intact in autism spectrum disorders. *Translational psychiatry*, *4*(1), e343.

Hadwin, J., Baron-Cohen, S., Howlin, P., & Hill, K. (1997). Does teaching theory of mind have an effect on the ability to develop conversation in children with autism? J*ournal of autism and developmental disorders*, *27*(5), 519-537.

Hadjikhani, N., Joseph, R. M., Snyder, J., & Tager-Flusberg, H. (2007). Abnormal activation of the social brain during face perception in autism. *Human brain mapping*, *28*(5), 441-449.

Haidt, J. (2001). The emotional dog and its rational tail: a social intuitionist approach to moral judgment. *Psychological review*, *108*(4), 814.

Haidt, J. (2003). The moral emotions. Handbook of affective sciences. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 852-870). Oxford: Oxford University Press.

Hale, C. M. & Tager-Flusberg, H. (2005). Social communication in children with autism: The relationship between theory of mind and discourse development. *Autism*, *9*(2), 157-178.

Hall, J. A. (1978). Gender effects in decoding nonverbal cues. *Psychological Bulletin, 85*, 845-857.

Halladay, A. K., Bishop, S., Constantino, J. N., Daniels, A. M., Koenig, K., Palmer, K., Messinger, D., Pelphrey, K., Sanders, S.J., Tepper Singer, A., Lounds Taylor, J., & Szatmari, P. (2015). Sex and gender differences in autism spectrum disorder: summarizing evidence gaps and identifying emerging areas of priority. *Molecular autism*, *6*(1), 36.

Happé, F. G. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of autism and other evelopmental disorders*, *24*(2), 129-154.

Happé, F. G. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child development*, *66*(3), 843-855.

Happé, F. (2013). Weak central coherence. In F. Volkmar (Ed.), *Encyclopedia of autism spectrum disorders* (pp. 3344-3346). New York: Springer.

Happé, F., Booth, R., Charlton, R., & Hughes, C. (2006). Executive function deficits in autism spectrum disorders and attention-deficit/hyperactivity disorder: examining profiles across domains and ages. *Brain and cognition*, *61*(1), 25-39.

Happé, F., Ehlers, S., Fletcher, P., Frith, U., Johansson, M., Gillberg, C., Dolan, R., Frackowiak, R., & Frith, C. (1996). 'Theory of mind' in the brain. Evidence from a PET scan study of Asperger syndrome. *NeuroReport, 8*(1), 197–201.

Happé, F. & Frith, U. (2006). The weak coherence account: detail-focused cognitive style in autism spectrum disorders. *Journal of autism and developmental disorders*, *36*(1), 5-25.

Happé, F., Ronald, A., & Plomin, R. (2006). Time to give up on a single explanation for autism. *Nature neuroscience*, *9*(10), 1218-1220.

Harris, G. J., Chabris, C. F., Clark, J., Urban, T., Aharon, I., Steele, S., McGrath, L., Condouris, K., & Tager-Flusberg, H. (2006). Brain activation during semantic processing in autism spectrum disorders via functional magnetic resonance imaging. *Brain and cognition*, *61*(1), 54-68.

Harris, S. L. & Handleman, J. S. (2000). Age and IQ at intake as predictors of placement for young children with autism: A four-to six-year follow-up. *Journal of autism and developmental disorders*, *30*(2), 137-142.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). *Wisconsin card sorting test manual: revised and expanded.* Odessa: Psychological Assessment Resources.

Heavey, L., Phillips, W., Baron-Cohen, S., & Rutter, M. (2000). The Awkward Moments Test: A naturalistic measure of social understanding in autism. *Journal of autism and developmental disorders*, *30*(3), 225-236.

Hegarty, W. H., & Sims, H. P. (1978). Some determinants of unethical decision behaviour: An experiment. *Journal of applied psychology*, *63*(4), 451.

Helson, R., Jones, C., & Kwan, V. S. (2002). Personality change over 40 years of adulthood: hierarchical linear modeling analyses of two longitudinal samples. *Journal of personality and social psychology*, *83*(3), 752.

Hill, E. L. (2004). Executive dysfunction in autism. *Trends in cognitive sciences*, *8*(1), 26-32.

Hill, E., Berthoz, S., & Frith, U. (2004). Brief report: Cognitive processing of own emotions in individuals with autistic spectrum disorder and in their relatives. *Journal of autism and developmental disorders*, *34*(2), 229-235.

Hill, E. L. & Bird, C. M. (2006). Executive processes in Asperger syndrome: Patterns of performance in a multiple case series. *Neuropsychologia*, *44*(14), 2822-2835.

Hill, E. L. & Frith, U. (2003). Understanding autism: insights from mind and brain. *Philosophical transactions of the Royal Society B: Biological sciences*, *358*(1430), 281-289.

Hill, E., Sally, D., & Frith, U. (2004). Does mentalising ability influence cooperative decision-making in a social dilemma? Introspective evidence from a study of adults with autism spectrum disorder. *Journal of consciousness studies*, *11*, 144-161.

Hillier, A. & Allinson, L. (2002). Understanding embarrassment among those with autism: Breaking down the complex emotion of embarrassment among those with autism. *Journal of autism and developmental disorders*, *32*(6), 583-592.

Hillier, A., Fish, T., Cloppert, P., & Beversdorf, D. Q. (2007). Outcomes of a social and vocational skills support group for adolescents and young adults on the autism spectrum. *Focus on autism and other developmental disabilities*, *22*(2), 107-115.

Hoffman, M. L. (1984). Interaction of affect and cognition in empathy. In C. E. Izard, J. Kagan, & R. B. Zajonc (Eds.), *Emotions, cognition, and behaviour* (pp. 103-131). Cambridge, UK: Cambridge University Press.

Hoffman, M. L. (1994). Discipline and internalization. *Developmental psychology, 30*, 26–28.

Hollander, E., Kolevzon, A., & Coyle, J. T. (Eds.). (2011). *Textbook of autism spectrum disorders*. Arlington, VA: American Psychiatric Publishing.

Holtmann, M., Bölte, S., & Poustka, F. (2007). Autism spectrum disorders: Sex differences in autistic behaviour domains and coexisting psychopathology. *Developmental medicine & child neurology*, *49*(5), 361-366.

Howell, D. C. (1997). Statistical methods for psychology. Belmont, CA: Duxbury Press.

Howlin, P. (2006). Autism spectrum disorders. *Psychiatry*, *5*(9), 320-324.

Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of child psychology and psychiatry*, *45*(2), 212-229.

Howlin, P. & Yates, P. (1999). The potential effectiveness of social skills groups for adults with autism. *Autism*, *3*(3), 299-307.

Hoyson, M., Jamieson, B., & Strain, P. S. (1984). Individualized group instruction of normally developing and autistic-like children: The LEAP curriculum model. *Journal of early intervention*, *8*(2), 157-172.

Hughes, C. (1996). Brief report: Planning problems in autism at the level of motor control. *Journal of autism and developmental disorders*, *26*(1), 99-107.

Hughes, R. & Huby, M. (2002). The application of vignettes in social and nursing research. *Journal of advanced nursing*, *37*(4), 382-386.

