Social Motivation in Adults with Autism: A Multi-method Approach

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Thesis Abstract

Social difficulties are suggested to be at the core of Autism Spectrum Disorders (ASD), and they persist into adulthood regardless of cognitive functioning and language abilities. The Social Motivation Theory (Chevalier et al., 2012) is proposed to explain social difficulties in ASD. The current thesis aimed to investigate social behaviour in relation to social motivation in adults with and without ASD. To this end, Study 1 and 2 utilized experimental paradigms to understand behavioural and psychophysiological correlates of social exclusion and social judgements in ASD and neurotypical (NT) adults. Using the Cyberball paradigm in Study 1, the experience of social exclusion was similar in the NT and ASD group, and physiological responses to exclusion did not reveal clear group differences. Using the Social Judgement Task in Study 2, it was found that while NT participants showed a clear cardiac slowing to unexpected social rejection, the autistic group showed this slowing in response to negative feedback more generally. Moreover, in both experimental studies, there was significant variability of psychophysiological responses both within and between groups. For all participants, high social anxiety was associated with heightened feelings of exclusion (Study 1) and higher expectations of rejection (Study 2).

The second part of the thesis focused on autistic testimony to understand social experiences of autistic and neurotypical adults. Study 3 demonstrated that autistic university students reported social challenges as well as academic strengths at university. Study 4 emphasized substantial individual differences in social motivation using self-report questionnaires. Older age and higher autistic traits predicted lower social motivation in both autistic and neurotypical adults, however, alexithymia played an additional role in social motivation in the ASD group only. Moreover, subgroups within ASD were defined using cluster analysis based on social motivation, social skills, and social anxiety. Finally, friendship experiences were investigated by combining questionnaire data with qualitative insights (Study 5). Results showed that many autistic adults reported a desire to make friends despite challenges in social communication. Overall, this mixed-methods thesis emphasized that there are not clear social motivation deficits in autistic adults and there is significant variability in social motivation within ASD, which might be associated with factors such as social skills and social anxiety.

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Chapter One: General Introduction

1.1. Autism Spectrum Disorders

Autism Spectrum Disorder (ASD) is a highly heterogeneous neurodevelopmental condition characterized by impairments in two core areas: (1) social communication and social interaction and (2) repetitive behaviours and restricted interests (American Psychiatric Association, DSM-V, 2013). ASD is a highly prevalent condition, affecting about 1 in 59 children in the USA (CDC, 2014) and 1.1% of the population in the UK (Brugha et al., 2012). However, there are many undiagnosed cases (ratio for known:unknown cases is 3:2) suggesting that the actual prevalence of ASD diagnosis is even higher (Baron-Cohen et al., 2009), particularly in adults with ASD (Lewis, 2018; Robison, 2019). Despite the high prevalence and increasing awareness and understanding of ASD, there is a gap between research and practice in terms of supporting individuals with ASD (Parsons et al., 2013). For example, most autistic[1] adults have relatively poor education and employment outcomes, especially in the first 2 years after second level education, when the rates for employment and post-secondary education are less than 50% (Shattuck et al., 2012).

According to DSM-V, social communication and interaction is a core area of difficulty, characterised by impairments in social-emotional reciprocity, understanding nonverbal communication cues in social interactions, and developing and maintaining social relationships (APA, 2013). Given the heterogeneous nature of ASD, social difficulties vary from a complete disinterest in social interactions to subtler difficulties such as integrating complex social information to understand and manage social situations (Pelphrey et al., 2011). The second core area of deficit is restricted and repetitive patterns of behaviour, interests, or activities, including a wide range of heterogeneous behaviours such as motor stereotypies, insistence on sameness, adherence to strict rules and routines, resistance to change, restricted and fixated

[1] : The term 'autistic person' is preferred by many individuals on the spectrum (Kenny et al., 2016). Therefore, we alternate between the use of this term and person-first language ('person with autism') throughout the paper in order to respect to wishes of all members of the community. Similar approaches have been adopted in existing published studies (Sedgewick et al., 2016).

interests, and self-injurious behaviour (APA, 2013). As well as heterogeneity in the two core domains that characterise the spectrum, variability is also high in terms of cognitive ability, ranging from intellectual disability to very high, superior intelligence (Grzadzinski, Huerta, & Lord, 2013). In addition to these core features of ASD, many other associated features have been identified including sensory sensitivities, cognitive and attentional differences, intolerance of uncertainty, and physical (e.g. epilepsy), developmental (e.g. ADHD) and psychiatric comorbidities (e.g. anxiety and depression) (Filipe, 2017; Neil, Olsson, & Pellicano, 2016; Pellicano, 2013; Kaat et al., 2013; Van Steensel, Bögels, & Perrin, 2011). Along with these difficulties, autistic individuals have many strengths that are both empirically and clinically observed including special skills, perceptual processing, and spatial memory (Meilleur, Jelenic, & Mottron, 2014; Fanning et al., 2018). Therefore, understanding the heterogeneity in ASD requires a comprehensive investigation of core and associated characteristics, together with a focus on both challenges and strengths for autistic individuals.

Despite several decades of research on ASD and great advancements to how we define the condition, the current understanding of its aetiology is limited. ASD is a highly heritable condition associated with multiple genetic variants and epigenetic factors that lead to complex cognitive and behavioural changes (Klauck, 2006). Even though genetic factors play a major role in having an ASD, it is impossible to explain the heterogeneity in ASD based on a single genetic variation (Tordjman et al., 2014; Yuan et al., 2017). This genetic and behavioural complexity has made it difficult for researchers to answer many crucial questions including those regarding atypical social behaviour in ASD. However, despite the diversity in phenotypic expression and genetic aetiology, social deficits are proposed to be at the core of ASD and they are the most common features shared by all the ASDs (Klin et al., 2002a; Pelphrey et al., 2011; Volkmar, 2011). Therefore, it is crucial to understand the biological, behavioural, and cognitive mechanisms that contribute to emergence of social difficulties in ASD (An & Claudianos, 2016). The next section will describe the nature of social impairments in ASD in more detail and the theories (cognitive, behavioural, and neural) that have been put forward by way of explanation. The Social Motivation Theory (Chevalier et al., 2012) will then be detailed, as a new way to potentially understand the core social difficulties in ASD.

1.2. Atypical social behaviour and social experience in ASD

According to the original descriptions provided by Kanner (1943), autistic people "have come into the world with an innate inability to form the usual, biologically provided affective contact with other people" (p. 250). This early description of autism emphasizes the importance of social interaction difficulties as the main defining feature of the condition, and present-day conceptualizations still emphasise social communication difficulties as the primary characteristic of ASD (DSM-V, 2013). Difficulties in social communication and interaction are a major source of impairment regardless of cognitive functioning or language abilities (Carter et al., 2005; Volkmar & McPartland, 2014) and they contribute to the adaptive function impairments autistic individuals experience (Tillman et al., 2019). For example, even though some autistic individuals function independently and self-sufficiently, they continue to experience significant social impairments (Shea & Mesibov, 2009). Furthermore, evidence suggests that social impairments do not improve with development and the gap in social competence between high functioning autistic individuals and their neurotypical (NT) peers increases over time (Klin et al., 2007). The worsening of social impairments during adulthood could be explained by the increase in societal demands and decrease in available support for autistic individuals together with increased awareness of their differences (Tantam, 2003).

Difficulties in social interactions have many direct and indirect consequences for individuals with ASD. Many autistic individuals report frequent experiences of loneliness, peer rejection, and isolation (Chown & Bevan, 2012; Zeedyk et al., 2016; White, Ollendick, & Bray, 2011). Even though they have a desire to form friendships, they most frequently have less friends and poorer social support compared to their NT peers (Bauminger & Kasari, 2000). In terms of education, social deficits can impact upon academic achievement in early and higher education (Eaves & Ho, 2008; Nasamran, Witmer, & Los, 2017). In addition, social deficits can contribute to high levels of mental health difficulties over time, including anxiety and depression (Myles, 2003;White & Roberson-Nay, 2009; Tantam, 2003). Therefore, it is crucial to understand the underlying mechanism of social deficits in ASD in order to improve the experiences and quality of life in autistic individuals. The rest of this section will focus on the key aspects of atypical social behaviour in ASD.

According to DSM-V, the diagnostic criteria for social impairments include absent or atypical behaviours important for social reciprocity (e.g. atypical social approach, restricted motivation to share interests or emotions with others, failure to initiate interactions), poor non-verbal social communication (e.g. reduced eye contact, poor integration of verbal and nonverbal cues, difficulties in understanding gestures and emotional expressions in conversations), and deficits in developing and maintaining age-appropriate friendships, (e.g. difficulties or lack of interest in friendships) (APA, 2013). As mentioned above, social impairments are highly variable among the autistic individuals, ranging from subtle differences in social reciprocity to more noticeable difficulties in eye contact, joint attention, facial expressions, and approach others for interaction (Lord et al., 2000). One of the atypical social behaviours in ASD is lack of social spontaneity. For instance, individuals with ASD have several difficulties in initiating and maintaining social interactions (APA, 2013). They are less likely to approach others and they are also less responsive to others' initiations for social interaction (Simpson et al., 1991; Stone & Lemanec, 1990). Young children with ASD also display reduced spontaneous social behaviour. For instance, 20-month-old children with ASD prefer to play alone rather than playing with their peers and they do not engage in spontaneous pretend play together with poor empathy and imitation skills (Charman et al., 1997). Thus, the reduced social approach in ASD is present throughout development and it may lead to further social withdrawal in autistic individuals.

The difficulties in social interactions could be explained by poor understanding of nonverbal communication in ASD. Orienting to social stimuli (e.g. forming eye contact with people) and sharing attentional focus between the environment and others (e.g. joint attention) are important nonverbal signs of communication and they are precursors for development of sociability (Bruinsma, Koegel, & Koegel, 2004). A large body of research has shown that autistic individuals have difficulties in using gaze information to understand the intentions of others and initiate joint attention (sharing attentional focus between the environment and others) (Baron-Cohen et al., 1999; Baron-Cohen et al., 2001; Dawson et al., 1998; Frith & Frith, 1999; Leekam, Hunnisett, & Moore, 1998; Bruinsma, Koegel, & Koegel, 2004). Infants with ASD have also been found to look less at the faces of their mothers as a reference for joint attention, they failed to orient the sound of their name, and they used fewer pointing gestures (Osterling & Dawson, 1994; Bruinsma, Koegel, & Koegel, 2004).

Other signs of nonverbal communication involve perception of faces and emotions as recognizing faces and understanding facial emotions are necessary for social reciprocity and successful social interactions. There is a vast literature on deficits in identifying faces (Weigelt, Koldewyn, & Kanwisher, 2012) and emotional expressions in ASD (Harms, Martin, & Wallace, 2010). For example, children and adults with ASD are slower to recognize faces and emotions, and their memory for faces are worse than their memory for objects (Schultz et al., 2000; Dawson, Webb, & McPartland, 2005; Grelotti, Gauthier, & Schultz, 2002; Uljarevic & Hamilton, 2013), despite some evidence of typical face recognition performance in ASD (for a review, see Sasson, 2006). Facial identity and emotion perception contribute to development of more sophisticated social behaviours such as understanding the intentions and mental states of others. Many studies have shown that individuals with ASD have difficulties in 'mentalizing' – explaining others' behaviours by attributing mental states (intentions, desires, thoughts, etc) to their actions (Hamilton, 2009; Vivanti et al., 2011). Even though autistic children can understand the basic intentional actions of others, they might be less willing to share them and they prioritize their own intentions over others if they conflict (Margoni & Surian, 2016).

Difficulties in mentalizing in ASD could be related to empathy skills as they are important for understanding others' feelings and using judgments to assess their actions (Decety & Cowell, 2014). In fact, deficits in empathy, especially cognitive empathy (e.g. ability to "understand" how others feel), have been consistently reported in individuals with ASD (Lombardo et al., 2007). Even though autistic individuals are more likely to empathise with other people with ASD and they are motivated to help them (e.g. intact affective empathy), their cognitive empathy for other autistic people is still limited (Komeda et al., 2019). In addition to making references in relation to others and their mental states, individuals with ASD have difficulties in making self-references. For example, autistic individuals talk less about their own mental states and emotions while describing their everyday experiences (Hurlburt, Happe, & Frith, 1994). Moreover, they do not show a typical memory advantage for self-related events/experiences as neurotypicals do, which is correlated with their empathy skills (Lombardo et al., 2007). Reduced self-referential cognition and empathy is related to language as well, such that children with ASD have atypical use of first-person pronouns, indicating an impaired development of self-concept in ASD (Lee, Hobson, & Chiat, 1994). These difficulties in recognizing faces and emotions, mentalising, and cognitive empathy together with poor self-referencing are frequently demonstrated in the literature and they create further challenges in social interactions, social participation, and academic achievement (Swineford et al., 2014; Cain et al., 2001).

Difficulties in understanding others' intentions and mental states together with poor verbal and nonverbal communication skills might interfere with typical friendship development (e.g. closeness and intimacy, reciprocity and empathic prosocial behaviours) in individuals with ASD (Wimpory et al., 2000; Bauminger & Kasari, 2000). In fact, children with ASD have difficulties socialising with peers at school as they have limited understanding of social conventions, difficulty with managing conflict and group interactions, and lack of negotiation skills (Foggo & Webster, 2017). As a result, individuals with ASD struggle to maintain their friendships, resulting in fewer friends, less social contact, and shorter friendship durations. Increased awareness of social difficulties along with limited resources to manage friendships might lead to experiences of loneliness, isolation, peer rejection, and even anxiety and depression in autistic individuals (Mazurek, 2014; Cook, Ogden, & Winstone, 2017). The next section will further explore the role of social anxiety in autistic social behaviour.

1.3. Social anxiety in ASD

Social anxiety is the most common psychiatric comorbidity in ASD, affecting children, adolescents, and adults, with lifetime prevalence of 56% and current prevalence of 40% (Maddox & White, 2015; Van Steensel et al., 2011). The high rate of social anxiety in ASD is very important to consider in research investigating atypical social behaviours in ASD described above. For example, an autistic individual who is aware of their difficulties in social skills (e.g. understanding social cues including emotions, gestures, nuances) may experience heightened anxiety in social situations (Bellini, 2004; 2006). Alternatively, an individual with high social anxiety might find it very hard to approach others or participate in social situations, owing to fear of negative evaluation, and this might result in social withdrawal and loneliness (Myles et al., 2001). In fact, higher scores of anxiety predicted greater social loneliness in adolescents with ASD (White & Roberson-Nay, 2009). In other words, social anxiety can play an important role in atypical social behaviour in autism.

The role of comorbid social anxiety in atypical social behaviour in ASD has been recently investigated. For example, higher self-reported deficits in social skills and communication were observed in individuals with ASD and Social Anxiety Disorder (SAD) compared to individuals with SAD only (Cath et al., 2008). Similarly, autistic individuals with high social anxiety reported greater impairments in communicating and interacting with others and decreased social motivation compared to autistic individuals without SAD (Maddox & White, 2015). Therefore, it is important to consider the role of social anxiety in understanding of atypical social behaviour in autistic and neurotypical individuals as it might modulate the social experience in ASD. It is particularly crucial to investigate the causal and maintaining factors for social anxiety (e.g. social skills and autistic traits) given its impact on social impairments and social functioning of autistic individuals.

1.4. Theories of social impairments in ASD

Despite substantial interest in the core social deficits in ASD, for the last number of decades there has been an emphasis on cognitive and perceptual models. These models, namely executive dysfunction (ED; Hill, 2004), central coherence theory (CC; Frith & Happe, 1994) and Theory of Mind (ToM; Baron-Cohen, Leslie, & Frith, 1985), were primary cognitive causal theories which attempted to define autism by focussing on a specific cognitive mechanism which could underlie all features of the condition. Of these, ED and CC primarily focussed on explaining the non-social cognitive deficits. ToM was the first and the most influential social cognitive theory focussed on the characterization of social behaviour in ASD (Baron-Cohen et al., 1995). Following ToM, the Social-First Hypothesis (SFH; Pelphrey, Adolphs, & Morris, 2004: Pelphrey & Carter, 2008) was proposed to explain social impairments associated with ASD by focusing on social-emotional processing in autistic individuals. As this thesis is focused on understanding the social deficits in ASD, especially in relation to Social Motivation Theory (SMT; Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012), a brief overview of social theories will be provided (ToM, SFH) before focusing in more detail on SMT. All three theories propose developmental, cascading influences of early atypicalities on subsequent development of social impairments in ASD. The main distinction between these theories is that ToM is a social cognitive theory, whereas SFH and SMT are purely social theories which are focused at social-emotional processing and social motivational factors to explain the ASD phenotype. While explanations of ToM and SFH will be concise, more emphasis will be given to the SMT as it provides the theoretical framework of the current PhD thesis.

1.4.1. Theory of Mind hypothesis

ToM is defined as the ability to attribute the full range of mental states (e.g. beliefs, desires, intentions, imaginations, and emotions) to oneself and to others' (Premack & Woodruff, 1978). It has long been thought that this ability emerges in the pre-school years (approx. 3-4 years of age; Wellman & Estes, 1986), but more recent studies suggest that aspects of ToM ability (e.g. implicit mentalising) can be observed earlier, in the second year of life, and they are positively correlated with social competence in later ages (Slaughter et al., 2015).

As mentioned before (see section 1.2), one of the atypical social behaviours in ASD is difficulties in understanding the intentions and mental states of others. According to the ToM hypothesis, children with ASD fail to develop the ability to mentalise in a typical way, and therefore, they fail to understand and predict others' behaviour (Baron-Cohen, Tager-Flusberg, & Cohen, 1994). The absence of ToM abilities is suggested to be the underlying reason behind the social communication deficits in ASD (Baron-Cohen, Leslie, & Frith, 1985). The first study to test ToM administered a false-belief task in children with ASD, Down's syndrome (DS) and NT children.

The groups were not matched in terms of chronological age and IQ; the ASD (mean age = 11.11) and DS group (mean age = 10.11) were older than the NT group (mean age = 4.5) and the IQ of ASD group (mean = 82) was higher than the DS group (mean = 64) (Baron-Cohen, Leslie, & Frith, 1985). The results showed that 23/27 of the NT children and 12/14 of the children with Down's syndrome passed this task, while 16/20 of the autistic children failed to give the right answer. These results emphasized that children with ASD struggle to represent mental states of others and therefore they cannot predict their behaviour. More importantly, the deficits in ToM cannot be attributed to low intellectual functioning as the performance of children with Down's syndrome was similar to NT children. Based on these results, the authors suggested that a specific cognitive deficit in ToM, that is independent of intellectual functioning, could explain social impairments in ASD.