Hughes, C. & Russell, J. (1993). Autistic children's difficulty with mental disengagement from an object: Its implications for theories of autism. *Developmental psychology*, *29*(3), 498.

Hughes, C., Russell, J., & Robbins, T. W. (1994). Evidence for executive dysfunction in autism. *Neuropsychologia*, *32*(4), 477-492.

Hume, D. (1960). *An enquiry concerning the principles of morals*. La Salle, IL: Open Court. (Original work published 1777).

Humphrey, N. & Lewis, S. (2008). Make me normal: The views and experiences of pupils on the autistic spectrum in mainstream secondary schools. *Autism*, *12*(1), 23-46.

Izuma, K., Matsumoto, K., Camerer, C. F., & Adolphs, R. (2011). Insensitivity to social reputation in autism. *Proceedings of the National Academy of Sciences*, *108*(42), 17302-17307.

Jacquemont, S., Coe, B. P., Hersch, M., Duyzend, M. H., Krumm, N., Bergmann, S., Beckmann, J. S., Rosenfeld, J.A., & Eichler, E. E. (2014). A higher mutational burden in females supports a "female protective model" in neurodevelopmental disorders. *The American journal of human genetics*, *94*(3), 415-425.

Jameel, L., Vyas, K., Bellesi, G., Cassell, D., & Channon, S. (2015). Great expectations: the role of rules in guiding pro-social behaviour in groups with high versus low autistic traits. *Journal of autism and developmental disorders*, doi: 10.1007/s10803-015-2393-x

Jameel, L., Vyas, K., Bellesi, G., Roberts, V., & Channon, S. (2014). Going 'Above and Beyond': Are those high in autistic traits less pro-social? *Journal of autism and developmental disorders*, *44*(8), 1846-1858.

James, R. & Blair, R. (1996). Brief report: Morality in the autistic child. *Journal of autism and developmental disorders*, *26*(5), 571-579.

Jankowski, K. F., & Takahashi, H. (2014). Cognitive neuroscience of social emotions and implications for psychopathology: examining embarrassment, guilt, envy, and schadenfreude. *Psychiatry and clinical neurosciences*, *68*(5), 319-336.

Jarrold, C. & Brock, J. (2004). To match or not to match? Methodological issues in autism-related research. *Journal of autism and developmental disorders*, *34*(1), 81-86.

Jarrold, C., Butler, D. W., Cottington, E. M., & Jimenez, F. (2000). Linking theory of mind and central coherence bias in autism and in the general population. *Developmental psychology*, *36*(1), 126.

Jolliffe, T. & Baron-Cohen, S. (1997). Are people with autism and Asperger syndrome faster than normal on the Embedded Figures Test? *Journal of child psychology and psychiatry*, *38*(5), 527-534.

Jolliffe, T. & Baron-Cohen, S. (1999). A test of central coherence theory: linguistic processing in high-functioning adults with autism or Asperger syndrome: is local coherence impaired? *Cognition*, *71*(2), 149-185.

Jones, C. D. & Schwartz, I. S. (2009). When asking questions is not enough: An observational study of social communication differences in high functioning children with autism. *Journal of autism and developmental disorders*, *39*(3), 432-443.

Joseph, R. M., & Tager–Flusberg, H. (2004). The relationship of theory of mind and executive functions to symptom type and severity in children with autism. *Development and psychopathology*, *16*(01), 137-155.

Just, M. A. & Carpenter, P. A. (1992). A capacity theory of comprehension: individual differences in working memory. *Psychological review*, *99*(1), 122.

Kaczmarek, B. L. J. (1984). Neurolinguistic analysis of verbal utterances in patients with focal lesions of frontal lobes. *Brain and language*, *21*(1), 52-58.

Kahn, P. H. (2004). Mind and morality. *New directions for child and adolescent development*, *2004*(103), 73-83.

Kaland, N., Callesen, K., Møller-Nielsen, A., Mortensen, E. L., & Smith, L. (2008). Performance of children and adolescents with Asperger syndrome or high-functioning autism on advanced theory of mind tasks. *Journal of autism and developmental disorders*, *38*(6), 1112-1123.

Kaland, N., Møller-Nielsen, A., Smith, L., Mortensen, E. L., Callesen, K., & Gottlieb, D. (2005). The strange stories test. *European child & adolescent psychiatry*, *14*(2), 73-82.

Kana, R. K., Wadsworth, H. M., & Travers, B. G. (2011). A systems level analysis of the mirror neuron hypothesis and imitation impairments in autism spectrum disorders. *Neuroscience & biobehavioral reviews*, *35*(3), 894-902.

Kant, I. (1965). Foundations of the metaphysics of morals (L. W. Beck, Trans.). Indianapolis, IN: Bobbs-Merrill. (Original work published 1785)

Keuken, M. C., Hardie, A., Dorn, B. T., Dev, S., Paulus, M. P., Jonas, K. J., Van Den Wildenberg, W. P. M., & Pineda, J. A. (2011). The role of the left inferior frontal gyrus in social perception: an rTMS study. *Brain research*, *1383*, 196-205.

Keysar, B., Converse, B. A., Wang, J., & Epley, N. (2008). Reciprocity is not give and take asymmetric reciprocity to positive and negative acts. *Psychological science*, *19*(12), 1280-1286.

Kirkland, R. A., Peterson, E., Baker, C.A., Miller, S., & Pulos, S. (2013). Meta-Analysis Reveals Adult Female Superiority in "Reading the Mind in the Eyes" Test. *North American journal of psychology, 15,* 121-146.

Klin, A., McPartland, J., & Volkmar, F. R. (2005). Asperger syndrome. In F.R. Volkmar, R. Paul, A. Klin, D.J. Cohen (Eds.). *Handbook of Autism and Pervasive Developmental Disorders* (pp. 88–125). Hoboken, NJ: Wiley.

Koegel, L. K., Stiebel, D., & Koegel, R. L. (1998). Reducing aggression in children with autism toward infant or toddler siblings. *Research and practice for persons with severe disabilities*, *23*(2), 111-118.

Kohlberg, L. (1984). *The psychology of moral development: The nature and validity of moral stages* (Vol. 2). Harpercollins College Div.

Kohls, G., Schulte-Rüther, M., Nehrkorn, B., Müller, K., Fink, G. R., Kamp-Becker, I., Herpertz-Dahlmann, B., Schultz, R.T., & Konrad, K. (2012). Reward system dysfunction in autism spectrum disorders. *Social cognitive and affective neuroscience*, doi: 10.1093/scan/nss033.

Koning, C. & Magill-Evans, J. (2001). Social and language skills in adolescent boys with Asperger syndrome. *Autism*, *5*(1), 23-36.

Lagnado, D. A., & Channon, S. (2008). Judgments of cause and blame: The effects of intentionality and foreseeability. *Cognition*, *108*(3), 754-770.

Lainhart, J. E. (1999). Psychiatric problems in individuals with autism, their parents and siblings. *International review of psychiatry*, *11*(4), 278-298.

Landa, R. J. (2005). Subtle executive impairment in children with autism and children with ADHD. *Journal of autism and developmental disorders*, *35*(3), 279-293.

Landa, R. J., & Goldberg, M. C. (2005). Language, social, and executive functions in high functioning autism: A continuum of performance. *Journal of autism and developmental disorders*, *35*(5), 557-573.

Landrigan, P. J. (2010). What causes autism? Exploring the environmental contribution. *Current opinion in pediatrics*, *22*(2), 219-225.

Latané, B. (1981). The psychology of social impact. *American psychologist*, *36*(4), 343.

Le Couteur, A., Rutter, M., Lord, C., Rios, P., Robertson, S., Holdgrafer, M., & McLennan, J. (1989). Autism diagnostic interview: A standardized investigator-based instrument. *Journal of autism and developmental disorders*, *19*(3), 363-387.

Leeb, R. T. & Rejskind, F. G., (2004). Here's looking at you kid! A Longitudinal study of perceived gender differences in mutual gaze behavior in young infants. *Sex Roles, 50,* 1-14.

Lehto, J. E., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British journal of developmental psychology*, *21*(1), 59-80.

Leslie, A. M., Mallon, R., & DiCorcia, J. A. (2006). Transgressors, victims, and cry babies: Is basic moral judgment spared in autism? *Social neuroscience*, *1*, 270-283.

Levitt, S. D. & List, J. A. (2007). What do laboratory experiments measuring social preferences reveal about the real world? *The journal of economic perspectives*, *21*(2), 153-174.

Li, A. S., Kelley, E. A., Evans, A. D., & Lee, K. (2011). Exploring the ability to deceive in children with autism spectrum disorders. *Journal of autism and developmental disorders*, *41*(2), 185-195.

Li, J., Zhu, L., & Gummerum, M. (2014). The relationship between moral judgment and cooperation in children with high-functioning autism. *Scientific reports*, doi:10.1038/srep04314.

Lin, A., Tsai, K., Rangel, A., & Adolphs, R. (2012). Reduced social preferences in autism: evidence from charitable donations. *Journal of neurodevelopmental disorders*, *4*(1), 8.

Linden, W., Wen, F., & Paulhus, D. L. (1995). Measuring alexithymia: reliability, validity, and prevalence. *Advances in personality assessment*, *10*, 51-95.

Liss, M., Fein, D., Allen, D., Dunn, M., Feinstein, C., Morris, R., Waterhouse, L., & Rapin, I. (2001). Executive functioning in high-functioning children with autism. *Journal of child psychology and psychiatry*, *42*(02), 261-270.

LoBue, V., Nishida, T., Chiong, C., DeLoache, J. S., & Haidt, J. (2011). When getting something good is bad: Even three-year-olds react to inequality. *Social Development*, *20*(1), 154-170.

Locke, J., Ishijima, E. H., Kasari, C., & London, N. (2010). Loneliness, friendship quality and the social networks of adolescents with high-functioning autism in an inclusive school setting. *Journal of research in special educational needs*, *10*(2), 74-81.

Locke, J., Rotheram-Fuller, E., Xie, M., Harker, C., & Mandell, D. (2014). Correlation of cognitive and social outcomes among children with autism spectrum disorder in a randomized trial of behavioral intervention. *Autism*, *18*(4), 370-375.

Loe, T. W., Ferrell, L., & Mansfield, P. (2000). A review of empirical studies assessing ethical decision making in business. *Journal of business ethics*, *25*(3), 185-204.

Lopez, B., Donnelly, N., Hadwin, J., & Leekam, S. (2004). Face processing in high-functioning adolescents with autism: Evidence for weak central coherence. *Visual cognition*, *11*(6), 673-688.

Lopez, B. & Leekam, S. R. (2003). Do children with autism fail to process information in context? *Journal of child psychology & psychiatry, 44*, 285–300.

Lord, C., & Jones, R. M. (2012). Annual Research Review: Re-thinking the classification of autism spectrum disorders. *Journal of child psychology and psychiatry*, *53*(5), 490-509.

Lord, C., Pickles, A., McLennan, J., Rutter, M., Bregman, J., Folstein, S., Fombonne, E., Leboyer, M., & Minshew, N. (1997). Diagnosing autism: analyses of data from the Autism Diagnostic Interview. *Journal of autism and developmental disorders*, *27*(5), 501-517.

Lord, C., Rutter, M., Goode, S., Heemsbergen, J., Jordan, H., Mawhood, L., & Schopler, E. (1989). Autism diagnostic observation schedule: A standardized observation of communicative and social behaviour. *Journal of autism and developmental disorders*, *19*(2), 185-212.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview-Revised: a revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of autism and developmental disorders*, *24*(5), 659-685.

Loveland, K. A., Pearson, D. A., Tunali-Kotoski, B., Ortegon, J., & Gibbs, M. C. (2001). Judgments of social appropriateness by children and adolescents with autism. *Journal of autism and developmental disorders*, *31*(4), 367-376.

MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (2001). Prompts and prompt-fading strategies for people with autism. In C. Maurice, G. Green, R.M. Foxx (Eds.). *Making a difference: Behavioral intervention for autism* (pp. 37–50). Austin, TX: Pro-Ed.

Mari, M., Castiello, U., Marks, D., Marraffa, C., & Prior, M. (2003). The reach–to–grasp movement in children with autism spectrum disorder. *Philosophical transactions of the Royal Society B: Biological sciences*, *358*(1430), 393-403.

Marriage, K. J., Gordon, V., & Brand, L. (1995). A social skills group for boys with Asperger's syndrome. *Australian and New Zealand journal of psychiatry*, *29*(1), 58-62.

Mathersul, D., McDonald, S., & Rushby, J. A. (2013). Understanding advanced theory of mind and empathy in high-functioning adults with autism spectrum disorder. *Journal of clinical and experimental neuropsychology*, *35*(6), 655-668.

Matson, J. L., & Kozlowski, A. M. (2011). The increasing prevalence of autism spectrum disorders. *Research in autism spectrum disorders*, *5*(1), 418-425.

Matson, A. J., & Levin, H. S. (1990). Frontal lobe dysfunction following closed head injury. A review of the literature. *The journal of nervous and mental disease*, *178*(5), 282-291.

Matson, J. L., & Nebel-Schwalm, M. S. (2007). Comorbid psychopathology with autism spectrum disorder in children: An overview. *Research in developmental disabilities*, *28*(4), 341-352.

Maximo, J. O., Cadena, E. J., & Kana, R. K. (2014). The implications of brain connectivity in the neuropsychology of autism. *Neuropsychology review*, *24*(1), 16-31.

Mazefsky, C. A. & Oswald, D. P. (2006). The discriminative ability and diagnostic utility of the ADOS-G, ADI-R, and GARS for children in a clinical setting. *Autism*, *10*(6), 533-549.

Mazurek, M. O. (2013). Loneliness, friendship, and well-being in adults with autism spectrum disorders. *Autism*, *18*(3), 223-232.

McClannahan, L. E. & Krantz, P. J. (1999). *Activity schedules for children with autism*. Bethesda, MD: Woodbine House.

McClintock, C. G., & Allison, S. T. (1989). Social value orientation and helping behaviour. *Journal of applied social psychology*, *19*(4), 353-362.

McCullough, M. (2008). *Beyond revenge: The evolution of the forgiveness instinct*. San Francisco, CA: Jossey–Bass.