ToM in ASD has had a very strong influence in autism research, however several limitations to the explanatory power of the theory have been identified (Happe, 2015; Boucher, 2012). Importantly, not every autistic individual fails the false-belief task, even in the original paper (Baron-Cohen, Leslie, & Frith, 1985; Senju, 2013). It is not clear why some autistic individuals pass false-belief tasks while others do not and whether those who succeed are using the same strategy as NTs. Furthermore, there is contrasting evidence in the literature as some studies have not found any group differences in terms of ToM abilities between autistic individuals and NTs (Senju, 2013). Differences in task demands (e.g. implicit versus explicit ToM) can explain some of these inconsistent results (Leppanen et al., 2018). For example, explicit false-belief tasks are verbally mediated, as the participants need to understand the verbal instructions and to express their answers verbally whereas implicit tasks have no language requirements and responses are expressed in behaviour (e.g. looking preferences). Research has shown that autistic children and adults performed poorly when implicit and spontaneous measures of ToM were used (Senju, 2012; Senju et al., 2009) whereas they could perform typically when explicit measures of ToM were used (Senju, 2013). These results demonstrate that different tasks of ToM have an impact upon performance of autistic individuals and autistic individuals are more likely to struggle when the task is implicit and more complex.

The second issue is whether false-belief understanding is a domain-general or domain-specific capacity (Leekam, 2016). The domain-specificity of ToM is different from the question whether it is specific to ASD. It questions whether the capacity to pass the ToM tasks belongs to a specific social cognitive or mentalising processes or it requires more general high-level cognitive or lower level perceptual processes. For instance, studies demonstrating impaired performance in both verbal and non-verbal false-belief tasks in children with ASD suggest that ToM in ASD cannot be explained by language or executive functioning (Iao & Leekam, 2014). Instead, more general conceptual capacity of understanding false representations might underlie the ToM performance in ASD, challenging the domain-specificity of this theory. The other issue raised is whether ToM is specific to ASD. For instance, problems with mentalising have been observed in many clinical populations, including schizophrenia (Frith & Corcoran, 1996) and intellectual disability (San José Cáceres et al., 2014). And lastly, it is still not clear whether other social atypicalities precede and therefore impact upon the development of ToM in ASD. For example, early atypicalities such as reduced social orienting, joint attention, and imitation could precede the development of the skills required for ToM (Dawson et al., 2012), implying that ToM is a secondary instead of a primary deficit (Happe, 2015). This argument paves the way for the next theoretical approach which proposes that initial social information processing atypicalities are the primary deficits of social impairments associated with ASD.

1.4.2. Social-First Hypothesis

According to social-first hypothesis (SFH), early and initial impairments in the development of neuroanatomical structures important for *social information processing* are the primary reason for developing ASD (Pelphrey, Adolphs, & Morris, 2004; Pelphrey et al., 2011). Therefore, the SFH proposes that studying the early development of the social brain could help to identify the precursors for subsequent social impairments in ASD and could allow for intervention before the symptoms emerge (Elsabbagh & Johnson, 2016).

According to SFH, early atypicalities (in the first year of life) in neural regions crucial for social information processing are the underlying cause of social impairments in

ASD. Due to a failure in neural regions to produce an appropriate intrinsic and input-driven signal, the development of typical connections among these regions is disrupted in autistic individuals (Sperdin et al., 2018; Pelphrey et al., 2011). This creates a situation in which the autistic individual is placed in a highly social world without the specialised neural structure that would normally facilitate the engagement in this social world. In neurotypical development, complex social behaviours are modulated by a specific neural network, defined as the social brain network, consisting of the superior temporal sulcus (STS), amygdala, orbital frontal cortex (OFC), and fusiform gyrus (FFG) (Brothers, 1990). The investigation of the social brain network in ASD has mostly involved children and adults, as it is very difficult to use neuroimaging methods with infants. The first studies of the social brain in ASD found reduced activation in FFG during a face discrimination task and a lack of a face inversion effect in individuals with ASD in comparison to NT subjects (Schultz et al., 2005). This diminished FFG response is proposed to occur due to atypical amygdala activation as a response to social stimuli (e.g. emotional faces) in ASD, resulting in underdeveloped neural circuity for face expertise including FFG (Schultz et al., 2005). Studies of the social brain in ASD have emphasized the importance of amygdala in directing attention to socially salient information, eyes/faces, and how atypical amygdala activation may be a core impairment in ASD (Perlman et al., 2010).

Other regions involved in the social brain network are STS and OFC (together with medial temporal cortex); STS is important for perception of dynamic non-verbal social cues (e.g. biological motion and gestures) required for understanding others' thoughts and intentions (Bonda et al., 1996) while OFC is involved in social reinforcement and reward processes more generally through its connections with amygdala and STS (Rolls, 2000; 2009). In studies involving autistic individuals, STS has been found to be less activated during eye movement perception (Pelphrey, Morris, & McCarthy, 2005), attribution of intentions to moving objects (Castelli et al., 2002), and understanding intentions of others from dynamic scenes (Pelphrey, Morris, & McCarthy, 2007) compared to NT participants. In addition, OFC and medial temporal circuit which are important for decoding and reasoning about others' mental states were found to be atypical in ASD (Sabbagh, 2004). Overall, the reduced functional connectivity between these regions involved in social information processing might be at the core of social deficits associated in ASD.

Social orienting is the key behavioural manifestation of early abnormalities in neural structures involved in social information processing in ASD. In typical development, orienting and giving attentional priority to social stimuli (e.g. faces, directed eye gaze, human-like sound) are already present in newborn infants, suggesting readiness to interact with other people (Friedlander, 1970; Goren, Sarty, & Wu, 1975; Johnson, Dziurawiec, Ellis, & Morton, 1991). According to SFH, this early sensitivity to social stimuli is lacking in autistic individuals, which has a cascading impact on the development of social behaviour as it results in fewer opportunities to learn about social situations and develop language skills in ASD (Dawson & Bernier, 2007). Therefore, studying social attention in ASD as a key behavioural manifestation of social information processing could provide important insights into the roots of atypical social behaviour in ASD.

A considerable body of research has focused on social attention in ASD (Klin et al., 2002a; Volkmar, 2011). In order to investigate attention to social stimuli, eye-tracking methodology has been used as a behavioural measure of social attention, recording where and when participants attend to visually presented social information (Falck-Ytter et al., 2013). Using this methodology, toddlers (Jones, Carr, & Klin, 2008) and adults with ASD (Klin et al., 2002b) were found to look less at eyes and more at the mouth in faces presented in dynamic videos. Hosozawa et al. (2012) found that children with ASD were quicker to look away from others when they were speaking and they looked overall less at faces even though the gaze behaviour was very heterogonous in the ASD group. Toddlers with autism (13-25 months) have also shown atypicalities in looking behaviour such as looking less at faces in video clips where the actress was both looking at the camera and talking spontaneously (Chawarska, Macari, & Shic, 2012). Given the importance of eye contact as a rich source of social information, reduced/absent social attention in autistic toddlers suggests an early impairment that might restrict opportunities for social learning and therefore lead to poorer social functioning in autistic individuals.

Given the high heterogeneity characterising autism, individual differences have been observed regarding gaze behaviour in infants and children with ASD. For example, Jones and Klin (2013) investigated how visual attention to the eyes in 2- to 6-month-old siblings of infants with ASD predicted their diagnostic outcome at 24-month-old. Decline in social attention from 2 to 6 months of age was observed in infants who were later diagnosed with ASD, together with high individual variabilities as, surprisingly, some of the infants at risk who later developed ASD looked "more" at the eyes. Therefore, the literature on social attention in ASD does not fully support the SFH, suggesting that there are limitations to the SFH, which will be discussed below.

1.4.3. Limitations to Social-First Hypothesis

Despite emerging evidence as outlined above, there are several issues to be addressed with the Social First Hypothesis, some of which are also raised in ToM. Firstly, the behaviours observed in infants at risk who developed ASD later could be due to more general information processing rather than social information processing, such as higher level of perceptual sensitivity (Gliga et al., 2014; Clifford et al., 2013) or a generally poor attentional flexibility (Elsabbagh & Johnson, 2016). Secondly, it is still not clear whether each infant at risk who later develops ASD displays early impairments in social orientation, and in reverse, early atypicalities in infants at risk do not always predict positive ASD diagnosis (Young et al., 2009; Elsabbagh et al., 2013a; 2013b). These findings suggest that there might be another mechanism underlying individual differences in social information processing, something that can be applied to all individuals with autism (Johnson, 2014). This argument will lead to another developmental social theory of autism which also places great emphasis on social attention, but from a different perspective, which is based on social motivational accounts. The next chapter will explore this most recent social theory of ASD, which provides the theoretical framework for the current thesis.

Chapter Two: Social Motivation Theory

As outlined in Chapter 1, social deficits are at the core of autism and seem to occur across developmental stages and level of intellectual functioning. Chapter 1 briefly summarized the theories that have sought to explain social atypicalities in autistic individuals, namely Theory of Mind and Social-First hypothesis. The aim of this chapter is to provide a detailed overview of the SMT of ASD, particularly focusing on the neural and behavioural evidence in support (as opposed to the evolutionary level of explanation). Limitations and further questions will be discussed, leading to an outline of the aims for the PhD research.

2.1. Social Motivation Theory

Social Motivation Theory (SMT) has recently been proposed to explain social impairments in autism in terms of social motivational factors (Chevallier et al., 2012). Both the Social First Hypothesis and the SMT focus on reduced social orienting as an early sign of atypical social communication in ASD. However, according to SMT, the underlying mechanism for reduced social orienting in autism is the diminished reward value of social stimuli. The SMT emphasizes that social interaction difficulties in ASD occur due to atypical processing of social reward, manifested in early signs of reduced orienting to social stimuli. In turn, reduced social orienting has a cascading influence on the development of social skills due to fewer opportunities for social learning, ultimately resulting in social interaction and communication difficulties (Dawson et al., 1998; Dawson, Webb, & McPartland, 2005; Dawson, Bernier, & Ring, 2012). The next section will give a detailed overview of the SMT in neurotypical and autistic individuals.

2.1.1. Overview of SMT

The SMT is primarily based on a biological model which explains the differences in social reward processing between the autistic and NT brain (Chevallier et al., 2012). According to SMT, the primary neural systems involved in reward processing, such as the dopaminergic system projecting to the striatum and frontal cortex, are impaired in individuals with ASD (Schultz, 1998). Starting from the first year of life, this system is important for anticipating the reward value of a stimulus and developing appropriate motivational behaviours such as attending to this stimulus. Atypicalities in this system lead to less attention towards salient stimuli (e.g. faces, human voices) that are critical for typical development of cortical localization/specification (see Figure 2.1). Even though infants with ASD would have similar exposure to faces and other social stimuli in the environment (e.g. faces of their mothers), they do not find them intrinsically interesting or rewarding, and therefore they do not attend to them as much as NTs. As a result, the brain circuitry required for developing social expertise (e.g. face and speech recognition) does not mature typically and cortical specialisation does not occur. For example, Kuhl et al. (2005) showed this altered motivation and links to cortical specialisation in a study using preferences for mother speech compared to mechanical auditory sounds in 3-4 year-old children with ASD. They found that children with ASD preferred to listen to mechanical auditory sounds rather than mother speech (Kuhl et al., 2005). More importantly, the neural responses of autistic children did not distinguish between mechanical and mother speech sounds, indicating a lack of cortical specialization for speech stimuli (Kuhl et al., 2005). The argument here is that reduced motivation towards social stimuli followed by lessened social expertise and atypical cortical development of social brain regions subsequently results in poor social cognition skills in ASD. The next section will introduce the components of the SMT and their neurological basis.

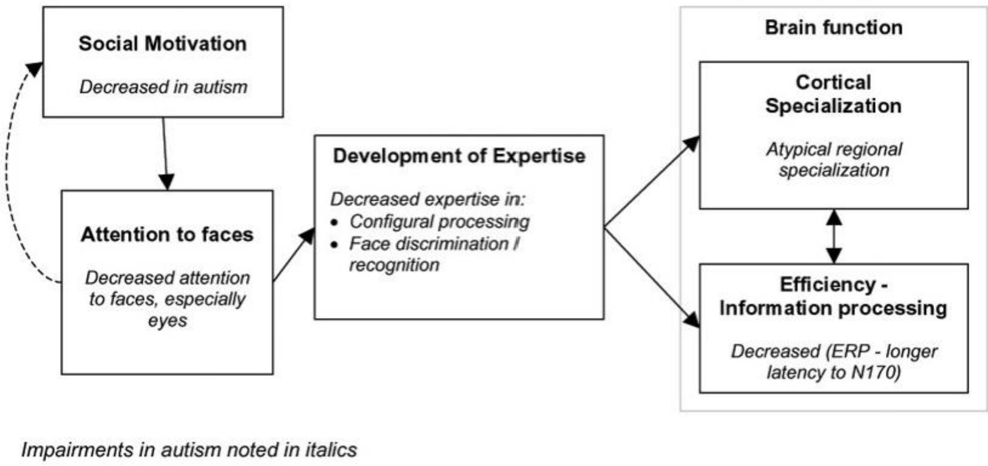


Figure 2.1. Effects of impairment in social motivation on development of neural systems underlying face processing in ASD (Dawson, Webb, & McPartland, 2005). This model can be applied to other social stimuli such as speech and emotion recognition.

2.2. The components of the SMT

Dawson, Webb and McPartland were the first to introduce a social motivational account of impairments in autism, and since then the theory was formalised in a review by Chevallier et al. (2012). In this review, the literature on social motivation in neurotypical and autistic populations was discussed and it was formulated in a promising framework that integrated social psychology, social neuroscience, and evolutionary biology to explain how social motivational factors may influence typical and atypical social behaviour, especially in autism. This section will describe the SMT by discussing this theoretical paper by Chevallier et al. (2012) while emphasizing the neural and behavioural processes involved in typical reward representations, and then, how the theory contributes to the understanding of social difficulties associated with ASD.

The SMT describes three behavioural manifestations of social interest, referred to as "components" of social motivation: social orientation, social wanting/liking, and social maintaining (Chevallier et al., 2012). *Social orienting* is defined as the prioritization of socially salient information over others (e.g. non-social information). *Social wanting/liking* reflects the fact that humans find social interactions intrinsically rewarding and therefore they seek and enjoy them, and lastly *social maintaining* is defined as the willingness to enhance and maintain social relationships over time.

Behavioural studies of *social orienting* have shown that newborns have a visual preference for face-like figures over inverted face-like figures and this preference gets fine-tuned (e.g. ability to distinguish between a positive-contrast face and negative-contrast face) when the babies are 6- and 12-weeks old (Mondloch et al., 1999). Similarly, 3-month old infants are more likely to look at natural faces rather than non-natural faces (e.g. scrambled or inverted faces) (Turati et al., 2005), and both infants and adults are distracted by faces embedded in a visual search task together with 3 or 5 other objects (Di Giorgio et al., 2012). These findings provide evidence for a very early preference for social stimuli (e.g. faces) which leads to cortical specialization to process socially important/salient information in humans (Schultz, 2005). The reason for orienting to social stimuli in the environment is that humans find these stimuli rewarding and pleasurable and this links to the *social wanting/liking* component (Dawson et al., 2012).

Within this component, it is important to make a distinction between social *wanting* and *liking* such that social *wanting* reflects the incentive value of the reward and it facilitates approach behaviour towards the reward, whereas social *liking* is related to the consumption value of the reward and it produces subjective pleasure when the reward is obtained (Berridge, Robinson, & Aldridge, 2009). For example, NT adults "put more effort" to earn social reward indicating the incentive value of the reward, reflecting the *wanting* component (Hayden et al., 2007), and they also "enjoy" cooperating with others while playing games reflecting the *liking* component (Fehr & Camerer, 2007). This behaviour is also observed in toddlers who prefer collaboration over trying individually to receive a reward (Rekers, Haun, & Tomasello, 2011). This kind of behaviour can be explained by the intrinsic value of social interactions, which motivate individuals to approach and form successful interactions with others (Krach, 2010). The *social maintaining* component reflects the fact that people develop strategies to be accepted/included by others (e.g. create a likeable impression rather than unlikeable) (Allen & Leary, 2010). Common behavioural manifestations of social maintaining include flattery and imitation. For instance, preschool children inflated their ratings of drawings when the painter was in the same room compared to the situation when the painter was absent and this behaviour was observed both when the painter was a child or an adult (Fu & Lee, 2007). Additionally, the children in this study showed more flattery to familiar versus unfamiliar people, suggesting that they modulate their social behaviour accordingly to the context. In terms of mimicry, it has been found that mimicry facilitates interactions and it does not only increase liking between interaction partners, but also people who are liked more are mimicked more (Stel et al., 2010). These behavioural findings suggest that humans are intrinsically motivated to act in certain ways that will facilitate their social interactions. The next section will discuss the neural underpinnings of social reward processing in neurotypical populations.

2.3. Neural manifestations of social reward processing

The behavioural manifestations of social motivation are modulated by an integrated neural circuitry responsible for reward processing and reward learning, consisting of the amygdala, ventral striatum (VS) including nucleus accumbens (Nacc), ventromedial prefrontal cortex (vmPFC), and orbitofrontal cortex (OFC) (Doherty, 2004). Each of these regions has a specific role: the amygdala is important for orienting to salient information while the VS plays a role in assigning a reward value to a stimulus and works together with OFC and vmPFC to develop a goal-directed behaviour (Delgado, 2007; Balleine & O'Doherty, 2010). Social reward processing overlaps with some of these interacting regions that are also involved in non-social rewards (e.g. food, money; Lin, Adolphs, & Rangel, 2012). The paradigms used to investigate social reward processing have employed a range of social stimuli including social positive or negative feedback (e.g. smiling or frowning face), attractive faces, or more complex situations (e.g. social media likings) (King-Casas et al., 2005; Spreckelmeyer et al., 2009) and activation in reward processing regions (e.g. striatum) as a response to these stimuli in neurotypical brain has been found.