McDonald, N. & Messinger*, D.* (2011). The development of empathy: How, when, and why. In A. Acerbi, J. A.Lombo, & J. J.Sanguineti (Eds.), *Free will, Emotions, and Moral Actions: Philosophy and Neuroscience in Dialogue.* Vatican City: IF-Press

McEvoy, R. E., Rogers, S. J., & Pennington, B. F. (1993). Executive function and social communication deficits in young autistic children. *Journal of child psychology and psychiatry*, *34*(4), 563-578.

McIntosh, D. N., Reichmann-Decker, A., Winkielman, P., & Wilbarger, J. L. (2006). When the social mirror breaks: deficits in automatic, but not voluntary, mimicry of emotional facial expressions in autism. *Developmental science*, *9*(3), 295-302.

Metts, S., & Cupach, W. R. (2007). Responses to relational transgressions: Hurt, anger, and sometimes forgiveness. In B. H. Spitzberg & W. R. Cupach (Eds.), *The dark side of interpersonal communication* (pp. 243–274). Mahwah, NJ: Lawrence Erlbaum.

Miller, E. K. (1999). The prefrontal cortex: complex neural properties for complex behavior. *Neuron*, *22*(1), 15-17.

Minio-Paluello, I., Baron-Cohen, S., Avenanti, A., Walsh, V., & Aglioti, S. M. (2009). Absence of embodied empathy during pain observation in Asperger syndrome. *Biological psychiatry*, *65*(1), 55-62.

Minshew, N. J., Muenz, L. R., Goldstein, G., & Payton, J. B. (1992). Neuropsychological functioning in nonmentally retarded autistic individuals. *Journal of clinical and experimental neuropsychology*, *14*(5), 749-761.

Misra, V. (2014). The social brain network and autism. *Annals of neurosciences*, *21*(2), 69.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive psychology*, *41*(1), 49-100.

Moll, J., Zahn, R., de Oliveira-Souza, R., Krueger, F., & Grafman, J. (2005). The neural basis of human moral cognition. *Nature Reviews Neuroscience*, *6*(10), 799-809.

Monchi, O., Petrides, M., Petre, V., Worsley, K., & Dagher, A. (2001). Wisconsin Card Sorting revisited: distinct neural circuits participating in different stages of the task identified by event-related functional magnetic resonance imaging. *The journal of neuroscience*, *21*(19), 7733-7741.

Moran, J. M., Young, L. L., Saxe, R., Lee, S. M., O'Young, D., Mavros, P. L., & Gabrieli, J. D. (2011). Impaired theory of mind for moral judgment in high-functioning autism. *Proceedings of the National Academy of Sciences*, *108*(7), 2688-2692.

Moriguchi, Y., Decety, J., Ohnishi, T., Maeda, M., Mori, T., Nemoto, K., Matsuda, H., & Komaki, G. (2007). Empathy and judging other's pain: an fMRI study of alexithymia. *Cerebral cortex*, *17*(9), 2223-2234.

Myers, D. G. (2000). The funds, friends, and faith of happy people. *American psychologist*, *55*(1), 56.

Müller, E., Schuler, A., & Yates, G. B. (2008). Social challenges and supports from the perspective of individuals with Asperger syndrome and other autism spectrum disabilities. *Autism*, *12*(2), 173-190.

Nah, Y. H. & Poon, K. K. (2010). The perception of social situations by children with autism spectrum disorders. *Autism*, doi: 1362361309353616.

Nazeer, A., & Ghaziuddin, M. (2012). Autism spectrum disorders: clinical features and diagnosis. *Pediatric Clinics of North America*, *59*(1), 19-25.

Neitzel, J. & Wolery, M. (2009). *Overview of prompting.* Chapel Hill, NC: The National Professional Development Center on Autism Spectrum Disorders, Frank Porter Graham Child Development Institute, The University of North Carolina.

Nelson, H. E. (1976). A modified card sorting test sensitive to frontal lobe defects. *Cortex*, *12*(4), 313-324.

Nisan, M. (1987). Moral norms and social conventions: A cross-cultural comparison. *Developmental psychology*, *23*(5), 719.

Noonan, S. K., Haist, F., & Müller, R. A. (2009). Aberrant functional connectivity in autism: evidence from low-frequency BOLD signal fluctuations. *Brain research*, *1262*, 48-63.

Norman, D. A. & Shallice, T. (1986). *Attention to action* (pp. 1-18). Springer US.

O'Connor, K. (2012). Auditory processing in autism spectrum disorder: a review. *Neuroscience & biobehavioral reviews*, *36*(2), 836-854.

Olson, I. R., McCoy, D., Klobusicky, E., & Ross, L. A. (2012). Social cognition and the anterior temporal lobes: a review and theoretical framework. *Social cognitive and affective neuroscience, 8(2):* 123-133.

Orsmond, G. I., Krauss, M. W., & Seltzer, M. M. (2004). Peer relationships and social and recreational activities among adolescents and adults with autism. *Journal of autism and developmental disorders*, *34*(3), 245-256.

Oswald, D. P. & Ollendick, T. H. (1989). Role taking and social competence in autism and mental retardation. *Journal of autism and developmental disorders*, *19*(1), 119-127.

Ozonoff, S. (2012). Editorial Perspective: Autism Spectrum Disorders in DSM‐5–An historical perspective and the need for change. *Journal of child psychology and psychiatry*, *53*(10), 1092-1094.

Ozonoff, S. & Jensen, J. (1999). Brief report: Specific executive function profiles in three neurodevelopmental disorders. *Journal of autism and developmental disorders*, *29*(2), 171-177.

Ozonoff, S. & Miller, J. N. (1995). Teaching theory of mind: A new approach to social skills training for individuals with autism. *Journal of autism and developmental disorders*, *25*(4), 415-433.

Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1991). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of child psychology and psychiatry*, *32*(7), 1081-1105.

Ozonoff, S., South, M., & Miller, J. N. (2000). DSM-IV-defined Asperger syndrome: Cognitive, behavioral and early history differentiation from high-functioning autism. *Autism*, *4*(1), 29-46.

Ozonoff, S., & Strayer, D. L. (1997). Inhibitory function in nonretarded children with autism. *Journal of autism and developmental disorders*, *27*(1), 59-77.

Ozonoff, S., & Strayer, D. L. (2001). Further evidence of intact working memory in autism. *Journal of autism and developmental disorders*, *31*(3), 257-263.

Ozonoff, S., Strayer, D. L., McMahon, W. M., & Filloux, F. (1994). Executive function abilities in autism and Tourette syndrome: An information processing approach. *Journal of child psychology and psychiatry*, *35*(6), 1015-1032.

Parks, C. W., Mitchell, D. B., & Perlmutter, M. (1986). Cognitive and social functioning across adulthood: Age or student status differences? *Psychology and aging, 1*(3), 248.

Parsons, S. & Cobb, S. (2011). State-of-the-art of virtual reality technologies for children on the autism spectrum. *European journal of special needs education*, *26*(3), 355-366.

Paul, L. K., Corsello, C., Tranel, D., & Adolphs, R. (2010). Does bilateral damage to the human amygdala produce autistic symptoms? *Journal of Neurodevelopmental Disorders*, *2*(3), 165.