It is important to emphasize that social *wanting* and *liking* components of SMT are modulated by different neural and behavioural manifestation as mentioned above (see section 2.1). Even though a desired reward (*wanting*) also produces pleasure (*liking*), it is possible that a reward can be wanted but not liked, or vice versa (Berridge, Robinson & Aldridge, 2009). The studies which have investigated this distinction of reward anticipation-*wanting* and consumption-*liking* have found both similarities and differences between the neural regions involved in social and monetary reward anticipation and consumption (Lin, Adolphs, & Rangel, 2012). For instance, anticipation of varying degrees of monetary (e.g. £0.20, £1 or £3) and social reward (female face expression with varying degrees of happiness) resulted in activation of the reward circuitry including the VS (Rademacher et al., 2010). On the other hand, social reward consumption activated amygdala while monetary reward consumption activated the thalamus (Rademacher et al., 2010). The neural manifestations of reward processing are also modulated by individual differences such as empathy and motivation for social interactions. For example, neurotypical individuals with lower empathy skills showed decreased activation in Nacc during social reward anticipation (Gossen et al., 2014) and individuals with higher preference for social interactions displayed increased VS activation during social reward tasks (Kawamichi et al., 2016). Overall, the evidence suggests that the reward circuitry in the brain, especially VS, is crucial for processing social and non-social reward, which is also influenced by individual differences in social motivation. The following sections in this chapter will explore the evidence on SMT and its three components in autistic populations.

2.4. Evidence on the social orienting component in ASD

According to the SMT, atypical social behaviour, including atypical social information processing, is due to reduced reward value of social stimuli in autism. This reduced sensitivity to social rewards in ASD is manifested in diminished orienting to socially salient information (e.g. people, faces). Therefore, reduced attention to social information is suggested to be one of the very early indicators of having an ASD diagnosis (Jones & Klin, 2013). There are many studies reporting less time spent looking at socially salient information in infants and young children with ASD (for review, see Guillon et al., 2014). For example, 3-4 year-old children with ASD have been reported to show atypically reduced social orienting and less sophisticated joint attention abilities and combined impairments in both social orienting and joint attention were the best predictor of group membership (Dawson et al., 2004). In a longitudinal investigation of gaze behaviour to faces, social smiles, and directed vocalizations in infants (at 6, 12, 18, 24, 36 months of age), it was found that the behaviour of infants who were later diagnosed with ASD started to deviate from others at 12 months (Ozonoff et al., 2010). Another longitudinal study found that the infants who showed a decline in social attention to the eyes from 2 to 6 months of age were more likely to be later diagnosed with ASD (Jones & Klin, 2013).

Social orienting has been further investigated in autistic children, adolescents and adults in relation to social functioning. In order to explore the relationship between attention to dynamic social images and autistic behaviours, children with ASD and their NT peers were asked to watch side-by-side presentations of dynamic social (e.g. 6-second videos of children moving and dancing) and geometric images (Franchini et al., 2017). First of all, autistic children oriented less to dynamic social stimuli and they were less likely to direct their first gaze to social stimuli compared to the control group. Secondly, looking more at the social stimuli in the ASD group was associated with higher joint attention behaviour (as measured by Early Social-Communication Scale) and better social communication skills (as measured by Vineland Adaptive Behavior Scales). These findings are in line with the SMT, suggesting that reduced social attention, as an indicator of reduced social interest, are associated with poor social skills in ASD.

Similar findings have been reported with autistic adults. Klin et al. (2002b) was the first to use dynamic stimuli consisting of movies depicting social interactions. In this study, cognitively able autistic individuals were found to look significantly less at eyes and more at the mouth, body, and objects compared to typical controls. Interestingly, looking more at the mouth region and less at objects predicted higher social competence and less autistic traits (Klin et al., 2002b). Later studies also used naturalistic stimuli that represent everyday life situations such as faces presented in socially complex scenes (Riby & Hancock, 2008) versus isolation (Hanley, McPhillips, Mulhern, & Riby, 2013), and even real time interactions (Hanley et al., 2015). For example, cognitively able young adults with and without ASD participated in a real social interaction paradigm while their eye movements were recorded (Hanley et al., 2015). Autistic individuals in this study looked less at their conversational partner’s eyes and more at mouth region than the NT group. More importantly, greater looking at eye region during social interactions was associated with higher social awareness (as measured by Social Responsiveness Scale; SRS) in adults with ASD (Hanley et al., 2015). This finding provides supporting evidence for the SMT by showing the link between social attention and social ability in autistic adults. Another study investigated social attention during video clips of real-world situations with high emotional content in cognitively young adults with ASD (Dijkhuis, Gurbuz et al., 2019). Even though the researchers did not find any group differences in fixation at eyes and faces, decreased attention to faces was correlated with the SRS scores across the participants, suggesting the link between decreased social attention and poor social functioning.

However, there are inconsistencies in the literature as some studies found no differences in social attention between the ASD and NT participants. For example, both autistic and NT adults looked for equal amounts at the eye region of the faces presented in pictures of natural social scenes (Fletcher-Watson et al., 2009). However, the same study reported atypical social attention when subtler measures were used, which might be more representative of the difficulties encountered in real life scenarios. Similarly, Grossman et al. (2015) found no differences in looking at the eyes in a video of a woman speaking between adolescents with ASD and their NT peers. However, this study showed that participants with ASD looked significantly less at the mouth and more at non-face regions in the video (Grossman et al., 2015). These results emphasize the importance of using more ecological measures of social attention and the importance of other social cues (e.g. mouth) in understand social attention in autism.

Overall, social attention differences in ASD have been widely reported across a number of contexts and with participant samples from infancy to adulthood in ways that link to social functioning, which provides broad support for aspects of the SMT. However, there are some inconsistencies in the adult literature which can be explained by differences in the ecological validity of the tasks and measurements of social attention across the studies. Moreover, the existing research findings are not sufficient to claim a causal link between social attention and social impairments in ASD, something which can only be revealed by longitudinal studies - and they are currently missing in the literature. The next section will review the literature on the social wanting/liking component of SMT in ASD.

2.5. Evidence on the social wanting/liking component in ASD

As discussed in section 2.1, the second component of SMT reflects the intrinsic reward value of social interactions which motivate people to seek (wanting) and enjoy (liking) social contact. The SMT suggests that social wanting and liking are absent or lessened in individuals with ASD. This section will review the neural and behavioural literature on social and non-social reward processing in ASD by emphasizing the distinction between reward anticipation – '*wanting'* and reward consumption – '*liking'*.

2.5.1. Neural studies on the social liking/wanting component in ASD

The majority of the literature on social wanting and liking components are provided by neurobiological data of reward processing in autism. Regarding the social wanting component, there is a considerable amount of neuroimaging studies showing atypical reward anticipation in children and adults with ASD (for a review, see Kohls, Chevallier, Troiani, & Schultz, 2012). For example, in an fMRI study with children (mean age = 12 years), the neural circuitry involved in reward learning was investigated as an indicator of the social *wanting* component (the motivational drive to achieve reward). In this study, participants performed an implicit reward task with two types of feedback as reward; social (e.g. face of a smiling woman with a verbal praise) and non-social (e.g. three golden coins). Compared to NT children, children with ASD were found to show hypoactivation in reward-related neural circuits on both social and monetary reward trials but this effect, especially in frontostriatal networks including VS, was more robust in response to social rewards (Scott-Van Zeeland et al., 2010). These results imply a reward-seeking deficiency, especially in social contexts, that might underlie difficulties in self-initiated social encounters characterized in ASD. In another fMRI study with autistic adolescents (mean age = 16.4 years), the role of social (sad face) and non-social negative feedback (losing money) was investigated (Damiano et al., 2015). In this study, adolescents with ASD showed hypoactivation of the right caudate nucleus while anticipating non-social negative reinforcement and hypoactivation of a network of frontostriatal regions (including the VS, Nacc, caudate nucleus, and putamen) while anticipating social negative reinforcement. These results further support that atypical responses while anticipating social feedback may underlie social motivation deficits in autism.

Regarding the social liking component, the neural responses to *receiving* social versus non-social feedback in reward learning tasks are informative. For example, in a social learning task where a smiling female face was used as positive feedback, autistic children displayed reduced activation of the right dorsolateral prefrontal cortex and right orbitofrontal cortex compared to NT children when they received social feedback (Choi et al., 2015). These findings suggest impaired social reward learning in autism indicated by diminished social liking response. In another fMRI study that combined reward anticipation and outcome, autistic and NT adults completed the incentive delay task where they earned either monetary or social reward (picture of smiling face) (Delmonte et al., 2012). The findings showed atypical social reward processing during reward outcome (but not reward anticipation) in autistic individuals, indicated by reduced dorsal striatum (DS) activation (but not in VS, OFC, or amygdala) compared to the NT group. In terms of non-social reward processing, the groups did not show any behavioural or neural activation differences. The same study also showed that quicker responses during social reward trials were associated with higher DS activation in both groups (Delmonte et al., 2012). Given the role of DS in evaluating action outcomes and developing goal-directed action, the atypical processing of social reward outcome – *liking* in the ASD group suggests that autistic individuals might find it difficult to acquire an appropriate response in social situations. The lack of neural differences in VS, OFC, or amygdala activation in the same study was unexpected since the majority of the previous studies found these regions atypically involved during reward processing in ASD (Delmonte et al., 2012). This could be explained by the tasks used in this study, because unlike previous studies, they did not have a punishment condition and therefore did not lead to VS activation, which is known to be responsive to negative feedback (Delgado et al., 2003). These studies suggest that reward processing in adults with ASD might be different from reward processing in children as they demonstrated diminished social reward *liking,* but not *wanting* in adults with ASD. Moreover, a recent meta-analysis showed that differences in brain responses to social reward in autism can disappear with age (Clements et al., 2018). Therefore, social reward processing at different stages of development requires further investigation.

It should be noted that there are some inconsistent findings regarding the domain-specificity of reward processing atypicalities in autism, as some studies have suggested a general reward processing deficit in autistic individuals. For example, 15-year-old children with ASD were found to show lower activation in reward-related neural circuitry including amygdala, striatum, and insula during social (static happy faces) and non-social reward (money), even more so for monetary rewards than social rewards (Kohls et al., 2013). These results contradict with the previous findings by showing that both social reward processing *and* non-social reward processing might be atypical in ASD, suggesting a general reward deficit in ASD. These inconsistent results could be explained by a number of factors, such as the ecological validity of the social stimuli. Ecologically validity (e.g. faces with verbal praise or video clips rather than static pictures of faces) may play an important role in revealing group differences in reward sensitivity. The use of ecologically valid stimuli is especially important because in everyday situations, social reward is presented within a complex social context (Krach, 2010). This requires not only mere exposure (as mostly tested in previous literature) to social stimuli but also processing and the interpretation of its meaning in a social context (Risko & Kingstone, 2017). Therefore, using socially meaningful stimuli representing real life situations could better capture the differences in reward sensitivity in ASD.

In a recent attempt to develop an ecologically valid paradigm, social reward was indicated by video clips of people giving positive feedback (e.g. thumbs up and smiling) (Kohls et al., 2018). Unlike previous studies using objects as non-social reward, in this study, the non-social reward was indicated by personalized circumscribed interests (CI). The results demonstrated that autistic adolescents (mean age = 15.7 years) displayed stronger reward system responses for CIs compared to social rewards. More importantly, the larger difference in neural responses to CI compared to social reward was related to greater social impairments in the ASD group. This study emphasizes the importance of using ecologically valid social and non-social stimuli in understanding the reward system dysfunction in autism. In line with the SMT, heightened responses to non-social stimuli that are related to CIs may contribute to enhanced motivation for restricted repetitive behaviours in ASD, along with diminished social motivation.

Overall, the reward related neural circuitry –VS in particular – has been found less active during both anticipation (‘*wanting*’) and consumption (‘*liking*’) of social reward in children and adults with ASD. Referring back to the SMT, diminished neural activity along with correlations between striatal hypoactivation and more severe social deficits could explain the reduced reward value of social interactions in ASD, resulting in poorer social cognition. However, there have been some inconsistent findings in the literature demonstrating both atypical social and non-social reward processing in autistic children (Kohls et al, 2013) and atypical social reward *liking* but not *wanting* in autistic adults (Delmonte et al., 2012). These inconsistent findings could be explained by differences in type of reward (both social and non-social) used across the studies, the ecologically validity of the paradigms, and sample characteristics (e.g. age). The next section will review the behavioural studies looking into the social liking/wanting component of SMT in ASD.

2.5.2. Behavioural studies on the social liking/wanting component in ASD

Compared to neurobiological studies of social reward processing, there are relatively few behavioural studies to investigate the social wanting/liking behaviour in ASD. Existing behavioural studies have mostly investigated the social wanting component, which is operationalised as "behavioural approach to social stimuli" or "effort to obtain/seek social contact" (Dubey, Ropar, & Hamilton, 2018). The aim of this section is to give an overview of the behavioural paradigms used to measure the social wanting component of social motivation in children and adults with ASD.

One of the behavioural paradigms used to measure social motivation is "Face Turn Approach–Avoidance Task" (Aharon et al., 2001). In this task, pressing the button more often or for longer to increase the presentation duration of a social stimulus (e.g. faces) indicates social wanting behaviour. Using this paradigm, Deckers et al. (2014) showed that children with ASD (ASD: *n* = 22, Pervasive Developmental Disorder-not otherwise specified: *n* = 41, mean age = 9.9 years) approached both social (static pictures of faces) and non-social stimuli (pictures of landscapes) more than NT children even though they reported a lower desire to engage in social activities (as measured by Wish for Social Interaction Scale; WSIS) (Deckers et al., 2014). In this study, there were no group differences in avoidance behaviour from social or non-social stimuli. Using the same paradigm, Silva et al. (2015) demonstrated that high-functioning adolescents with ASD (*n* = 25, mean age = 13.96) displayed more avoidance of pictures of faces with positive emotion than NT subjects (*n* = 25, mean age = 14.12). On the other hand, autistic participants in this study approached more towards cartoons with positive emotions. However, there were not any group differences in avoidance behaviour from negative stimuli. Overall, these two studies emphasize the dissociation between implicit responses to social reward and explicit desire for social reward in autistic children (Deckers et al., 2014). Furthermore, social stimuli were approached and preferred less by autistic adolescents especially when they were presented along with non-social stimuli with an incentive value (e.g. cartoons) (Silva et al., 2015).

Using a more ecological approach-avoidance paradigm, children with ASD (*n* = 19, mean age = 11.5 years) and NT controls (*n* = 23, mean age = 11.1 years) performed a virtual reality (VR) task with avatars expressing dynamic emotions (Kim et al., 2015). Participants used a joystick to approach or avoid virtual avatars with different emotional expressions at different intensity levels. Even though both groups identified emotions accurately, the autistic group showed less approach behaviour to positive emotions (e.g. happy) compared to NT children who approached increasingly more towards happy faces with higher intensities. Higher approach responses towards happy avatars were associated with less symptom severity in the ASD group. However, both groups showed similar levels of aversion behaviour from negative social stimuli, without any group differences. The lack of aversion from negative social stimuli in autistic children in this study is in line with the previous findings (Silva et al., 2015; Deckers et al., 2014). Overall, less approach to positive social stimuli in autism could be explained by reduced willingness to share positive feelings with others owing to the diminished reward value assigned to social stimuli in ASD, which aligns with the SMT.

Another behavioural paradigm to study social motivation is called the "Viewing Game" (Ewing, Pellicano, & Rhodes, 2013). In this game, participants are asked to press a combination of keys as many or few times as they want in order to see a stimulus. More key presses for social stimuli in the Viewing Game indicates greater social reward *wanting*. Using this paradigm, children with ASD (*n* = 19, mean age = 11.39) and NT controls (*n* = 19, mean age = 11.35) were found to be equally willing to press the keys in order to see the social stimuli (static faces). However, both groups were more willing/keen to see the non-social stimuli (cars) than faces raising the question whether the car images in this study aroused interest in NT children as well. One very critical point in this study and the study by Deckers et al. (2014) is that the autistic children displayed more key presses in both stimuli types, suggesting atypical motor response behaviour in ASD which might confound the study results (Deckers et al., 2014; Ewing, Pellicano, & Rhodes, 2013). Therefore, pressing more to obtain social and non-social stimuli in ASD should be interpreted cautiously as it could indicate difficulties in controlling motor behaviour in ASD.

The “Monetary Choice Task” is another behavioural task used to measure social wanting by calculating how much money participants sacrifice to obtain social and non-social rewards (Watson et al., 2015). Children and adolescents with ASD (*n* = 12, mean age = 15.3) sacrificed more cash to see only CI-related objects in comparison to NT children (*n* = 22, mean age = 13.4), but the groups did not differ in their behaviour in relation to seeing faces or other objects. These results are in line with the neural studies discussed in section 2.5.1. and emphasize that reduced social motivation in ASD might be linked with heightened interest in CIs.

The last behavioural effort paradigm to measure *social wanting* behaviour is the “Choose a Movie” (CAM) paradigm developed by Dubey et al. (2015). In this paradigm, participants choose between boxes with varying number of locks to open in order to see a social or non-social movie. After learning the associations between each box and type of the movie, participants decide between opening a box with less locks or more locks. Thus, participants experience a trade-off between the effort required to open a box (e.g. number of locks) and the preference to watch a certain movie (e.g. social versus non-social) (Dubey, Ropar, & Hamilton, 2015). In this task, autistic adolescents (*n* = 31, mean age = 14.22) were more likely to choose object movies over social movies (smiling adults directly looking at the camera for 3 seconds) compared to their neurotypical peers (Dubey et al., 2018). However, autistic adolescents were able to modulate their behaviour based on change in effort required to open the box. As such, when the non-social stimuli required more effort than the social stimuli, they were likely to switch and open the box with the social stimuli. This paradigm was replicated in adults with two social conditions; movies of direct or averted social gaze (Dubey, Ropar, & Hamilton, 2015). The results showed that autistic participants were more likely to choose to view object videos over social direct gaze videos compared to the NT group. However, like adolescents, if the object video required more effort to be seen than the social video with an averted gaze, autistic adults shifted to the other stimuli which required less effort. These results suggest that the CAM paradigm with direct and averted gaze as social stimuli is a reliable measure to assess social motivation in autistic adults, who displayed reduced effort to obtain social stimuli, and therefore in line with the SMT. The lack of extreme aversion from direct gaze in ASD, as indicated by switching to social videos when less effort required, suggests that the reduced preference for social stimuli is driven mostly by social disinterest rather than aversion from the social stimuli (Dubey et al., 2016).