Paul, R., Orlovski, S. M., Marcinko, H. C., & Volkmar, F. (2009). Conversational behaviors in youth with high-functioning ASD and Asperger syndrome. *Journal of autism and developmental disorders*, *39*(1), 115-125.

Pelligra, V. (2011). Empathy, guilt-aversion, and patterns of reciprocity. *Journal of neuroscience, psychology, and economics, 4*(3), 161.

Pelphrey, K. A., Shultz, S., Hudac, C. M., & Vander Wyk, B. C. (2011). Research review: constraining heterogeneity: the social brain and its development in autism spectrum disorder. *Journal of child psychology and psychiatry*, *52*(6), 631-644.

Pennington, B. F. (1994). The working memory function of the prefrontal cortices: Implications for developmental and individual differences in cognition. In M.M. Haith, J. Benson, R. Roberts, & B.F. Pennington (eds). *Future-oriented processes in development*. Chicago: University of Chicago Press. (pp. 243-289).

Perner, J. & Wimmer, H. (1985). "John thinks that Mary thinks that…" attribution of second-order beliefs by 5-to 10-year-old children. *Journal of experimental child psychology*, *39*(3), 437-471.

Persico, A. M. & Bourgeron, T. (2006). Searching for ways out of the autism maze: genetic, epigenetic and environmental clues. *Trends in neurosciences*, *29*(7), 349-358.

Peterson, C. (2014). Theory of mind understanding and empathic behaviour in children with autism spectrum disorders. *International journal of developmental neuroscience*, *39*, 16-21.

Petrides, M. (2000). Middorsolateral and midventrolateral prefrontal cortex: Two levels of executive control for the processing of mnemonic information. In S. Monsell & J. Driver (Eds.), *Attention and performance XVIII: Control of cognitive performance* (pp. 535-548). Cambridge, MA: MIT Press.

Phillips, L. H., MacLean, R. D., & Allen, R. (2002). Age and the understanding of emotions neuropsychological and sociocognitive perspectives. *The journals of gerontology Series B: Psychological sciences and social sciences*, *57*(6), P526-P530.

Pierce, K. & Courchesne, E. (2000). Exploring the neurofunctional organization of face processing in autism. *Archives of General Psychiatry*, *57*(4), 344-346.

Pierce, K., Glad, K. S., & Schreibman, L. (1997). Social perception in children with autism: An attentional deficit? *Journal of autism and developmental disorders*, *27*(3), 265-282.

Piven, J., Arndt, S., Bailey, J., & Andreasen, N. (1996). Regional brain enlargement in autism: a magnetic resonance imaging study. *Journal of the American academy of child & adolescent psychiatry*, *35*(4), 530-536.

Pizarro, D. (2000). Nothing more than feelings? The role of emotions in moral judgment. *Journal for the theory of social behaviour*, *30*(4), 355-375.

Plaisted, K., Swettenham, J., & Rees, L. (1999). Children with autism show local precedence in a divided attention task and global precedence in a selective attention task. *Journal of child psychology and psychiatry*, *40*(05), 733-742.

Polezzi, D., Daum, I., Rubaltelli, E., Lotto, L., Civai, C., Sartori, G., & Rumiati, R. (2008). Mentalising in economic decision-making. *Behavioural brain research*, *190*(2), 218-223.

Ponnet, K., Buysse, A., Roeyers, H., & De Corte, K. (2005). Empathic accuracy in adults with a pervasive developmental disorder during an unstructured conversation with a typically developing stranger. *Journal of autism and developmental disorders*, *35*(5), 585-600.

Ponnet, K. S., Roeyers, H., Buysse, A., De Clercq, A., & Van Der Heyden, E. (2004). Advanced mind-reading in adults with Asperger syndrome. *Autism*, *8*(3), 249-266.

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioural and brain sciences*, *1*(04), 515-526.

Prinz, J. J. (2004). *Gut reactions: A perceptual theory of emotion*. Oxford University Press.

Prior, M., Dahlstrom, B., & Squires, T. L. (1990). Autistic children's knowledge of thinking and feeling states in other people. *Journal of child psychology and psychiatry*, *31*(4), 587-601.

Prior, M. & Hoffmann, W. (1990). Brief report: Neuropsychological testing of autistic children through an exploration with frontal lobe tests. *Journal of autism and developmental disorders*, *20*(4), 581-590.

Rankin, K. P., Kramer, J. H., & Miller, B. L. (2005). Patterns of cognitive and emotional empathy in frontotemporal lobar degeneration. *Cognitive and behavioural neurology*, *18*(1), 28-36.

Rao, P. A., Beidel, D. C., & Murray, M. J. (2008). Social skills interventions for children with Asperger's syndrome or high-functioning autism: A review and recommendations. *Journal of autism and developmental disorders*, *38*(2), 353-361.

Regan, D. T. (1971). Effects of a favour and liking on compliance. *Journal of experimental social psychology*, *7*(6), 627-639.

Rende, B., Ramsberger, G., & Miyake, A. (2002). Commonalities and differences in the working memory components underlying letter and category fluency tasks: a dual-task investigation. *Neuropsychology*, *16*(3), 309.

Roberts, W. & Strayer, J. (1996). Empathy, emotional expressiveness, and prosocial behaviour. *Child development*, *67*(2), 449-470.

Robertson, J. M., Tanguay, P. E., L'ecuyer, S., Sims, A., & Waltrip, C. (1999). Domains of social communication handicap in autism spectrum disorder. *Journal of the American academy of child & adolescent psychiatry*, *38*(6), 738-745.

Roeyers, H., Buysse, A., Ponnet, K., & Pichal, B. (2001). Advancing advanced mind-reading tests: Empathic accuracy in adults with a pervasive developmental disorder. *Journal of child psychology and psychiatry*, *42*(02), 271-278.

Rogers, K., Dziobek, I., Hassenstab, J., Wolf, O. T., & Convit, A. (2007). Who cares? Revisiting empathy in Asperger syndrome. *Journal of autism and developmental disorders*, *37*(4), 709-715.

Ropar, D. & Mitchell, P. (1999). Are individuals with autism and Asperger's syndrome susceptible to visual illusions? *Journal of child psychology and psychiatry*, *40*(08), 1283-1293.

Ropar, D. & Mitchell, P. (2001). Susceptibility to illusions and performance on visuospatial tasks in individuals with autism. *Journal of child psychology and psychiatry*, *42*(04), 539-549.

Rowley, E., Chandler, S., Baird, G., Simonoff, E., Pickles, A., Loucas, T., & Charman, T. (2012). The experience of friendship, victimization and bullying in children with an autism spectrum disorder: Associations with child characteristics and school placement. *Research in autism spectrum disorders*, *6*(3), 1126-1134.

Ruedy, N. E., Moore, C., Gino, F., & Schweitzer, M. E. (2013). The cheater's high: The unexpected affective benefits of unethical behaviour. *Journal of personality and social psychology, 105*(4), 531-548.

Rumsey, J. M. (1985). Conceptual problem-solving in highly verbal, nonretarded autistic men. *Journal of autism and developmental disorders*, *15*(1), 23-36.

Rumsey, J. M. & Hamburger, S. D. (1988). Neuropsychological findings in high-functioning men with infantile autism, residual state. *Journal of clinical and experimental neuropsychology*, *10*(2), 201-221.