Overall, the literature on behavioural indices of social wanting in children and adults mostly align with the SMT, suggesting reduced approach behaviour to social stimuli without avoiding the negative social stimuli. However, there are some inconsistent findings suggesting similar seeking behaviour towards both social and non-social stimuli in autistic individuals and NT peers, especially when the non-social stimuli (e.g. cars) were appealing to both groups (Ewing, Pellicano, & Rhodes, 2013) or increased approach behaviour to CI-related non-social stimuli in autistic individuals (e.g. cartoons; Watson et al., 2015). Therefore, the inconsistent findings can be explained by differences in content and ecological validity of the social and non-social stimuli used in different tasks. When more ecologically valid paradigms (e.g. VR) and stimuli (e.g. dynamic videos of averted versus direct gaze) were used, group differences in social wanting behaviour were more apparent (Dubey, Ropar, & Hamilton, 2016). The next section will discuss the last component of social motivation in ASD.

2.6. Evidence on the social maintaining component in ASD

The third component of SMT is *social maintaining* which reflects the drive to enhance and maintain social interactions with others in order to facilitate inclusion and avoid rejection. For example, people act more prosocial in the presence of others in order to maintain their reputation due to the incentive value of others' opinion about themselves (Chevallier et al., 2012). In order to investigate the social reputation management, autistic children and NT controls (age range = 12 to 15 years) were asked to rate the quality of self-portrait drawings in the presence or absence of the drawer in the room (Chevallier, Molesworth, & Happe, 2012). While the NT group inflated their ratings when the drawer was in the room, the ASD group did not change their initial ratings. More importantly, the participants with higher inflated ratings in the presence of the drawer reported more pleasure gained from social interactions (Chevallier, Molesworth, et al., 2012). Similarly, NT controls donated more to a charity in the presence of others, while donations made by autistic participants did not change based on the presence or absence of others (Izuma et al., 2011). One reason for diminished social reputation management in ASD could be explained by the lack of understanding others' emotions, where autistic individuals may fail to think others might be affected by their negative evaluations. Alternatively, and as proposed by the SMT, individuals with ASD do not inflate their judgements about others when they are present because they may be less worried about being liked by others due to reduced interest in developing and maintaining relationships with them.

Another study used the same donation task and added a motivational condition in which half of the participants were instructed that the observer was also the recipient of the donations and s/he would later have the chance to donate back to them (Cage, Pellicano, Shah, & Bird, 2013). This condition aimed to test whether the participants would change their behaviour to obtain more donations expecting a reciprocal behaviour from the observer. The results showed that although autistic participants (*n* =19) did not increase their donations at the presence of the observer (no motivation condition), they made similar donations with NT participants (*n* = 20) in the motivational condition and donated more when they believed that the observer would later have the chance to donate to them. These results suggest that individuals with ASD strategically modulate their behaviour, but only when it is beneficial to do so. Thus, when explicit instructions were given to autistic individuals about the behavioural consequences of their actions, they could consider how others are affected by these actions even though they still did not change their behaviour in the presence of others. These findings further align with the SMT by showing that behaviour on the donation task is not about failure to understand what others might think, but instead it indicates a lack of motivation/interest in others. Thus, the previous evidence is supportive of the SMT by showing reduced social maintaining behaviour in autism.

2.7. Self-report studies of social motivation in ASD

Given the biological basis of the SMT, neurobiological studies of social motivation in autism dominate the literature, followed by behavioural studies. However, there is an emerging interest in self-report studies of social motivation in autism. The majority of these self-report studies have used quantitative questionnaires, asking mainly about individuals' experience of pleasure derived from social interactions and their desire for social engagement. The first self-report study of social motivation demonstrated reduced social, but not physical pleasure, in children with ASD compared to their NT peers (as measured by The Pleasure Scale; Kazdin, 1989; Chevallier, Grèzes, Molesworth, Berthoz, & Happé, 2012). Self-report measures of social motivation in adults with ASD showed that autistic adults had significantly higher social anhedonia (as measured by Social Anhedonia Scale (SAS); Eckblad et al., 1982) and physical anhedonia scores than parents of children with ASD and NT adults. Furthermore, the social anhedonia scores of autistic adults in this study were higher than the physical anhedonia scores, suggesting diminished experiences of pleasure in social situations (Berthoz et al., 2013). Using the same questionnaire, Carré et al. (2015) showed similar results demonstrating that 80% of the autistic group reported significantly higher social anhedonia scores than the NT adults. In this study, autistic traits (as measured by the Autism Quotient; AQ) were significantly correlated with the SAS scores in both groups. Overall, these findings suggest that children and adults with ASD might differ in the way they experience social pleasure, albeit this difference might also include physical pleasure, indicating more general deficits in the experience of pleasure in ASD. To examine this further in a non-clinical sample, NT young adults (n = 265, mean age = 18.95 years) were administered two questionnaires measuring the ability to experience social (as measured by Anticipatory and Consummatory Interpersonal Pleasure Scale; ACIPS) and physical pleasure (as measured by Temporal Experience of Pleasure Scale; TEPS) (Novacek, Gooding, & Plum, 2016). Even though both capacity for social and physical pleasure were associated with AQ scores, only the social pleasure was a strong predictor of AQ traits (explaining 21% of the variance), while the physical pleasure did not predict the AQ scores. These results emphasize that the higher the autistic traits, the lower the pleasure in social interactions. Overall, these findings provide evidence for reduced self-reported experience of pleasure in social encounters, which is predicted by higher autistic traits in autistic and NT populations.

In addition to quantitative questionnaires of social motivation, a few qualitative studies have been conducted to gain insight into autistic people's motivation for social interactions. Contrary to findings from the quantitative measures, qualitative measures suggested that some individuals with ASD have average or above average levels of motivation to interact with others (Sumiya, Igarashi, & Miyahara, 2018; Cook et al., 2018; Sedgewick et al., 2016; Calder et al., 2013). However, their motivation might be impacted by other factors such as difficulties in socializing (Sumiya et al., 2018; Foggo & Webster 2017; Calder, Hill & Pellicano, 2012) or getting anxious in social situations (Sumiya et al., 2018; Sedgewick, Hill & Pellicano, 2018). It is possible that the perception and experience of social interactions are qualitatively different in individuals with ASD, in a way that cannot be revealed by standardized social motivation questionnaires.

Reports of social motivation in autism may also be context-dependent, such as where and with whom the social interaction occurs. For example, Chen et al. (2015) investigated motivation for participating in everyday interactions using a more ecological momentary measure, namely the Experience Sampling Methodology (ESM). In this study, 14 Australian (mean age = 24.8 years) and 17 Taiwanese (mean age = 27.8 years) students with high-functioning ASD were asked to report their experiences of social interactions (e.g. what they were doing, with whom, motivation to engage, perceived difficulty and social reciprocity) for 7 days using the ESM (Chen et al., 2015). The results showed that autistic participants were more intrinsically motivated to engage with family members and intimate friends, however they defined their motivation for interactions with people at school or work as necessity. It was also observed that autistic individuals were motivated to socially interact only when they felt confident and when they did not perceive the social situation difficult. More interestingly, social anxiety in this study was related to perceived difficulty in social situations. These results suggest that motivation to participate in social interactions might be context dependent in ASD. Furthermore, autistic individuals might engage less in social interactions due to their perceived difficulty or heightened anxiety, rather than lack of motivation. Therefore, other factors, such as anxiety and social difficulties, might interact with social motivation and impact upon social behaviour in autism, something which has largely been overlooked in the literature on SMT thus far.

It is important to emphasize here that most of the self-report data on social motivation come from adults with ASD. Self-report measures are commonly used, especially in adults with ASD, and they provide valuable insights into subjective experience that cannot be obtained through objective methods (Balwin, 2000). However, the autistic adults included in self-report studies might represent a small subsection within ASD as they are mostly high-functioning individuals who provide rich insights into their lived experiences. Thus, the discrepancies between quantitative and qualitative experiences in relation to social motivation might be driven by differences in level of intellectual functioning across samples. Therefore, it is critical to complement self-reports with more objective measures of social motivation in ASD. This issue will become important while discussing the aims of this thesis.

2.8. Evaluation of the SMT

The SMT has furthered our understanding of the social impairments in autism by providing a developmental and multi-level explanation of atypical social behaviour in ASD. The majority of the evidence on social motivation has come from neurobiological data, indicating differences in neural responses to social stimuli in ASD. These differences in neural responses are mostly placed in brain regions responsible for reward processing. Therefore, this theory adds to the literature on autism by demonstrating social motivational deficits as a mechanism for atypical social behaviour which underlie reduced social orienting (as suggested by Social First Hypothesis) and impaired social cognition (as suggested by Theory of Mind).

Even though the SMT provides an explanation for the atypical social development in ASD, there are some problematic issues in the SMT to be considered. Firstly, there are inconsistent findings across studies of social motivation in autism, which might reflect differences in sample characteristics (e.g. age), the behaviours measured (e.g. neurobiological versus self-report), and the tasks used across the studies (e.g. ecological validity of the task). Moreover, recent evidence from autistic individuals themselves who report desire to interact with others has generated a huge debate in the literature (Gillespie-Lynch et al., 2017). For example, Jaswal and Akhtar (2019) have argued that autistic individuals have different ways of expressing their motivation which cannot be captured using traditional measures of social motivation. They also proposed alternative arguments to explain atypical social behaviour in ASD. For example, autistic individuals might avoid eye-contact due to visual and auditory hypersensitivities rather than reduced social motivation, and instead, focus on lip reading to facilitate communication. Therefore, an autistic individual might act or be perceived as socially uninterested but actually desire social interactions, which can only be understood if autistic individuals are given a voice to talk about their unique social experiences and ways of expressing social motivation (Pellicano & Stears, 2011).

In addition to contrasting evidence and recent critiques of the SMT in autism, there are several important questions which remain to be answered, such as whether there are individual differences in social motivation and what role other factors associated with ASD, such as social anxiety, play in social motivation. A major issue to be considered while answering these questions is how social motivation should be measured? Is it really sufficient to try to capture social motivation using pictures or clips of unfamiliar faces? Therefore, the SMT requires further investigation in autism, especially using ecologically valid measures and multiple sources of data in relevant populations. This section will evaluate the SMT by focusing on the limitations of the theory and gaps in the literature to be addressed.

2.8.1. Ecological validity of social motivation paradigms

As mentioned in previous sections, a critical issue to be addressed is the measurement of social motivation in ASD. Firstly, social motivation is a very complex construct including several components, which makes it difficult to conceptualize and measure in lab settings (Keifer et al., 2019). Currently, there are not many available measures to reliably assess this multidimensional construct and each of its components (Uljarević et al., 2019). Early attempts to measure social motivation led to development of paradigms that are focused on specific processes of social reward, which are not ecologically valid (e.g. static faces), socially meaningful (e.g. relevance of social reward) or representative of real-world social scenarios. For example, looking at faces in isolation when there is no opportunity for social interaction may not be a sensitive measure. As such, the social attention literature in autism has shown that the closer the stimuli/experimental conditions replicate realistic social information, the greater the atypicalities in ASD (Hanley et al., 2013; Hanley et al., 2015; for a review, see Chita-Tegmark, 2016; Fletcher-Watson et al., 2009). Similarly, using social meaningful stimuli is very crucial. For example, using adult faces as social reward in a study with autistic adolescents may not be socially relevant as adult faces are not perceived as appealing/rewarding to adolescents and therefore may not activate the motivational behaviour (Dubey et al., 2016).

Given the complex nature of social phenomenon, using ecologically valid paradigms to study social behaviour in autism is very important in order to understand and predict social difficulties in autism. In fact, some differences in autistic social behaviour can only be revealed when ecologically valid experimental paradigms are used (Chevallier et al., 2015; Hanley et al., 2013). Thus, in order to probe social motivation further, experimental paradigms which are more ecologically valid and social are required.

2.8.2. Individual differences in social motivation

Another very critical issue reflects individual differences in social motivation. According to the SMT, unlike social cognition deficits, primary social motivation deficits are claimed to appear in all or nearly all individuals with ASD (Chevallier et al., 2012). However, given the high heterogeneity in ASD, it is not known whether social motivation lies on a continuum, as opposed to being an all-or-nothing phenomena. The first attempt to show that motivation for social interactions is not absent in all children with ASD was made by Wing and Gould (1979), who classified autistic individuals into sub-groups based on their social interaction styles. According to this classification, there are three sub-groups with atypical social approach: “socially aloof”, “passive”, and “active but odd”. “Socially aloof” refers to a group of autistic individuals who do not show interest in any sort of social contact. Individuals in the “passive” group accept social approaches of others but they do not actively seek or initiate interaction. The “active but odd” group involves individuals who actively initiate interaction with others but they do not engage in appropriate reciprocal behaviours and they are less aware of others’ needs/interests in the interaction (e.g. keep talking about the subjects they are deeply interested in even if the other part is not listening or showing any interest). Overall, individual differences in social interaction styles of autistic individuals may reflect individual differences in social motivation, which warrants further investigation.

The existence of autistic subgroups with varying levels of social motivation has been investigated only in one study. In this study, social motivation was measured by parent reports from 6-items measuring motivation of the child for social interaction with his/her peers (Garman et al., 2016). The results demonstrated that there were equal numbers of autistic adolescents (mean age = 13.17) with low and high social motivation, suggesting heterogeneity of social motivation in ASD. More interestingly, high social motivation in autistic adolescents in this study unexpectedly was associated with poorer facial emotion recognition performance. These results suggest that there might be some autistic individuals who are socially motivated to interact with their peers, yet struggle to interpret facial emotions, therefore finding social interactions challenging. It is important to mention that social motivation in this study was measured by parent report questionnaires with only 6 items, and as this was not a direct measure of social motivation, it may not be very reliable (Garman et al., 2016). However, this line of research emphasizes that, even though social challenges are defining features of ASD, autistic individuals may differ in terms of social interest, engagement, and social skills (Wing & Gould, 1979). Therefore, it may be that social motivation is not an ‘all-or-nothing’ phenomenon, and that there might be individual variability on the autism spectrum in terms of social motivation.

Related to the issues regarding individual differences in social motivation, the role of mental health comorbidities, especially social anxiety and depression, is very important for understanding social behaviour in ASD (Wood & Gaddow, 2010). As mentioned in Chapter 1 (section 1.3), social anxiety could have impact upon social behaviour in autism by restricting social approach in ASD. Given the unpredictable and complex nature of social interactions, individuals with ASD and high social anxiety might find them too challenging, leading to social withdrawal. For example, autistic individuals with a comorbid social anxiety reported higher stress (as measured by DASS-stress subscale), higher social anxiety (as measured by Social Interaction Anxiety Scale) and lower social motivation (as measured by SRS-2) compared to a group with ASD only (Maddox & White, 2015). These results demonstrate that heightened social anxiety in autistic individuals might be associated with lessened social motivation as a result of difficulties in social interactions. However, further research is needed to clarify the extent to which social anxiety, relative to low social motivation, influences their behaviour in social interactions.

2.8.3. Importance of autistic testimony and multi-method approach

Another important challenge to the SMT comes from individual observations and reports of autistic individuals themselves regarding their motivation to interact with others. The perspectives of autistic individuals are very valuable in both understanding their social motivation and the unconventional ways they express these motivations – which have been greatly overlooked in literature (Jaswal & Akhtar, 2019). Previous research has shown that autistic individuals relate to others differently such that they prefer structured activities (Gunn et al., 2014) and to spend more time with other autistic individuals (Strunz et al., 2017; Crompton et al., 2020). Therefore, differences in social behaviour of autistic individuals could be related to their different social interaction styles, not lack of social motivation as such. For example, many autistic adults reported to be motivated to interact with others and to have desire to make friends (Gillespie-Lynch et al., 2017; Sedgewick et al., 2016), however they might have unconventional ways of showing their motivation, which may not be captured by the existing measures/methodologies that are originally developed for NT populations. Lack of awareness of these unconventional expressions of social interest by NT individuals might cause autistic individuals to feel discouraged to engage in further interactions with others (Akhtar et al., 2016; Prizant & Fields-Meyer, 2015). Therefore, diminished social motivation might be a consequence of early negative experiences in social interactions as an adaptive response rather than a cause of autism (Brown & Foxley-Webb, 2019). As a result, individuals with ASD might withdraw from social situations, leading to high levels of loneliness (Hedley et al., 2018), mental health difficulties (Moseley & Sui, 2019), and suicidality (Camm-Crosbie et al., 2019).

Additionally, an emerging body of evidence around the high rates of camouflaging behaviour in social interactions as reported by autistic individuals themselves provides a contrast to the ideas proposed by the SMT around social maintaining (Lai et al., 2017). The fact that a significant proportion of individuals with ASD engage in behaviours to fit in with neurotypical social interaction styles (e.g. pre-planning conversations) could reflect motivation to socially interact with others (Livingston, Shah, & Happe, 2019; Livingston et al., 2019). In fact, autistic individuals who compensate may have higher social motivation because they have to use more resources to compensate for their social-cognitive deficits, which might lead to exhaustion and ill-mental health such as anxiety and depression (Lai et al., 2017). Alternatively, camouflaging behaviour in autism can also reflect the motivation to avoid negative experiences in social interactions. Therefore, this relationship between compensation, social motivation, and mental health should be further investigated by using the perceptive of autistic individuals.

The testimony of autistic individuals is also important to clarify the discrepancy between the self-reported social interest in autistic individuals and the behavioural expression of social motivation (Tottenham et al., 2013). To this end, the combination of objective and experimental methods of social motivation with first-hand accounts of autistic individuals on their desire/interest for social engagements would be very informative. The majority of the evidence described in this chapter comes from behavioural and neurobiological studies in ASD. Qualitative insights into perspectives of autistic individuals on their motivation for social interactions and related social experience might inform the researcher about the unique ways of expressing social interest and therefore provide a more comprehensive understanding of social motivation in ASD. However, even though autistic testimony is essential in understanding social motivation, relying on self-report alone may be problematic. First of all, the participants who are willing to take part might be a selected group of autistic individuals who are already social motivated (Dinishak, 2019). Secondly, reporting typical social motivation does not always indicate typical social motivation and therefore autistic testimony of social motivation and social experiences should be complementary to other experimental methods of social behaviour and social motivation in autism (Yankowitz & Clements, 2019).