Russell, J., Hala, S., & Hill, E. (2003). The automated windows task: the performance of preschool children, children with autism, and children with moderate learning difficulties. *Cognitive development*, *18*(1), 111-137.

Russell, J., Jarrold, C., & Henry, L. (1996). Working memory in children with autism and with moderate learning difficulties. *Journal of child psychology and psychiatry*, *37*(6), 673-686.

Russell, J., Jarrold, C., & Hood, B. (1999). Two intact executive capacities in children with autism: Implications for the core executive dysfunctions in the disorder. *Journal of autism and developmental disorders*, *29*(2), 103-112.

Russell, J., Mauthner, N., Sharpe, S., & Tidswell, T. (1991). The 'windows task' as a measure of strategic deception in preschoolers and autistic subjects. *British journal of developmental psychology*, *9*(2), 331-349.

Russell, J., Saltmarsh, R., & Hill, E. (1999). What do executive factors contribute to the failure on false belief tasks by children with autism? *Journal of child psychology and psychiatry*, *40*(06), 859-868.

Rutherford, M. D., Baron-Cohen, S., & Wheelwright, S. (2002). Reading the mind in the voice: A study with normal adults and adults with Asperger syndrome and high functioning autism. *Journal of autism and developmental disorders*, *32*(3), 189-194.

Sakaiya, S., Shiraito, Y., Kato, J., Ide, H., Okada, K., Takano, K., & Kansaku, K. (2013). Neural correlate of human reciprocity in social interactions. *Frontiers in neuroscience*, *7*, 239.

Sally, D. (2000). A general theory of sympathy, mind-reading, and social interaction, with an application to the prisoners' dilemma. *Social science information, 39*, 567–634.

Sally, D. & Hill, E. (2006). The development of interpersonal strategy: Autism, theory-of-mind, cooperation and fairness. *Journal of economic psychology*, *27*(1), 73-97.

Salminen, J. K., Saarijärvi, S., Äärelä, E., Toikka, T., & Kauhanen, J. (1999). Prevalence of alexithymia and its association with sociodemographic variables in the general population of Finland. *Journal of psychosomatic research*, *46*(1), 75-82.

Salmond, C. H., De Haan, M., Friston, K. J., Gadian, D. G., & Vargha-Khadem, F. (2003). Investigating individual differences in brain abnormalities in autism. *Philosophical transactions of the Royal Society of London B: Biological sciences*, *358*(1430), 405-413.

Samson, D. (2009). Reading other people's mind: Insights from neuropsychology. *Journal of neuropsychology*, *3*(1), 3-16.

Samson, D., Apperly, I. A., Chiavarino, C., & Humphreys, G. W. (2004). Left temporoparietal junction is necessary for representing someone else's belief. *Nature neuroscience*, *7*(5), 499-500.

Santor, D. A., Messervey, D., & Kusumakar, V. (2000). Measuring peer pressure, popularity, and conformity in adolescent boys and girls: Predicting school performance, sexual attitudes, and substance abuse. *Journal of youth and adolescence*, *29*(2), 163-182.

Saxe, R. & Kanwisher, N. (2003). People thinking about thinking people: the role of the temporo-parietal junction in "theory of mind". *Neuroimage*, *19*(4), 1835-1842.

Saxe, R., Xiao, D. K., Kovacs, G., Perrett, D. I., & Kanwisher, N. (2004). A region of right posterior superior temporal sulcus responds to observed intentional actions. *Neuropsychologia*, *42*(11), 1435-1446.

Scheeren, A. M., de Rosnay, M., Koot, H. M., & Begeer, S. (2013). Rethinking theory of mind in high-functioning autism spectrum disorder. *Journal of child psychology and psychiatry*, *54*(6), 628-635.

Schieman, S. & Van Gundy, K. (2000). The personal and social links between age and self-reported empathy. *Social psychology quarterly*, *63,* 152-174.

Schmidt MFH, Sommerville JA (2011) Fairness Expectations and altruistic sharing in 15-month-old human infants. *PLoS ONE*, 6(10): e23223.

Schneider, S. G. & Asarnow, R. F. (1987). A comparison of cognitive/neuropsychological impairments of nonretarded autistic and schizophrenic children. *Journal of abnormal child psychology*, *15*(1), 29-45.

Schopler, E., Van Bourgondien, M. E., & Bristol, M. M. (1993). *Preschool issues in autism*. New York: Springer Science & Business Media.

Schultz, R. T. (2005). Developmental deficits in social perception in autism: the role of the amygdala and fusiform face area. *International journal of developmental neuroscience*, *23*(2), 125-141.

Schultz, R. T., Grelotti, D. J., Klin, A., Kleinman, J., Van der Gaag, C., Marois, R., & Skudlarski, P. (2003). The role of the fusiform face area in social cognition: implications for the pathobiology of autism. *Philosophical transactions of the Royal Society of London B: Biological sciences*, *358*(1430), 415-427.

Schultz, N. R., & Moore, D. (1988). Loneliness: Differences across three age levels. *Journal of social and personal relationships*, *5*(3), 275-284.

Schultz, R. T. & Robins, D. L. (2005). Functional neuroimaging studies of autism spectrum disorders. In F. Volkmar, A. Klin, R. Paul (Eds.). *Handbook of Autism and Pervasive Developmental Disorders, Volume 1, Third Edition* (pp. 515-533). New York: Wiley.

Schultz, R. T., Romanski, L. M., & Tsatsanis, K. D. (2000). Neurofunctional models of autistic disorder and Asperger syndrome: Clues from neuroimaging. In A. Klin, F. R. Volkmar, & S. S. Sparrow (Eds.), *Asperger syndrome*. New York, NY: The Guilford Press.

Schwenck, C., Mergenthaler, J., Keller, K., Zech, J., Salehi, S., Taurines, R., Romanos, M, Schecklmann, M., Schneider, W., Warnke, A., & Freitag, C. M. (2012). Empathy in children with autism and conduct disorder: group-specific profiles and developmental aspects. *Journal of child psychology and psychiatry*, *53*(6), 651-659.

Scott, F. J., & Baron-Cohen, S. (1996). Imagining real and unreal things: Evidence of a dissociation in autism. *Journal of cognitive neuroscience*, *8*(4), 371-382.

Selman, R. L., Jaquette, D., & Lavin, D. R. (1977). Interpersonal awareness in children. *American journal of orthopsychiatry*, *47*(2), 264-274.

Seltzer, M. M., Shattuck, P., Abbeduto, L., & Greenberg, J. S. (2004). Trajectory of development in adolescents and adults with autism. *Mental retardation and developmental disabilities research reviews*, *10*(4), 234-247.

Shah, P. & Miyake, A. (1999). Models of working memory. In A. Miyake & P. Shah (Eds.). *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 1-27). Cambridge, UK: Cambridge University Press.

Shaw, P., Lawrence, E. J., Radbourne, C., Bramham, J., Polkey, C. E., & David, A. S. (2004). The impact of early and late damage to the human amygdala on 'theory of mind' reasoning. *Brain*, *127*(7), 1535-1548.