In conclusion, the heterogeneity and complexity of social motivation is not entirely captured in the SMT and there are several questions to be answered. Some of the issues to be addressed are (1) developing ecologically valid and socially meaningful paradigms to reliable measure social motivation, (2) investigating individual differences in social interest and social behaviour together with the role of mental health comorbidities in autism, (3) including the perspective of autistic individuals about their social motivation and social experiences in real life social encounters, and (4) implementing complementary methodologies including behavioural, biological and survey measures. Based on these questions and critiques of social motivation, the current PhD research aims to understand social behaviour and social experience in relation to social motivation in autism. The final section in this chapter will outline the aims of each study conducted in the current PhD thesis.

2.9. The aims of the current PhD thesis

The studies involved in this PhD thesis aim to understand social behaviour and social experience in relation to social motivation in adults with ASD, especially those without intellectual disabilities, using a multimethod approach. As discussed above, assessment of social motivation requires ecologically valid and socially meaningful paradigms. Therefore, the first part of this thesis is focused on understanding social motivational behaviour in autistic adults using ecologically valid paradigms (Chapter 3 and 4). In this part, two behavioural paradigms were administered to measure sensitivity to social rejection and social exclusion as indicators of social motivation in young adults with ASD. Moreover, behavioural and psychophysiological responses were monitored in these studies in order to explore behavioural and biological indicators of social motivational behaviour in autism.

The second part of the current thesis has two aims; (1) to explore individual differences in social motivation and (2) to understand social experiences and social motivation in autistic adults based on their first-hand accounts. To this end, the third study (Chapter 5) looked at social and academic challenges and strengths in university students with and without ASD using both quantitative and qualitative self-report measures. This approach offered a valuable insight into the experiences of autistic university students regarding motivation, social skills, social and academic functioning, isolation, adaptation to the academic institution at university and provided further explanations for the behavioural and psychophysiological responses observed in previous two experimental studies (Chapter 3 and 4). The reason university students were a focus of interest is because of the importance of the transitioning period into adulthood including extra social challenges (e.g. independent living, building up permanent social relationships) together with decreased formal support (Kapp, Gantman, & Laugeson, 2011). Therefore, the first three studies (Chapter 3, 4, & 5) focused on autistic and NT students at university.

The last two studies in the second part of the thesis recruited a broader sample of autistic and NT adults in order to investigate social behaviour and social experiences of autistic adults in general. In order to investigate the heterogeneity in social motivation, the fourth study (Chapter 6) examined individual differences in social motivation and autistic traits, social skills (e.g. alexithymia), social anxiety, and depression and the role they play in social motivation using self-report questionnaires. Moreover, this study examined whether there are subgroups in social motivation within ASD. Lastly, the relationship between social motivation and friendships, as an indicator of social functioning in real-world situations, was studied using both quantitative and qualitative measures of friendships (Chapter 7). It is crucial to explore the unique experiences of friendships in autism as they might be different in terms of quantity and quality (e.g. perceptions of friendships) in autistic individuals compared to their NT peers (Petrina et al., 2014). Therefore, the last study in this thesis provides qualitative and quantitative insights into unique experiences of friendships and social motivation in autistic and NT adults. As some participants participated in both studies discussed in Chapter 6 & 7, further links between varying levels of social motivation (from Chapter 6) and friendship experiences (from Chapter 7) were made.

The overarching aim of the current thesis is to provide a comprehensive understanding of social behaviour and social experience in relation to social motivation in adults with ASD adopting a mixed-method approach. In order to further clarify the issues raised above, social motivation is investigated using experimental and self-report measures, while considering individual differences, especially social anxiety, throughout the thesis (Van Steensel et al., 2011). Understanding the complexity of social behaviour in relation to social motivation, mental health, and social functioning is very crucial to develop personalized interventions and ultimately improve quality of life and well-being in young adults with ASD, which will be discussed in Chapter 8. SPSS 22 was used for analysis throughout the thesis, however, R-Studio was used for data visualisations in some of the chapters (Chapter 6 and 7).

Chapter Three: Psychological and physiological responses to social exclusion in young adults with autism

An important challenge in the autism literature, as discussed in chapter 2, is the operationalization and measurement of social motivation. The majority of existing studies have investigated neural responses to social reward by using static pictures of faces (e.g. with a smile to indicate positive feedback or frown to indicate negative feedback), and this approach is simply not representative of real-world social situations. Therefore, one of the aims of the current PhD thesis is to measure social motivation using a more ecologically valid and socially meaningful paradigm in adults with ASD.

One way to probe social motivation is to investigate the experiences of social exclusion. According to the Social Motivation Theory, the negative effects of social exclusion are the strongest proof of social motivation in neurotypical individuals (Chevallier et al., 2012). Therefore, people with reduced social motivation, as proposed for individuals with ASD, are assumed to experience reduced adverse effects of exclusion. In order to test this assumption, two studies (Chapter 3 and 4) were conducted using behavioural paradigms to probe responses to exclusion and rejection in university students with ASD in comparison to their NT peers. The data for Chapters 3 and 4 were from the same participants in the same testing session. This chapter focuses on the first paradigm, namely the Cyberball game as a measure of responses to social exclusion in ASD (Van Beest & Williams, 2006).

3.1. Introduction

According to the SMT, the negative effects of social exclusion occur due to strong social motivation in humans (Chevallier et al., 2012). Social exclusion constitutes a threat to social connectedness and its negative effects have an impact on well-being (see Leary, 1990 for review; Eisenberger & Lieberman, 2004; Eisenberger, 2012). For example, people who are rejected or excluded are more likely to seek social interaction to increase their chances of inclusion (Maner et al., 2007). Thus, responses to social exclusion have been proposed to inform our understanding of social motivation. On the other hand, as claimed by the SMT, individuals with ASD experience reduced adverse effects of social exclusion compared to neurotypical individuals, owing to the proposed reduced value of social interactions. To date, this aspect of social motivation has been relatively overlooked, yet it offers a meaningful way to test SMT in ASD. To this end, the current study examined behavioural and psychophysiological responses during a social exclusion paradigm in young adults with ASD and neurotypical (NT) adults.

The majority of studies investigating social exclusion in NT individuals have used a well-established paradigm called the ‘Cyberball’ game (Williams, Cheung, & Choi, 2000). In this game, participants play a virtual online ball-tossing game with two other players on the computer. In the first part, participants receive an equal share of the ball with other players – *inclusion condition*. In the second part, participants receive the ball only a few times in the beginning and never receive it again until the end of the game – *exclusion condition.* Although participants believe they are playing against two other real people, in reality, the game and the trials are programmed by the computer. The psychological experiences of this game have been mostly measured with the self-reported Need Threat Scale (NTS; Williams, Cheung, & Choi, 2000) which assesses fundamental needs and consists of items about feelings of inclusion/belonging, meaningful existence, self-esteem and control over the game. In neurotypical participants, this paradigm has consistently been found to elicit feelings of social exclusion and negative mood (for a review, see Wesselmann & Williams, 2017). A meta-analysis including 120 Cyberball studies with children and adults showed that the exclusion effects of Cyberball are large and they occur across a variety of conditions (e.g. playing with a computer versus human, playing with partners of the same or opposite sex; Hartgerink, Van Beest, Wicherts, & Williams, 2015). Individuals have been consistently found to experience lower levels of fundamental needs, indicated by reduced feelings of belonging, self-esteem, control and meaningful existence (as measured by the NTS), and higher negative mood after the exclusion condition in comparison to the inclusion condition (Williams & Jarvis, 2006; Zadro, Williams, & Richardson, 2004). These results suggest that Cyberball is a valid paradigm to induce social exclusion across conditions and developmental groups.

Other work with the Cyberball paradigm has shown that the negative effects of social exclusion remain even when it is financially beneficial to be excluded (Van Beest & Williams, 2006). This was first demonstrated in an adapted version of the Cyberball paradigm where the exclusion and inclusion were made either financially rewarding or costly (Van Beest & Williams, 2006). In this adapted version, a monetary reward/cost was introduced to the game such that participants either earned or lost money every time they received the ball in each condition, so the earnings depended on the number of ball tosses *received*. For example, in "gain" conditions, the participants *earn* money when they received the ball, and in "loss" conditions, the participants *lose* money when they received the ball. This manipulation resulted in four different conditions (social experience x financial outcome); inclusion-gain, inclusion-loss, exclusion-gain, exclusion-loss. The researchers were specifically interested in the "exclusion-loss" condition where the participants lost money when they received the ball, thus it was financially detrimental to be included and financially beneficial to be excluded. Therefore, the researchers speculated that exclusion-loss condition might alleviate the feelings of distress and negative mood following exclusion. However, they did not find this in neurotypical participants, who instead reported psychological distress and feelings of exclusion in exclusion-loss condition (Van Beest & Williams, 2006). These results suggest that social exclusion is a powerful experience and it hurts the individual even when it is financially beneficial. However, these results were at the self-report level, and what happens at the neurobiological and psychophysiological is discussed below.

3.1.1. Neurobiological and psychophysiological correlates of social exclusion in NT populations

As reviewed in Chapter 2 (see section 2.3), there is a specialised neural circuit that is responsible for modulating social and non-social reward and punishment, and it is suggested to be underactive in individuals with ASD (Chevallier et al., 2012). Some of the regions involved in this circuitry have been found to be reactive in processing social exclusion including dorsal anterior cingulate cortex (dACC) and anterior insula (AI) (for a review, see Eisenberger, 2012). These two regions show activation to physical pain as well, indicating an overlap between social and physical pain in the brain. According to a review of 42 neuroimaging studies, these regions have been found to be active during the exclusion condition in the Cyberball game (Wang, Braun

& Enck, 2017). In the review by Wang and colleagues, different EEG activities were reported at initial stages of exclusion (200-300 ms) and later stages (400-900 ms). The activity at early stages of the game was suggested to be related to processing negative effect of ostracism, while the activity at later stages indicated the participant reflecting on their exclusion experiences and regulating emotions. These findings suggest that processing initial social exclusion and regulating negative affect following social exclusion are governed by distinct neural regions in the brain.

One of the main methods used in the literature, and also the focus of the current chapter, is psychophysiology, which is the study of bodily functions to understand experience and behaviour of organisms in social and physical environments (Cacioppo et al., 2000). In this context, psychophysiological reactivity is defined as the deviation in physiological state as a response to a discrete, environmental stimulus. Psychophysiological reactivity is mostly indicated by changes in the autonomic nervous system (ANS) activity (Cacioppo et al., 2000). One of the indexes of ANS activity and also the most widely studied one in the literature is Electrodermal Activity (EDA; Dawson, Schell, & Filion, 2007), also known as Skin Conductance Levels (SCLs). SCLs primarily reflect changes in sympathetic activation that are associated with emotion, arousal, and attention (Boucsein, 2012). The SCL responses to external stimuli are governed by certain regions in the brain, such as the ventromedial prefrontal cortex, the orbitofrontal cortex, the anterior cingulate cortex, the amygdala, and the insula (Dawson, Schell, & Filion, 2007). These regions are also important for social reward processing and social functioning (Dichter & Adolphs, 2012). More interestingly, brain regions important for emotion and attention have been found to be differentially involved in EDA responses (Critchley et al., 2000). Therefore, SCL is a crucial measure in understanding the body’s response to social-affective stimuli.

Previous research has utilized psychophysiology methods to measure responses during Cyberball in NT individuals. For example, in a study taking this approach, participants (age range = 18-30 years old) performed both inclusion and exclusion conditions, the order of which was counterbalanced across participants (Kelly, McDonald, & Rushby, 2012) and the researchers found that even though the participants reported lower levels of fundamental needs after social exclusion, participants' SCLs decreased with time over the course of both conditions. However, the SCL during exclusion did not reduce as much as it did in the inclusion condition. Therefore, higher arousal levels during exclusion were suggested to be due to stress associated with social pain, suggesting a functional relationship between arousal and social exclusion. In another psychophysiology study, participants were randomly assigned to inclusion or exclusion conditions followed by a 15 minute waiting period and their heart rate (HR) and SCL were monitored throughout the game and after the 15-min waiting period (Iffland, Sansen, Catani, & Neuner, 2014a). In this study, participants who played the exclusion condition reported significantly lower fundamental needs (except for self-esteem) compared to the participants who played the inclusion condition. Psychophysiology results showed that the heart rate of participants playing the exclusion condition was significantly higher compared to heart rate of participants playing the inclusion condition. However, the exclusion condition did not have an effect on the SCL responses of the participants (Iffland et al., 2014a). These results suggested that social exclusion evoked sympathetic activation as indicated by accelerated heart rate, however, they did not show any change in SCL responses to exclusion. However, the fact that different participants were tested in each condition makes it difficult to compare the results between them due to individual differences in physiological reactivity to social exclusion. In another study, the same researchers investigated the effect of social exclusion in NT individuals and individuals with social anxiety disorder (SAD) and observed an increase in SCLs immediately after the exclusion across all participants (Iffland et al., 2014b). These results were in line with the study by Kelly et al. (2012) and further emphasized that social exclusion causes a physiological stress response indicated by higher SCLs. Therefore, SCL can be proposed as an important measure to reflect changes in arousal as a response to social exclusion in neurotypical and clinical populations.

Overall, behavioural Cyberball studies in NT populations emphasized that social exclusion compared to inclusion elicits reduced feelings of inclusion and positive affect. The majority of evidence on Cyberball has come from neurobiological data, showing that exclusion leads to activation in brain regions important for processing negative social cues and emotion regulation, the timing of which is crucial. Out of three psychophysiology studies, two of them found higher SCLs during exclusion condition of Cyberball, suggesting a relationship between high arousal and social stress. However, these studies did not employ a within-subject design where the same participants were first included and then excluded. This is important to control for individual differences in responses to inclusion and exclusion.

3.1.2. The role social anxiety and depression in exclusion responses

Social anxiety and depression might influence responses to social exclusion, as individuals with high social anxiety and depression might be more sensitive to social exclusion. Previous research has examined the behavioural and neural responses to social exclusion in individuals with SAD and depression. For example, individuals with SAD reported significantly greater feelings of exclusion compared to neurotypical participants after the exclusion condition (Heeren et al., 2017). In terms of neural responses, both groups activated similar brain regions including the dACC, the bilateral insula, and thalamus as a response to exclusion. However, only the SAD group had significantly higher activation, especially in left inferior frontal gyrus (IFG) during recovery from exclusion. Moreover, higher activation in IFG was associated with higher self-report feelings of social exclusion in the SAD group, but not in the neurotypical group. These results indicate that the neural and behavioural responses to exclusion are heightened in individuals with clinical social anxiety. Other studies using event-related potential (ERP) responses to social exclusion in Cyberball also reported associations between neural responses to social exclusion and individual differences in self-reported distress in NT young adults (Crowley et al., 2009) and children (Van Noordt et al., 2015). These findings suggest that social anxiety might play a crucial role in responses to social exclusion, especially recovering from the exclusion.

Another study investigated responses to Cyberball in depressed and NT participants and found that depressed patients had lower NTS scores following the inclusion condition and reduced neural activation (e.g. P3) to inclusion compared to NT participants (Zhang et al., 2017). Moreover, neural responses to inclusion in depressed patients were negatively correlated with their anhedonia scores in this study. However, there were not any group differences in behavioural and neural responses to the exclusion condition in Cyberball. These results suggest that depression might be associated with deficits in enjoying the positive social experiences (e.g. social inclusion) rather than avoiding the negative social cues (e.g. social exclusion) in Cyberball. However, another study demonstrated that patients with Major Depressive Disorder (MDD) displayed greater activation in amygdala, insula, and ventrolateral prefrontal cortex to exclusion in Cyberball, and activation in these regions correlated negatively with self-reported hedonic symptoms and self-esteem scores across all participants (Kumar et al., 2017). These results contradict with the previous findings of hypoactive responses to inclusion, with no differences in exclusion (Zhang et al., 2017), and demonstrated that depression might be associated with hyperactivation in reward related neural circuits during exclusion. However, to date, there has not been any psychophysiological studies of Cyberball to investigate the role of both social anxiety and depression in NT or autistic populations.

3.1.3. Neurobiological and psychophysiological correlates of social exclusion in ASD

Compared to the number of studies with NT individuals, fewer studies have investigated psychological, neural and psychophysiological reactions to social exclusion in autistic individuals. In the first study using the Cyberball game in an autistic population, adolescents with ASD (*n* = 19, mean age = 16.9) and their NT peers (*n* = 13, mean age = 16.9) played the inclusion condition first, followed by the exclusion condition (Sebastian et al., 2009). The results of this behavioural study showed that both autistic and NT participants reported higher levels of anxiety (as measured by the State/Trait Anxiety Inventory) and lower psychological needs (as measured by the NTS) after the exclusion condition in comparison to the inclusion condition. However, in this study, exclusion did not modulate the mood of autistic participants while NT participants reported less positive mood after being excluded. Another behavioural study comparing children and adults with autism to an age-matched neurotypical group found similar results such that both autistic children and adults reported lower fundamental psychological needs following the exclusion condition in comparison to the inclusion condition (Peristeri, Tsimpli, & Williams, 2016). Similarly to the study by Sebastian et al. (2009), the mood of autistic individuals did not change after the exclusion condition, while neurotypicals reported more negative mood after exclusion in comparison to inclusion. These two studies of Cyberball in autistic individuals were only based on behavioural self-reports and did not include any objective measures of exclusion. Both studies showed that autistic adolescents and adults could detect exclusion in a similar way to NTs, however their mood was not modulated by the exclusion. The absence of mood change after the exclusion condition in autistic participants in these studies could be due to the inability to understand how their experiences influence their emotional states or the difficulty to identify and label their current emotions (Hill, Berthoz, & Frith, 2004).

Neural indices of social exclusion during Cyberball have been investigated in children and adults with ASD. Using electroencephalogram (EEG), NT children (age range = 8-15 years of age) were found to show higher P2 amplitudes during social exclusion trials in comparison to inclusion trials, indicating higher arousal, and their self-reported distress correlated with the amplitude of this response (McPartland et al., 2011). However, autistic children showed attenuated responses to social exclusion trials and their neural responses were not associated with the reported distress after social exclusion. These findings suggested that children with ASD struggle to use their resources in socially stressful contexts. In another Cyberball study, adolescents with autism (mean age =14 years) were found to show reduced activity in brain regions associated with peer rejection including vlPFC, VC, and AI, compared to their NT peers even though both groups reported similar levels of distress during exclusion (Masten et al., 2011). These results demonstrated that autistic adolescents could experience the adverse effects of social exclusion, however their neural responses to social exclusion were different. Overall, the neural studies of Cyberball in autistic individuals have suggested a differential neural processing of social exclusion (e.g. mostly indicated by attenuated/reduced activation) in autism, even if they reported equivalent feelings of distress and exclusion to neurotypical individuals.

To date, there has been only one study which investigated psychophysiological responses to social exclusion using the Cyberball in adults with ASD (Trimmer, McDonald, Kelly, & Rushby, 2017). Participants with ASD (*n* = 25) and NT (*n* = 26) played both conditions of the Cyberball game, the order of which was counterbalanced, while their SCLs were monitored. The results demonstrated that autistic adults reported fewer feelings of inclusion after the exclusion condition (e.g.

less meaningful existence, sense of belonging), which was similar with their neurotypical peers. However, in line with previous findings (Sebastian et al., 2009; Persiteri et al., 2016), the mood of autistic adults in this study was not modulated with task condition as they reported overall negative mood, regardless of being included or excluded. In terms of physiological responses, firstly, the SCLs were higher throughout the game in the ASD compared to NT group. Secondly, the ASD group had significantly higher SCLs during the exclusion condition compared to the NT group, but there was no group difference in the inclusion condition. More importantly, the arousal levels of autistic individuals did not habituate to the same extent as the NT group in the exclusion condition. These results suggest that individuals with ASD experience greater distress or emotional pain due to exclusion, which did not reflect to their mood ratings. Heightened arousal and lack of habituation during exclusion in autistic participants might also indicate difficulties in regulating the adverse effects of social exclusion.

Previous research with NT individuals has demonstrated that social anxiety and depression might have an impact upon experiences of social exclusion. While social anxiety is associated with difficulty to self-regulate following exclusion, depression might be associated with increased sensitivity to social exclusion (Zimmer-Gembeck et al., 2016). As such, individuals with social anxiety disorder and major depressive disorder were found to experience heightened feelings of exclusion along with increased neural activation to exclusion (Heeren, et al., 2017; Kumar et al., 2017). There is only one study which measured self-reported anxiety in the Cyberball game with autistic adolescents and it showed that there was no difference between the autistic and NT adolescents in their anxiety levels following exclusion, which was higher in comparison to inclusion in both groups (Sebastian et al., 2009). However, the role of social anxiety and depression on behavioural and psychophysiological responses to social exclusion in Cyberball has not been studied in autistic and NT adults. Considering the previous findings of consistent low mood in ASD, which does not change after exclusion, along with high rates of social anxiety among autistic individuals, it is crucial to investigate the association between social anxiety, depression, and behavioural and psychophysiological responses to social exclusion in autism.

Another important factor that might modulate experiences of social exclusion is the financial offset, which might diminish or balance the effect of social exclusion in Cyberball. Previous studies in neurotypical individuals have demonstrated that exclusion in Cyberball evoked feelings of distress and ‘hurt’ even when being excluded was financially rewarding (Van Beest & Williams, 2006). According to Social Motivation Theory, autism is primarily associated with deficits in processing social reward value, while prioritizing the non-social rewards. However, as discussed in Chapter 2, recent reviews suggested that autism might be associated with general reward processing deficits indicated by atypical neural and behavioural processing of both social and non-social rewards (Bottini, 2018; Clements et al., 2018). Therefore, adding this financial manipulation (gaining or losing money) to Cyberball experience (inclusion versus exclusion) for the first time in autistic individuals would allow us to investigate the social (inclusion versus exclusion) and non-social (gaining versus losing money) aspects of behaviour by testing whether social exclusion would still elicit similar feelings of distress and hurt in individuals with ASD when exclusion was made financially rewarding.

Overall, studies of social exclusion in ASD showed similar self-reported experiences of negative feelings and distress after exclusion in autistic individuals with the NTs. However, neural and psychophysiological responses of autistic individuals during the Cyberball game differ from the responses in NT individuals. Consistent hypoactive/attenuated neural responses during social exclusion (McPartland et al., 2011; Masten et al., 2011; Bolling et al., 2015) suggest a diminished experience of social exclusion in ASD. The only psychophysiological study using the Cyberball game demonstrated higher arousal in ASD, especially during the exclusion condition, which was not reflected to mood ratings (Trimmer et al., 2017). The discrepancies in self-report and biological findings from neural and psychophysiological studies of Cyberball warrant further investigation of social exclusion experiences in ASD while considering the role of other factors, such as social anxiety and depression, in experiences of social exclusion in autistic and NT individuals. Moreover, investigating the financial component together with the social component in Cyberball is important to probe social and non-social motivation in ASD.

3.1.4. The Current Study

The current study aimed to investigate the behavioural and psychophysiological responses associated with social exclusion to probe social motivation in young adults with ASD compared to NT individuals. To this end, we used an adapted version of Cyberball game with a financial manipulation as described in Van Beest and Williams (2006). This is the first study to administer Cyberball with this manipulation in autistic adults to investigate (1) how individuals with ASD would respond to social exclusion as measured by behavioural (NTS and mood scale) and psychophysiological reactions (SCLs) in comparison to NT individuals, and (2) the role of other factors, such as autistic traits, social anxiety and depression, on experiences of social exclusion. Based on the Social Motivation Theory and previous literature, the following hypotheses were made; i) in terms of behavioural responses, both autistic and NT participants would report lower fundamental needs after exclusion compared to the inclusion condition, even when social exclusion was made financially beneficial, ii) in terms of psychophysiological responses, the arousal levels at baseline and during each condition would be higher in the ASD group compared to the NT group, iii) given the adverse effects of social exclusion, as proposed by the SMT, higher arousal during exclusion compared to inclusion condition was expected in the NT group, on the other hand, iv) autistic participants were expected to show atypical psychophysiological responses to social exclusion compared to their NT peers. However, given the previous evidence for both reduced neural activity in support for the SMT (Masten et al., 2011; Bolling et al., 2011; McPartland et al., 2015) and higher arousal during social exclusion in individuals with autism (Trimmer et al., 2017), the directionality of the SCLs during social exclusion in the ASD group could not be predicted. If the SMT holds true, it would be expected that autistic adults would respond less to social exclusion compared to NT individuals, especially when it was financially beneficial to be excluded as a result of increased non-social and decreased social reward value in ASD. Therefore, while a group difference was hypothesised, the direction could not be predicted (two tailed hypothesis). Lastly, it was expected that, v) experiences of social rejection would be associated with autistic traits, depression, and social anxiety across participants. Previous studies examining the relationship between experiences of exclusion and social anxiety (Heeren et al., 2017) and depression (Kumar et al., 2017) compared clinical groups with healthy controls, however this relationship has never been tested adopting a dimensional approach including autistic and NT individuals. Therefore, this hypothesis was tested by running a regression analysis including all participants with a wide range of social anxiety and depression scores.

The current study had one exploratory analysis with the SCL responses throughout the Cyberball game. Based on previous studies showing differential neural activation during early and late stages of exclusion (Wang, Braun & Enck, 2017) and reduced psychophysiological habituation over the course of exclusion in autistic individuals (Trimmer et al., 2017), a further descriptive time-course psychophysiological analysis was conducted to investigate the change in response over time within each condition per group. This analysis was only exploratory as the current sample was underpowered to run inferential statistics with the SCLs at multiple time points.

3.2. Methods

3.2.1. Participants

Forty neurotypical participants (21 males, mean age = 22.83 years, SD = 4.13) and 20 participants with ASD (11 males, mean age = 23.58 years, SD = 4.33) participated in the current study. The participants were recruited through social media and advertisements at the campus of Durham University, representing a wide range of studies and faculties. The groups were matched in terms of age; $t(58) = .652$, $p = .52$ and gender, $X^2(1,) = .033$, $p = .86$. Participants were asked to report if they had any psychophysiological conditions (e.g. cardiac conditions) and none were reported. Participants with ASD were also asked to confirm if they had any co-morbid diagnoses. Thirteen of the 20 autistic participants (65%) self-reported comorbid diagnoses, 8 of which (40%) had mental health disorders. Participants in the NT group were also screened for developmental disorders and none were reported. Ethical approval was provided by the ethics committee at Durham University prior to the commencement of the study.

First, the outliers were examined based on the self-report measures of autistic traits, depression, and social anxiety. Based on the criteria of z-scores greater than 3.29 or -3.29 (Tabachnick & Fidell, 2001; Ghosh & Vogt, 2012), one NT participant was identified as an outlier with a DASS-21 score of 112 (z-score = 3.36 > 3.29), and therefore excluded from the rest of the analysis. Autistic traits were measured using the Autism Quotient (AQ; Baron-Cohen et al., 2001) and the ASD group had significantly higher AQ total scores than the NT group, $t(58) = 7.759$, $p < .001$, $d = 2.24$. Regarding the Cyberball, the data from one NT participant had to be excluded as this participant did not play the game due to technical issues, resulting in 38 NT participants (20 males, mean age = 22.91 years, *SD* = 4.22) and 20 ASD participants (11 males, mean age = 23.58 years, *SD* = 4.33) in the behavioural analysis. In terms of psychophysiology analysis, data from two neurotypical participants were excluded from further analysis due to poor quality of the SCL data, resulting in 36 NT participants (20 males, mean age = 23.03 years, *SD* = 4.31) in the final psychophysiology analysis. Finally, one participant in the ASD group did not fill in the social anxiety questionnaire due to technical issues and therefore was not included in the regression analysis.

3.2.2. Measures

The Cyberball paradigm and procedure

The Cyberball paradigm used in this study was adapted from Van Beest and Williams (2006). In this paradigm, participants played an online ball-tossing game and they were told that they would be playing with two other players who were connected to the system online. Before they started the Cyberball game, participants performed a baseline task for about 5 minutes. In this task, random words were presented on the screen and participants had to press “1” if the word on the screen was written in ‘CAPITAL’ letters and press “3” if the word was written in ‘lowercase’.

After the baseline, the participants were given full instructions about the Cyberball. They were told that the game was about mental visualizations. For instance, they were asked to visualize how the game would look like if they were playing it in real-world. In order to play the Cyberball game, the participants were asked to press the *right* button on the mouse in order to throw the ball to the player on the *right* and press the *left* button on the mouse in order to throw the ball to the player on the *left*. Before participants started the game on the computer, they entered their information about gender, ethnicity and age to ensure that the other players were from similar age and same gender. And then, they chose one out of nine football shoes which would be their icon throughout the game. The other two players were also represented by football shoes on the screen (see Figure 3.1). The name of each player was presented above the corresponding football shoe. During each ball throw, the ball made a travelling sound and landed on one of the football shoes.

In order to convince the participants that the game was real, the experimenter made an actual phone call with another experimenter in another lab where two players were waiting to play with the participant. The participants could hear the phone call so that they believe there were actually two other players waiting for them to start the game. In reality, there were not any other players in another lab and the call was made with another independent researcher who was given a script about what to say on the phone. After the 'Connecting…' sign on the screen, participants started the game. In total, there were two conditions with 30 trials in each condition and all trials in each condition were pre-programmed by the researchers. All participants first played the inclusion condition followed by the exclusion condition. In the original experiment by Williams et al. (2000), a fixed-order was also implemented as the researchers suggested that inclusion condition is the control condition to which ostracism is compared and one should be included first to feel excluded. The experience and cost manipulation in each condition are described below (also see Table 3.1):

Inclusion – money gain: All participants first played the inclusion condition in which the share of the ball tosses was equal and each player received 1/3 of the ball tosses. The participants started the game with £0 and they were instructed that every time they received the ball, they would *earn* £1 indicated by a green upwards arrow next to their icon on the screen (See Figure 3.1). The amount of money they earned with each ball catch was presented on a counter above their name throughout the game. Since the participant received 10 throws in total, they earned £10 at the end of this condition. Therefore, this condition was both socially and financially rewarding.

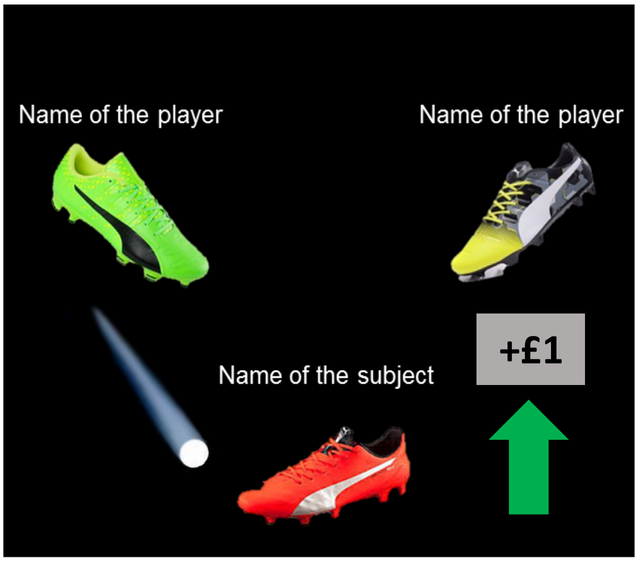
Exclusion – money loss: After inclusion, participants played the exclusion condition in which the participant received the ball two times in the beginning and never received the ball again until the end of the game. The participants were instructed that every time they received the ball, they would *lose* £1, which would be subtracted from the £10 they had earned in the inclusion condition. The money losses were indicated by a red downwards arrow next to their icon on the screen (See Figure 3.1) and they could track how much money they had left on a counter above their name. Since they started the game with £10 and only received the ball two times at the first two trials of the game, they would all finish the game with £8. Therefore, this condition was socially costly but financially rewarding.

Table 3.1. Cyberball game conditions and financial manipulation

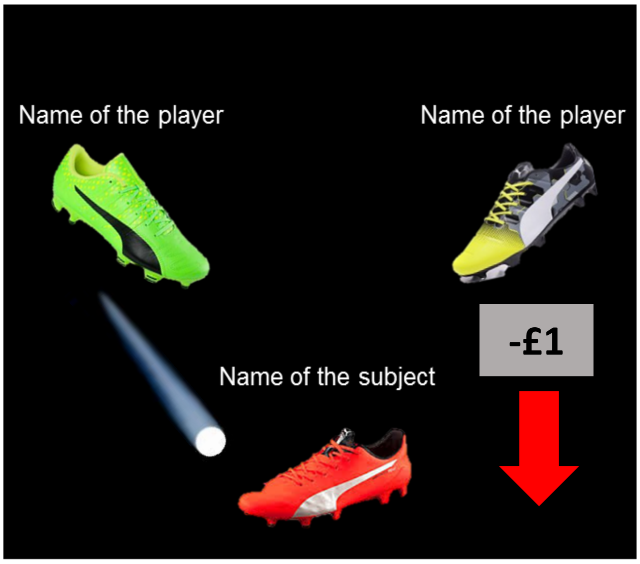
Condition	Social outcome	Financial outcome
Inclusion	Rewarding	Rewarding
Exclusion	Costly	Rewarding

Need for Threat and Mood Scale

After each condition of the Cyberball, participants were asked to complete the Need Threat Scale (Van Beest & Williams, 2006) with 20 items assessing feelings of belonging, self-esteem, meaningful existence, and control over the game (see Appendix A). Participants rated their agreement with each item on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*) (Cronbach's alpha for all participants in the current study, $\alpha = .856$). Higher scores indicated more satisfaction, greater feelings of inclusion, and the fundamental needs of the participants being met. Then, participants completed the Mood Scale (Van Beest & Williams, 2006) in which they rated their positive (happy, cheerful, and elated) and negative emotions (sad, angry, and hurt) during each game on a scale from 1 (*not at all*) to 5 (*very much*) (Cronbach's alpha for all participants in the current study, $\alpha = .727$). The negative emotions were reverse-coded and a mean mood index score was calculated for inclusion and exclusion condition.



A



B

Figure 3.1. The inclusion (A) and exclusion (B) conditions of the Cyberball game.

Self-report measures of anxiety and depression

Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987) was administered to assess social anxiety. LSAS contains 24 items; 13 of which measure performance anxiety and 11 measure social interaction anxiety. Participants rate each item for *fear* (0-3; none-severe) and *avoidance* (0-3; never-usually). In previous research, the self-report version of LSAS (LSAS-SR) has been reported to have strong test-retest reliability, internal consistency, and convergent and discriminant validity (Baker et al., 2002). When compared to the clinician-administered version (LSAS-CA), the LSAS-SR is a valid measure with high internal consistency and identical subscale intercorrelations (Fresco et al., 2001). For the current full sample, internal consistency of LSAS total scores was very high, α = 0.959 (*avoidance* subscale; α = .918 and *fear* subscale; α = .929). Depression Anxiety Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995) is a 21-item self-report measure of depression, anxiety and stress. On a 4-point Likert scale (from 1 = *did not apply to me at all* to 4 = *applied to me very much or most of the time*), participants rate each item based on its applicability to their life experiences over the past week, with higher scores indicating more severe symptoms. When administered to autistic adults, the DASS-21 has been reported to show good reliability and validity, with Cronbach's alpha of .89 for the *depression* subscale, .83, for the *anxiety* subscale, and .86 for the *stress* subscale (Nah et al., 2018). The internal consistency of DASS-21 total scores in the current sample was α = .924 (*anxiety* subscale; α = .834, *depression* subscale; α = .793, *stress* subscale; α = .836)

3.2.3. Procedure

Following the instructions about the Cyberball game, participants were prepared for psychophysiology testing. The SCL responses were recorded from two 11 mm electrodes attached to the medial phalange surface of the index and middle fingers of the non-dominant hand of the participants. Participants first performed the 5-minute baseline task. Afterwards, they were given instructions about the Cyberball followed by the phone call (see section 3.2.2 for full instructions), after which they started the Cyberball with two other players on the screen (this was the same procedure as in Iffland et al., 2014a). The inclusion condition was administered first, followed by the exclusion condition. After each condition, participants filled in the NTS and the mood scale. In order to check whether the manipulation worked, they also guessed the percentage of balls they received in each condition and they rated how rewarding it was to receive the ball on a scale from 1 (*not rewarding*) to 7 (*rewarding*). Finally, participants filled in the self-reported questionnaires including the AQ, LSAS, and DASS-21.