Shallice, T. (1982). Specific impairments of planning. *Philosophical transactions of the Royal Society B: Biological sciences*, *298*(1089), 199-209.

Shallice, T. & Burgess, P.W. (1996). The domain of supervisory processes and temporal organisation of behaviour. *Philosophical transactions of the Royal Society of London*, *B351*, 1405–1412

Shamay-Tsoory, S. G. (2011). The neural bases for empathy. *The neuroscientist*, *17*(1), 18-24.

Shamay-Tsoory, S. G., Aharon-Peretz, J., & Perry, D. (2009). Two systems for empathy: a double dissociation between emotional and cognitive empathy in inferior frontal gyrus versus ventromedial prefrontal lesions. *Brain*, *132*(3), 617-627.

Shriberg, L. D., Paul, R., McSweeny, J. L., Klin, A., Cohen, D. J., & Volkmar, F. R. (2001). Speech and prosody characteristics of adolescents and adults with high-functioning autism and Asperger syndrome. *Journal of speech, language, and hearing research*, *44*(5), 1097-1115.

Shulman, C., Guberman, A., Shiling, N., & Bauminger, N. (2012). Moral and social reasoning in autism spectrum disorders. *Journal of autism and developmental disorders*, *42*(7), 1364-1376.

Sigman, M. (1998). Change and continuity in the development of children with autism. *Journal of child psychology and psychiatry*, *39*(06), 817-827.

Sigman, M. D., Kasari, C., Kwon, J. H., & Yirmiya, N. (1992). Responses to the negative emotions of others by autistic, mentally retarded, and normal children. *Child development*, 796-807.

Silani, G., Bird, G., Brindley, R., Singer, T., Frith, C., & Frith, U. (2008). Levels of emotional awareness and autism: an fMRI study. *Social neuroscience*, *3*(2), 97-112.

Silk, T. J., Rinehart, N., Bradshaw, J. L., Tonge, B., Egan, G., O'Boyle, M. W., & Cunnington, R. (2006). Visuospatial processing and the function of prefrontal-parietal networks in autism spectrum disorders: a functional MRI study. *The American journal of psychiatry*, *163*(8), 1440-1443.

Singer, T., Critchley, H. D., & Preuschoff, K. (2009). A common role of insula in feelings, empathy and uncertainty. *Trends in cognitive sciences*, *13*(8), 334-340.

Singer, T., & Lamm, C. (2009). The social neuroscience of empathy. *Annals of the New York Academy of Sciences*, *1156*(1), 81-96.

Singer, T., Seymour, B., O'Doherty, J., Kaube, H., Dolan, R. J., & Frith, C. D. (2004). Empathy for pain involves the affective but not sensory components of pain. *Science*, *303*(5661), 1157-1162.

Smetana, J. G. (1981). Preschool children's conceptions of moral and social rules. *Child development*, *52*(4), 1333-1336.

Smetana, J. G. (1985). Preschool children's conceptions of transgressions: Effects of varying moral and conventional domain-related attributes. *Developmental psychology*, *21*(1), 18.

Smetana, J. G. & Braeges, J. L. (1990). The development of toddlers' moral and conventional judgments. *Merrill-Palmer Quarterly (1982-)*, 329-346.

Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on autism and other developmental disabilities*, *16*(2), 86-92.

Smith, A. (2006). Cognitive empathy and emotional empathy in human behaviour and evolution. *Psychological record*, *56*(1), 3-21.

Smith, T., Buch, G. A., & Gamby, T. E. (2000). Parent-directed, intensive early intervention for children with pervasive developmental disorder. *Research in developmental disabilities*, *21*(4), 297-309.

Smith, T., Eikeseth, S., Klevstrand, M., & Lovaas, O. I. (1997). Intensive behavioural treatment for pre-schoolers with severe mental retardation and pervasive developmental disorder. *American journal on mental retardation*, *102*(3), 238-249.

Snowling, M., & Frith, U. (1986). Comprehension in "hyperlexic" readers. *Journal of experimental child psychology*, *42*(3), 392-415.

Snyder, M., & Ickes, W. (1985). Personality and social behaviour. *Handbook of social psychology*, *2*, 883-947.

South, M., Ozonoff, S., & Mcmahon, W. M. (2007). The relationship between executive functioning, central coherence, and repetitive behaviours in the high-functioning autism spectrum. *Autism*, *11*(5), 437-451.

Sparks, B. F., Friedman, S. D., Shaw, D. W., Aylward, E. H., Echelard, D., Artru, A. A., Maravilla, K.R., Giedd, J.N., Munson, J., Dawson, G., & Dager, S. R. (2002). Brain structural abnormalities in young children with autism spectrum disorder. *Neurology*, *59*(2), 184-192.

Spek, A. A., Scholte, E. M., & Van Berckelaer-Onnes, I. A. (2010). Theory of mind in adults with HFA and Asperger syndrome. *Journal of autism and developmental disorders*, *40*(3), 280-289.

Spence, S. H. (2003). Social skills training with children and young people: Theory, evidence and practice. *Child and adolescent mental health*, *8*(2), 84-96.

Spreen, O. & Strauss, E. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary*. New York: Oxford University Press.

Staub, E. (2003). *The psychology of good and evil: Why children, adults, and groups help and harm others*. Cambridge University Press.

Steel, M. J. G., Gorman, R., & Flexman, J. E. (1984). Neuropsychiatric testing in an autistic mathematical idiot-savant: Evidence for nonverbal abstract capacity. *Journal of the American academy of child psychiatry*, *23*(6), 704-707.

Stich, S., Fessler, D. M., & Kelly, D. (2009). On the morality of harm: A response to Sousa, Holbrook and Piazza. *Cognition*, *113*(1), 93-97.

Stokes, M., Newton, N., & Kaur, A. (2007). Stalking, and social and romantic functioning among adolescents and adults with autism spectrum disorder. *Journal of autism and developmental disorders*, *37*(10), 1969-1986.

Stone, V. E., Baron-Cohen, S., & Knight, R. T. (1998). Frontal lobe contributions to theory of mind. *Journal of cognitive neuroscience*, *10*(5), 640-656.

Stotland, E. (1969). Exploratory investigations of empathy. *Advances in experimental social psychology*, *4*, 271-314.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of experimental psychology*, *18*(6), 643.

Stuss, D. T., Gallup, G. G., & Alexander, M. P. (2001). The frontal lobes are necessary for theory of mind'. *Brain*, *124*(2), 279-286.

Stuss, D. T., & Levine, B. (2002). Adult clinical neuropsychology: lessons from studies of the frontal lobes. *Annual review of psychology*, *53*(1), 401-433.

Swart, M., Kortekaas, R., & Aleman, A. (2009). Dealing with feelings: characterization of trait alexithymia on emotion regulation strategies and cognitive-emotional processing. *PLoS One*, *4*(6), e5751.

Szatmari, P., Bartolucci, G., Bremner, R., Bond, S., & Rich, S. (1989). A follow-up study of high-functioning autistic children. *Journal of autism and developmental disorders*, *19*(2), 213-225.

Tabachnick, B. G. & Fidell, L. S. (1983). *Using multivariate statistics*. New York, NY, Harper and Row.