At the end of the whole session, participants were debriefed that they did not play the Cyberball game with real players, but with the computer and all the trials in the Cyberball game were pre-programmed (see Appendix B for debrief). They were also informed that the phone call was acted and there were not any players at another lab. Finally, regardless of how much they earned during the game, they all received £10.

During debrief, we also asked participants whether they believed to play the Cyberball with real people. Three neurotypical participants reported that they did not and removing these participants made no difference to the results. All the analysis was done with and without them. Two participants in the ASD group reported doubting the reality of the game, especially during the exclusion condition, but they were not certain and therefore, they were not excluded from the analysis. The whole paradigm took about an hour to complete. The same participants also completed another task, the results of which are reported in Chapter 4.

3.2.4. Data analysis

Preparation of physiology data

Skin conductance levels were collected throughout the Cyberball using BIOPAC *Acqknowledge* software 4.1 (Biopac System Inc.). The sampling rate was 1000 kHz. SCL was converted to microsiemens (μS). Before filtering the data, SCL responses were downsampled to 62.500 kHz. In order to remove artefacts, the downsampled data were smoothed using the same smoothing factor (63 samples/second) with the sampling size (Braithwaite et al., 2013). In addition, the remaining artefacts were visually inspected and manually edited. The mean SCL responses (in μS) were calculated for inclusion and exclusion condition using a newer version of BIOPAC software, *Acqknowledge* 4.3.

The mean SCL during the last 1-minute of the baseline task was used as the baseline measure. The change scores for inclusion and exclusion condition were calculated for each participant by subtracting the baseline mean SCL from the mean SCL during each condition. In addition, changes in mean SCL for each 10-second epochs were quantified by subtracting the 1-minute baseline from the mean SCL value occurring for each 10-second epoch throughout the game. These epochs were used for further exploratory analysis.

Data analysis plan

All statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS 24) for Windows. First, in order to check whether the manipulations in Cyberball worked, participants' guesses about the percentage of balls they received in each condition and the reward ratings of receiving the ball were investigated using paired sample *t*-tests. To test the first hypothesis which was that both groups would report fewer fundamental needs after exclusion compared to the inclusion condition, a mixed model repeated-measures analysis of variance (RM ANOVA) was performed with the Need Threat Scale mean scores after each Condition as within-subject factor (2; inclusion NTS, exclusion NTS) and Group as between-subject factor (2; ASD, NT). The mood scale data were analysed also using mixed model RM ANOVA with within-subjects factors of Condition (2; inclusion mood, exclusion mood) and between-subject factor of Group (2; ASD, NT).

To test the second hypothesis which stated that the arousal levels at baseline and throughout the game would be higher in the ASD group compared to the NT group, independent samples *t*-test were conducted to compare the overall mean SCLs between the groups during the baseline, inclusion, and exclusion conditions. In order to test the third hypothesis of higher SCLs during exclusion compared to the inclusion condition in the NT group, a mixed model RM ANOVA was conducted with the change scores as within-subject factors of Condition (2; inclusion SCL, exclusion SCL) and Group as between-subject factor (2; ASD, NT). This analysis would also answer the fourth hypothesis which was that the ASD group would show atypical SCLs during exclusion condition, the direction of which could not be predicted. In addition, the baseline-corrected, 10-second epochs of mean SCL during inclusion and exclusion were graphed to explore how psychophysiological responses changed over time for each group, however, the inferential statistics were not carried out with the 10-sec epochs as there was not enough statistical power. Huynh and Feldt type corrections were carried out when needed.

Lastly, in order to test the fifth hypothesis that whether the experience of exclusion in the Cyberball game was associated with physiological responses to exclusion, autistic traits, social anxiety, and depression symptoms, bivariate Pearson correlations were carried out across all participants. Based on these correlations, hierarchical regression analyses were conducted to examine the predictor role of physiological responses of exclusion, autistic traits, social anxiety, and depression symptoms, on experiences of exclusion indicated by the NTS exclusion mean scores. The regression analyses were run across all participants and not for each group separately due to small sample size in the ASD group and the dimensional approach of the current study.

3.3. Results

3.3.1. Group comparisons of social anxiety and depression symptoms

The mean, SD, and range in self-reported autistic traits, social anxiety, and depression in the ASD and NT participants are presented in Table 3.2 and 3.3 respectively. The ASD group reported significantly higher social anxiety scores measured with LSAS compared to the NT group, $t(56) = -6.254$, $p < .001$, $d = 2.73$. The LSAS subscales of *fear,* $t(56) = -6.572$, $p < .001$, $d = 1.96$ and *avoidance,* $t(56) = -5.506$, $p < .001$, $d = 1.66$ were also significantly higher among autistic participants when compared to their neurotypical peers. Similarly, the ASD group had a significantly higher DASS-21 total scores compared to NT group, $t(57) = -3.121$, $p = .004$, $d = 1.19$. When each subscale was compared, the autistic students scored significantly higher on *anxiety*, $t(57) = -3.058$ $p = .005$, $d = 0.89$ and *stress*, $t(57) = -4.035$, $p < .001$, $d = 1.28$, but not on the *depression* subscale, $t(57) = -1.603$, $p = .120$, $d = 0.58$.

Table 3.2. Descriptive information from self-reported measures of autistic traits, social anxiety, and depression in the ASD group

Measures		Mean	SD	Range	
				Possible	Obtained
AQ	Total score	34.65	8.74	0-50	16-48
LSAS	Total score	76.74	26.05	0-144	36-137
	Fear subscale	40.26	12.77	0-72	15-69
	Avoidance subscale	36.48	13.98	0-72	20-68
DASS-21	Total score	42.20	25.43	0-136	10-108
	Anxiety subscale	11.70	8.93	0-42	0-36
	Depression subscale	11.60	10.03	0-42	0-32
	Stress subscale	18.90	9.85	0-42	6-42

AQ: Autism Quotient. LSAS: Liebowitz Social Anxiety Scale. DASS-21: Depression Anxiety and Stress Scales- 21 Items.

Table 3.3. Descriptive information from self-reported measures of autistic traits, social anxiety, and depression in the NT group

Measures		Mean	SD	Range	
				Possible	Obtained
AQ	Total score	16.93	8.14	0-50	4-34
LSAS	Total score	36.69	14.36	0-144	7-73
	Fear subscale	19.23	8.04	0-72	5-38
	Avoidance subscale	17.46	7.99	0-72	2-35
DASS-21	Total score	22.95	16.08	0-136	2-82
	Anxiety subscale	5.08	5.25	0-42	0-18
	Depression subscale	7.59	6.93	0-42	0-36
	Stress subscale	10.05	6.84	0-42	0-28

AQ: Autism Quotient. LSAS: Liebowitz Social Anxiety Scale. DASS-21: Depression Anxiety and Stress Scales- 21 Items.

3.3.2. Manipulation checks

There were two questions to check whether the Cyberball manipulations worked; the percentage of balls received (answered by $n = 52$ participants, missing $n = 7$ due to not knowing how to answer) and the reward value of receiving a ball (answered by $n = 58$ participants, missing $n = 1$). The results showed that all participants understood the manipulations such that they reported higher percentages of ball catches (actual mean = 33%, estimated mean = 32.89%, $SD = 11.11$) in inclusion compared to the exclusion condition (actual mean = 6.66%; estimated mean = 6.67%, $SD = 4.72$), $t(51) = 20.107$, $p < .001$, $d = 2.79$. Furthermore, participants reported significantly higher reward value of receiving the ball in the inclusion (mean = 5.47, $SD = 1.41$) compared to exclusion condition (mean = 1.47, $SD = 1.19$), $t(57) = 14.908$, $p < .001$, $d = 1.96$.

3.3.3. Behavioural results

Need for Threat Scale

Behavioural analyses with the Need Threat Scale scores were conducted to test whether exclusion led to fewer fundamental needs in the ASD and NT group. The mean and SD values of NTS and its subscales for each group are presented in appendix (see Appendix C). The results showed a significant main effect of Condition (inclusion NTS, exclusion NTS), $F(1, 56) = 130.865$, $p < .001$, $\eta_p^2 = .700$ and Group, $F(1, 56) = 4.400$, $p = .040$, $\eta_p^2 = .073$, but not an interaction between Condition and Group, $F(1, 56) = 0.001$, $p = .976$, $\eta_p^2 < .001$. Bonferroni corrected pairwise comparisons demonstrated that all participants reported significantly higher scores on Need Threat Scale following inclusion ($M = 5.20$, $SD = .67$) compared to the exclusion condition ($M = 3.76$, $SD = .85$), $p < .001$, $d = 1.60$. Follow up analysis of the main effect of Group showed that the participants in the ASD group reported overall lower satisfaction in both inclusion ($M = 4.98$, $SD = .88$) and exclusion conditions ($M = 3.56$, $SD = .82$) compared to the NT group.

Mood Scale Index

The 2 x 2 RM ANOVA with the Mood Scale Index scores showed that there was no main effect of Condition, $F(1,56) = 1.705$, $p = .197$, $\eta_p^2 = .030$, or an interaction effect between Condition and Group, $F(1,56) = 1.102$, $p = .298$, $\eta_p^2 = .019$. However, there was a main effect of Group, $F(1,56) = 6.163$, $p = .016$, $\eta_p^2 = .099$. These results suggested that the mood of participants did not change across conditions and groups. However, the ASD group reported consistently lower positive feelings compared to the NT group, irrespective of the conditions (See Table 3.4).

Table 3.4. Mean and SD scores of Need Threat Scale and Mood Scale during inclusion and exclusion by group

Condition	Measure	ASD		NT	
		Mean	SD	Mean	SD
Inclusion	NTS	4.98	0.88	5.32	0.49
	Mood Index	3.57	0.62	3.79	0.44
Exclusion	NTS	3.51	0.82	3.86	0.85
	Mood Index	3.59	0.83	4.04	0.62

3.3.4. Psychophysiology results – Skin Conductance Levels

One of the aims of the current study was to examine the overall SCL responses during baseline and each condition in the ASD and NT group. Figure 3.2. illustrates the overall mean SCL during baseline, inclusion and exclusion condition for each group. The SCLs were higher in the ASD group throughout the paradigm. When each condition was compared, the mean SCL during baseline was higher in the ASD group (M = 7.01, SD = 2.82) than the NT group (M = 5.75, SD = 2.47), but this difference was not significant, $t(54) = -1.737$, $p = .088$, $d = 0.48$. During the inclusion condition, the ASD group had overall higher SCLs compared to the NT group, however this result did not reach statistical significance, $t(54) = -1.932$, $p = .059$, $d = 0.54$. Lastly, participants in the ASD group had significantly higher overall mean SCLs during the exclusion condition compared to NT participants $t(54) = -2.472$, $p = .017$, $d = 0.67$.

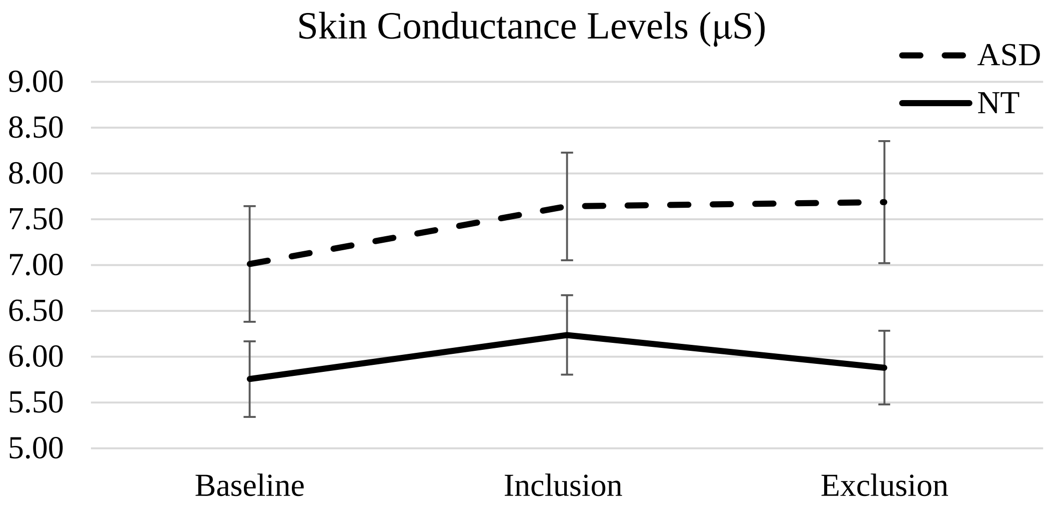


Figure 3.2. The mean SCLs during baseline, inclusion and exclusion condition by group. Error bars represent the SDs.

One of the main aims of the current study was to investigate whether psychophysiological responses to exclusion would differ across the groups and Cyberball conditions. It was particularly important to focus on the SCLs during exclusion and whether they would be higher in comparison to inclusion condition in the NT group, but not in the ASD group. In order to examine whether there was a change from inclusion to exclusion in SCLs in each group while taking account of the individual variability in baseline SCL, a mixed model RM ANOVA with baseline-corrected mean SCL (see section 3.2.4.1 for calculation of change scores) in each Condition (inclusion SCL, exclusion SCL) as a within-subject factor and Group as a between-subject factor was performed. There was no main effect of Condition, $F(1, 54) = 3.387$, $p = .07$, $\eta_p^2 = .059$ or Group, $F(1, 54) = .508$, $p = .479$, $\eta_p^2 = .009$. However, there was a significant interaction effect between Group and Condition, $F(1, 54) = 5.576$, $p = .020$, $\eta_p^2 = .097$. Follow-up analyses with one-way ANOVAs conducted with each group separately showed that the NT group had significantly higher mean SCL during the inclusion condition ($M = .4822$, $SD = 1.48$) compared to the exclusion condition ($M = .1257$, $SD = 1.61$) with a large effect size, $F(1, 35) = 16.383$, $p < .001$, $\eta_p^2 = .319$. However, there was no difference in SCL between the conditions for the ASD group, $F(1, 19) = .087$, $p = .772$, $\eta_p^2 = .005$ (see Figure 3.3). Comparisons of baseline corrected SCLs between the groups did not show a significant difference between the ASD and NT group in inclusion, $t(54) = -.314$, $p = .755$, $d = 0.083$ or exclusion condition, $t(54) = -.951$, $p = .349$, $d = 0.277$. As shown in Figure 3.3, there was a large variability in the SCLs, especially during the exclusion condition in the ASD group.

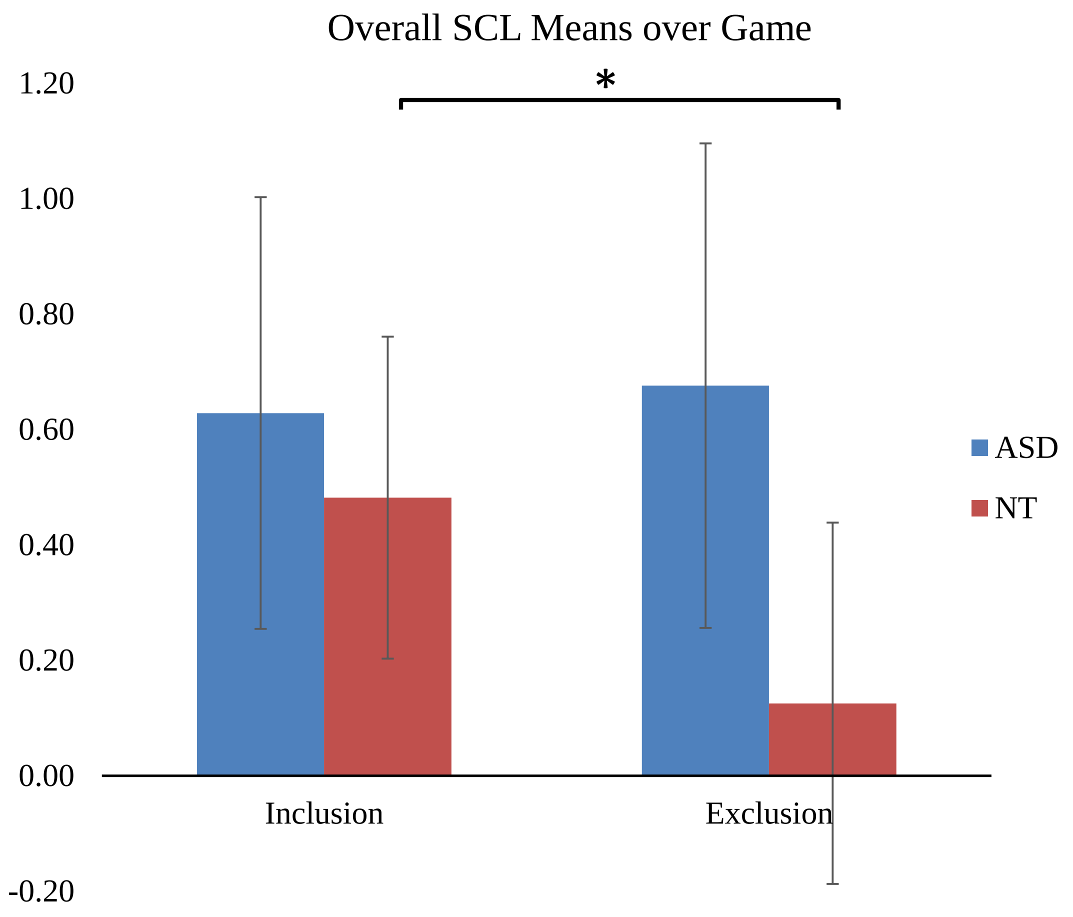
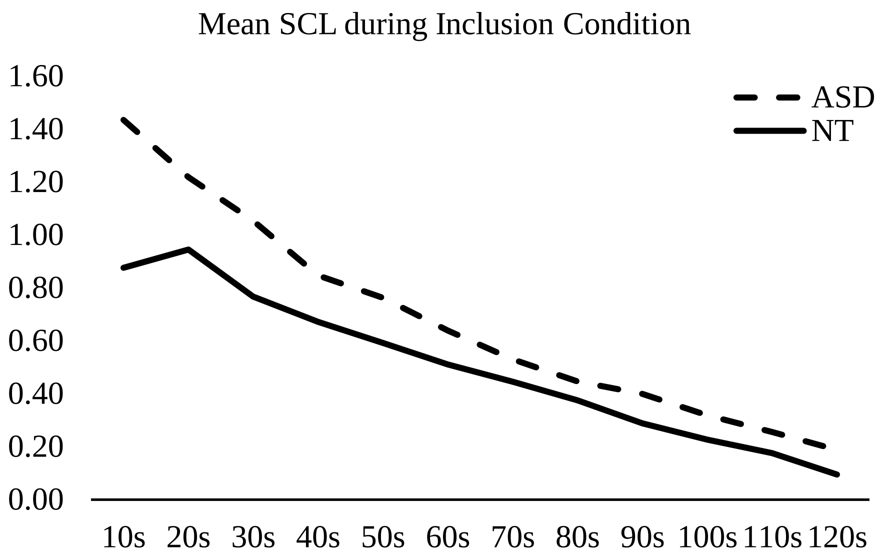


Figure 3.3. Baseline corrected SCLs during the inclusion and exclusion condition for the ASD and NT groups. The error bars represent the Standard Error.