Tager-Flusberg, H., & Sullivan, K. (1994). A second look at second-order belief attribution in autism. *Journal of autism and developmental disorders*, *24*(5), 577-586.

Taylor, G. J., Bagby, R. M., & Parker, J. D. (1999). *Disorders of affect regulation: Alexithymia in medical and psychiatric illness*. Cambridge University Press.

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A., & Updegraff, J. A. (2000). Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. *Psychological review*, *107*(3), 411.

Timmerman, P. (2014). *Moral contract theory and social cognition: an empirical perspective* (Vol. 48). Springer Science & Business Media.

Travis, L., Sigman, M., & Ruskin, E. (2001). Links between social understanding and social behavior in verbally able children with autism. *Journal of autism and developmental disorders*, *31*(2), 119-130.

Trembath, D., Germano, C., Johanson, G., & Dissanayake, C. (2012). The experience of anxiety in young adults with autism spectrum disorders. *Focus on autism and other developmental disabilities*, *27*(4), 213-224.

Trepagnier, C. Y., Olsen, D. E., Boteler, L., & Bell, C. A. (2011). Virtual conversation partner for adults with autism. *Cyberpsychology, behavior, and social networking, 14*, 21-27.

Tsuchida, A. & Fellows, L. K. (2013). Are core component processes of executive function dissociable within the frontal lobes? Evidence from humans with focal prefrontal damage. *Cortex*, *49*(7), 1790-1800.

Turiel, E. (1983). *The development of social knowledge: Morality and convention*. Cambridge University Press.

Turiel, E. (2008). Thought about actions in social domains: Morality, social conventions, and social interactions. *Cognitive development*, *23*(1), 136-154.

Turner, M. A. (1999). Generating Novel Ideas: Fluency Performance in High-functioning and Learning Disabled Individuals with Autism. *Journal of child psychology and psychiatry*, *40*(2), 189-201.

Turner-Brown, L. M., Perry, T. D., Dichter, G. S., Bodfish, J. W., & Penn, D. L. (2008). Brief report: Feasibility of social cognition and interaction training for adults with high functioning autism. *Journal of autism and developmental disorders*, *38*(9), 1777-1784.

Ugazio, G., Lamm, C., & Singer, T. (2012). The role of emotions for moral judgments depends on the type of emotion and moral scenario. *Emotion*, *12*(3), 579.

Underwood, B., & Moore, B. (1982). Perspective-taking and altruism. *Psychological bulletin*, *91*(1), 143.

Van den Bos, W., van Dijk, E., Westenberg, M., Rombouts, S. A., & Crone, E. A. (2009). What motivates repayment? Neural correlates of reciprocity in the Trust Game. *Social cognitive and affective neuroscience*, *4*(3):294-304,

Van Hees, V., Moyson, T., & Roeyers, H. (2014). Higher education experiences of students with autism spectrum disorder: challenges, benefits and support needs. *Journal of autism and developmental disorders*, doi: 10.1007/s10803-014-2324-2.

Vardi, Y., & Weitz, E. (2004). *Misbehaviour in organizations: Theory, research, and management*. Mahwah, NJ: Lawrence Erlbaum Associates.

Volkmar, F., Rogers, S., Paul, R., & Pelphrey, K. A. (2014). *Handbook of autism and pervasive developmental disorders*. Hoboken, NJ: John Wiley & Sons.

von Hippel, W. (2007). Aging, executive functioning, and social control. *Current directions in psychological science*, *16*(5), 240-244.

Wechsler, D. (2001). *Wechsler test of adult reading*. San Antonio, TX: The Psychological Corporation.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child development*, *72*(3), 655-684.

Werling, D. M. & Geschwind, D. H. (2013). Sex differences in autism spectrum disorders. *Current opinion in neurology*, *26*(2), 146.

West, S. A., Griffin, A. S., & Gardner, A. (2007). Evolutionary explanations for cooperation. *Current Biology*, *17*(16), R661-R672.

White, S. J., Frith, U., Rellecke, J., Al-Noor, Z., & Gilbert, S. J. (2014). Autistic adolescents show atypical activation of the brain's mentalising system even without a prior history of mentalising problems. *Neuropsychologia, 56*, 17–25.

White, S. W., Ollendick, T. H., & Bray, B. C. (2011). College students on the autism spectrum: Prevalence and associated problems. *Autism*, doi: 1362361310393363.

White, S. W., Oswald, D., Ollendick, T., & Scahill, L. (2009). Anxiety in children and adolescents with autism spectrum disorders. *Clinical psychology review*, *29*(3), 216-229.

Whiten, A. (1991). *Natural theories of mind: Evolution, development and simulation of everyday mindreading*. Oxford: Basil Blackwell.

Wilhelm, M. O. & Bekkers, R. (2010). Helping behavior, dispositional empathic concern, and the principle of care. *Social psychology quarterly*, *73*(1), 11-32.

Williams, C. A. (1990). Biopsychosocial elements of empathy: A multidimensional model. *Issues in mental health nursing*, *11*(2), 155-174.

Williams, D. L., Goldstein, G., Carpenter, P. A., & Minshew, N. J. (2005). Verbal and spatial working memory in autism. *Journal of autism and developmental disorders*, *35*(6), 747-756.

Wimmer, H. & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, *13*(1), 103-128.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. (1971). *A manual for the group embedded figures test*. Palo Alto, CA: Consulting Psychologists Press.

Worthington, E. L., & Scherer, M. (2004). Forgiveness is an emotion-focused coping strategy that can reduce health risks and promote health resilience: Theory, review, and hypotheses. *Psychology & health*, *19*(3), 385-405.

Xenitidou, M. & Edmonds, B. (2014). *The Complexity of Social Norms*. Heidelberg: Springer.

Young, L., Cushman, F., Hauser, M., & Saxe, R. (2007). The neural basis of the interaction between theory of mind and moral judgment. *Proceedings of the National Academy of Sciences*, *104*(20), 8235-8240.

Young, L., & Saxe, R. (2009). An FMRI investigation of spontaneous mental state inference for moral judgment. *Journal of cognitive neuroscience*, *21*(7), 1396-1405.

Yirmiya, N., Sigman, M. D., Kasari, C., & Mundy, P. (1992). Empathy and cognition in high-functioning children with autism. *Child development*, *63*(1), 150-160.

Zager, D. B., Wehmeyer, M. L., & Simpson, R. L. (2012). *Educating students with autism spectrum disorders: Research-based principles and practices*. New York, NY: Routledge.

Zalla, T., Barlassina, L., Buon, M., & Leboyer, M. (2011). Moral judgment in adults with autism spectrum disorders. *Cognition*, *121*(1), 115-126.

Zalla, T. & Leboyer, M. (2011). Judgment of Intentionality and Moral Evaluation in Individuals with High Functioning Autism. *Review of philosophy and psychology, 2*(4), 681-698.

Zalla, T., Sav, A. M., Stopin, A., Ahade, S., & Leboyer, M. (2009). Faux pas detection and intentional action in Asperger Syndrome. A replication on a French sample. *Journal of autism and developmental disorders*, *39*(2), 373-382.

Zelazo, P. D., Craik, F. I., & Booth, L. (2004). Executive function across the life span. *Acta psychologica*, *115*(2), 167-183.