As one of the aims of the current study was to investigate the change in response *over time* within each condition, descriptive analyses with baseline-corrected 10-second epochs of mean SCL in inclusion and exclusion condition were conducted. Due to being underpowered for inferential analysis, this analysis was only exploratory. As seen in Figure 3.4, the SCL declined over time in both groups, especially during inclusion condition (see Figure 3.4A). However, during exclusion, participants with

ASD started with higher SCLs and their responses did not decline as much as neurotypical participants throughout the game (see Figure 3.4B).

A



B

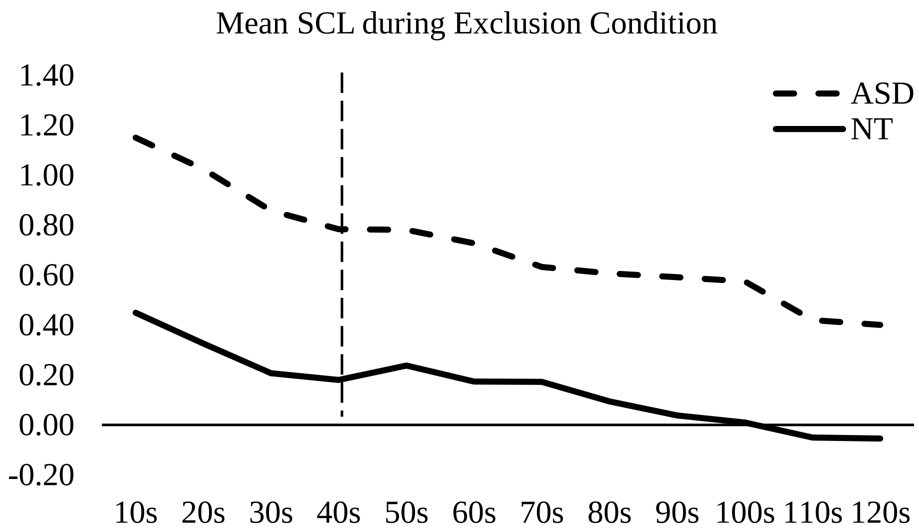


Figure 3.4. 10-second epochs of mean SCL at the first 120 seconds of inclusion (A) and exclusion (B) condition of the Cyberball game by each group. The dotted lines indicate when the exclusion occurred.

3.3.5. Individual differences in experiences of social exclusion

The last aim of the current study was to probe individual differences in experiences of exclusion based on psychophysiological markers of exclusion, autistic traits, and mental health, especially social anxiety and depression. In doing so, a neurodiverse approach was adopted and both autistic and NT participants were included in this analysis. Bivariate Pearson correlations were carried out to examine the associations between behavioural experiences of exclusion in the Cyberball game and psychophysiological responses during exclusion, autistic traits, social anxiety, and depression symptoms across all participants (see Table 3.5). The results showed that lower NTS scores during exclusion, reflecting heightened feelings of exclusion, were associated with higher social anxiety symptoms, as measured by LSAS total scores. However, physiological responses of exclusion, autistic traits, social anxiety, and depression symptoms were not correlated with the self-reported experiences of exclusion in the whole sample.

Table 3.5. Bivariate correlations between feelings of rejection, AQ, LSAS, and DASS-21 (n = 58)

Variable	1	2	3	4	5
NTS exclusion	1	-.014	-.153	-.400**	-.091
SCL exclusion		1	.000	-.005	-.039
AQ			1	.760**	.378**
LSAS				1	.463**
DASS-21 depression					1

**Correlation is significant at the 0.01 level (2-tailed).

Hierarchical regression analysis with total LSAS scores as the predictors and self-reported exclusion experiences as outcome variable demonstrated that higher social anxiety scores significantly predicted elevated feelings of exclusion β = -.405, t(54) = -3.223, p = .002, accounting for 14.8% of the variance. These results suggested that participants with higher social anxiety symptoms felt more excluded after the exclusion condition. Adding autistic traits, depression symptoms, and physiological markers of exclusion did not improve the model as they were not significant predictors of experiences of exclusion (AQ; β = .263, t(54) = 1.352, p = .182, DASS-21 depression subscale; β = .074, t(54) = .522, p = .604, SCLs during exclusion; β = -.003, t(54) = -.026, p = .979). Therefore, while social anxiety might predict approximately 15% of the variance in the experiences of exclusion, over 85% of the variance was not predicted by other concepts measured here.

3.4. Discussion

3.4.1. Behavioural responses to exclusion in NT and ASD participants

The current study was the first to investigate the behavioural and psychophysiological responses to an online social exclusion paradigm with a cost manipulation in young adults with ASD and age-matched NT participants. The results showed that both NT and autistic participants could detect the experience of being included and excluded in the game and could identify different reward values of receiving the ball in inclusion versus exclusion condition. However, participants with ASD had overall fewer feelings of inclusion compared to the NT participants. Previous studies showed that social exclusion resulted in lower need satisfaction levels in NT individuals (Van Beest & Williams, 2006). The current findings replicated these results in the NT individuals and further demonstrated that autistic adults experienced reduced feelings of belonging, control over the game, self-esteem, and meaningful existence during exclusion even when it was made financially rewarding. However, overall lower levels of self-reported inclusion in autistic participants suggested that individuals with ASD started the game at a different level. These results might represent a qualitative difference in the experience of inclusion and exclusion between the ASD and NT individuals.

In terms of mood ratings, participants reported similar levels of positive feelings after the inclusion and exclusion conditions, indicating that exclusion did not elicit more negative mood in either group. These results contradict the results of Van Beest and Williams (2006), who found that participants reported more negative feelings after being excluded in comparison to being included, even when exclusion was financially beneficial. In the current study, autistic individuals reported overall less positive mood, irrespective of being included and excluded. These results in the ASD group were in line with previous studies reporting overall lower mood in autistic individuals playing the Cyberball game (Sebastian et al., 2009; Trimmer et al., 2017). To summarize the present behavioural findings, the pattern of the results was very similar in autistic and NT participants such that they both reported lower fundamental needs after exclusion compared to the inclusion condition, but their mood was not modulated by inclusion or exclusion. However, the only areas where the groups differed were that participants with ASD reported lower overall satisfaction and positive mood than NT participants irrespective of inclusion or exclusion.

3.4.2. Psychophysiological responses to exclusion in NT and ASD participants

In terms of psychophysiological responses during the baseline, inclusion, and exclusion conditions, participants with ASD demonstrated overall higher arousal SCLs, especially during the exclusion condition compared to NT adults. When the baseline corrected SCLs during inclusion and exclusion were investigated, neurotypical participants had higher arousal levels during inclusion compared to the exclusion condition while participants with ASD did not show any differences in arousal levels between the inclusion and exclusion condition. Moreover, the groups did not differ in terms of baseline corrected SCLs in either conditions. A couple of points can be made based on these results; firstly, exclusion did not lead to higher arousal compared to inclusion in NT participants, which contrasts with the SMT. Quite the reverse, NT participants had higher arousal levels during the inclusion condition compared to the exclusion condition. Previous studies also failed to find differences in terms of SCLs between inclusion and exclusion conditions in neurotypical participants (Iffland et al., 2014a; Trimmer et al., 2017). The current and previous findings in NT populations demonstrating lack of higher arousal levels in exclusion could suggest that the SCL might be more sensitive to task engagement, but not to negative effects of exclusion. These would explain the higher SCLs in NT participants during the inclusion condition and lower SCLs in the exclusion condition as they were not playing, and therefore not engaged in the game. Alternatively, even though the validity of the Cyberball paradigm was confirmed by self-reports, the current psychophysiological results suggested that exclusion experiences in Cyberball did not evoke higher arousal levels in NT participants, and therefore the task might not be intense enough to elicit an adverse effect (Krimsky, 2010).

In terms of psychophysiological responses in the ASD group, the mean SCLs were overall higher throughout the game compared to NT participants, which was also observed in the previous study of Cyberball in autistic adults (Trimmer et al., 2017). Indeed, autistic individuals in the current study started the paradigm with higher SCLs, which stayed high throughout the experiment. Therefore, it can be argued that individuals with ASD were generally less impacted by both inclusion and exclusion, together with a high variability in psychophysiological responses to exclusion. Based on previous studies in NT populations, it could be interpreted that autistic participants in the current study showed a neurotypical pattern as they did not have different arousal levels between the inclusion and exclusion conditions (Iffland et al., 2014a; Trimmer et al., 2017). One explanation for this response pattern in individuals with ASD might be general hyper-arousal of sympathetic nervous system that has reduced sensitivity to task manipulations along with reduced habituation over time (Kushki et al., 2015; Lydon et al., 2016). Participants with ASD had slightly higher arousal during exclusion compared to inclusion, however, this was not significant. These findings suggest that individuals with ASD did not respond differently to exclusion compared to inclusion condition, therefore it did not support the SMT which would assume reduced sensitivity to social exclusion in ASD. Previous research found higher SCLs during exclusion compared to inclusion in individuals with ASD (Trimmer et al., 2017), and in fact the ASD participants in the current study showed the same pattern of performance as NT participants in the Trimmer and colleagues paper. Visual exploration of 10-second epochs of SCL during inclusion and exclusion in the current study also emphasized that even though the SCL decreased over time in both conditions and in both groups, autistic participants had overall higher arousal which did not decline as much over time in the exclusion condition. These findings require future investigation using time-course analyses of exclusion responses in autistic individuals with a bigger sample size, which will provide a high statistical power to test group differences over time using inferential statistics.

3.4.3. Individual differences in experiences of social exclusion across participants

The second aim of the present study was to understand what role the autistic traits, social anxiety, and depression play in self-reported experiences of exclusion across all participants. To this end, a neurodiverse approach including all participants was adopted to investigate the roles of other factors in experiences of exclusion, regardless of the diagnosis. Relationships between heightened feelings of rejection and higher social anxiety, but not autistic traits or depression symptoms, were reported. These results demonstrated that autistic traits might not have an impact upon self-reported experiences of exclusion, suggesting that individuals with similar autistic traits could experience different levels of exclusion and other factors might be more influential on individuals' feelings of exclusion. Similarly, lack of association between depression and experiences of exclusion indicated that depression symptoms might not be related to self-reported experiences of exclusion. Previous Cyberball studies with depressed patients have shown both elevated feelings of exclusion (Kumar et al., 2017) and reduced feelings of inclusion, but not greater feelings of exclusion in depressed patients (Zhang et al., 2017). Using autistic and NT individuals, the current findings suggest that depression may not be associated with feelings of exclusion and this is not surprising given that there was no difference in depression scores between groups.

Regression analysis demonstrated that participants who reported higher social anxiety symptoms were more likely to experience elevated feelings of exclusion. This is an important finding as the ASD group had overall higher social anxiety symptoms compared to the neurotypical group, suggesting that autistic participants who also have high social anxiety might be prone to experience greater exclusion. A previous study demonstrated that patients with a social anxiety disorder reported greater feelings of exclusion after the exclusion condition in Cyberball (Heeren et al., 2017). These results emphasized that social anxiety might be associated with difficulty to regulate feelings following exclusion and recovering from social exclusion (Oaten at al., 2008). Two studies using event-related potential (ERP) responses to social exclusion in Cyberball also reported associations between neural responses to social exclusion and individual differences in self-reported distress in young adults (Crowley et al., 2009) and children (Van Noordt et al., 2016). The current findings are in line with previous findings of heightened behavioural and neural responses to social exclusion, further providing support for the crucial role of social anxiety in responses to social exclusion.

The current results did not show any associations between the physiological markers and self-reported experiences of exclusion (supporting Kelly et al., 2012). The lack of correlations with the SCLs in the present study might be due to using overall SCLs during exclusion as predictors, not the responses at the exact period time when the exclusion occurred. Therefore, future studies should carry out time-sensitive analysis in order to investigate the relationship between feelings of exclusion and phasic psychophysiological correlates of exclusion.

3.4.4. Limitations

The current study has a number of limitations, one of which was the fixed sequential order of the inclusion and exclusion conditions. This decision was made based on the previous studies which have suggested that the effect of exclusion can only be observed after being included (Williams & Jarvis 2006; Williams, 2007). However, since all participants completed the inclusion condition followed by the exclusion condition without another baseline period in between, arousal levels may have been impacted. Furthermore, the participants already knew the game when they started the exclusion condition, and therefore, the novelty effect was absent. This might also explain why participants, especially NT participants, started the exclusion condition with lower arousal levels, which did not increase overall. Alternatively, the lack of increased arousal levels during exclusion could be due to less immersive 2D nature of the Cyberball game. Administering more ecologically valid, 3D Cyberball paradigms or real-world tasks might elicit stronger feelings of exclusion (Venturini & Parsons, 2018).

Another limitation of the present study was the lack of comparison conditions with no financial manipulation, but only the experience of inclusion and exclusion. This would provide the opportunity to differentiate between the social and monetary components in the inclusion and exclusion conditions. However, adding these conditions using a between-subject design would require a larger sample size, especially in the ASD group. Therefore, the current results should be interpreted with caution as it is not possible to directly tell whether they reflect the social (e.g. inclusion versus exclusion) or financial (loss versus earn money) aspects of the game. Even though the self-reports demonstrated that inclusion and exclusion condition led to different fundamental needs in all participants, future work is warranted to investigate the social and monetary components of the Cyberball game separately in each condition.

Another limitation was that the present study did not measure the recovery from social exclusion, which might be experienced differently especially in autistic individuals. For example, patients with SAD displayed atypical neural and psychological responses to recovery phase following exclusion phase, but not during inclusion or exclusion condition (Heeren et al., 2017). Therefore, given the higher social anxiety symptoms in the present ASD sample, it is particularly important to examine the recovery from immediate social exclusion and how it affects the subsequent prosocial behaviour in ASD (Panasiti, Puzzo, & Chakrabarti, 2016). Lastly, the reliance on self-reports to measure autistic traits and mental health could be problematic, especially for autistic participants as they might find it harder to identify and label their internal processes (Berthoz & Hill, 2005). Moreover, adding a state measure of anxiety and depression after each condition in Cyberball could give more insight into experiences of immediate distress during exclusion in neurotypical and autistic participants.

3.4.5. Conclusion

Overall, the current study demonstrated that autistic and NT participants experienced similar feelings of exclusion even when it was made financially beneficial to be excluded, suggesting that autistic individuals can detect and feel being excluded which contrast with the assumptions of the SMT. However, mood was not affected by being excluded in either group, and it was overall lower in ASD. The psychophysiological responses of SCL differed between the groups such that autistic participants had higher arousal levels overall, which did not change from inclusion to exclusion condition. The arousal levels of NT participants decreased significantly from inclusion to exclusion condition. These results suggested that psychophysiological responses of autistic individuals might be less sensitive to task manipulations (Edmiston, Jones, & Corbett, 2016) and/or difficulty with habituation in exclusion. Overall elevated arousal levels during exclusion in autistic individuals in comparison to NT participants might indicate atypicalities in the ANS activity, which might underline some of the social difficulties associated with ASD (e.g. emotion regulation; Song, Liu, & Kong, 2016). Further research is required to make firm conclusions and to understand whether overall higher arousal and general reduced flexibility/reactivity of autonomic arousal is related to social difficulties in autism (e.g. flexible adaptations in social interactions). Furthermore, the psychophysiological responses to exclusion was highly heterogeneous within the ASD group, suggesting there might be individual differences in experiences of exclusion in ASD, which requires further investigation.

The discrepant results between the self-reported experiences and psychophysiological markers of exclusion emphasized the importance of adapting a multi-method approach in understanding social behaviour. Moreover, using other measures of psychophysiology, such as heart rate, might give further insights into the processing of negative social cues. Lastly, the associations between higher social anxiety and elevated feelings of exclusion across-participants emphasized that social anxiety seems to play an important role in experiences of online exclusion, more so than autistic traits, which is crucial for the current PhD. The role of social anxiety in negative social experiences, such as peer rejection, should be further investigated in autism but also in individuals who do not have autism, and it will be possible to probe this issue further in in the next chapter.

Chapter Four: Social Judgements and Psychophysiological Responses to Social Rejection in Autism

The findings from Chapter 3 emphasized that young adults with ASD can detect and experience social exclusion as their NT peers, despite differences in psychophysiological reactions to exclusion as indicated by SCLs. However, several issues were raised in this study, such as the lack of conditions to allow direct comparisons between social and non-social aspects of the behaviour, SCL as a measure of task engagement but not social exclusion, and the continuous nature of the paradigm not allowing for analysis of phasic responses to exclusion (see section 3.4.1). Therefore, the study described in the current chapter administered another experimental paradigm to probe social motivation in individuals with ASD, while considering the limitations in Chapter 3. This paradigm is different from the Cyberball game in Chapter 3, such that (1) it is a social "rejection" paradigm, (2) it assesses more discrete/phasic responses (3) using heart rate (HR), and (4) it assesses the social and non-social aspects of the behaviour in two separate tasks completed in parallel. This is the first study to administer this paradigm to autistic individuals to probe social rejection as an indicator of social motivation in comparison to age-matched NT individuals, and it is particularly useful in understanding the potential negative social experiences experienced by some adults with ASD.

4.1. Introduction

Using the same participants as Chapter 3, the current study administered another behavioural paradigm, namely the Social Judgement Task (SJT; Somerville, Heatherton, & Kelley, 2006). The SJT was designed to investigate the underlying mechanisms of social rejection (e.g. social negative feedback) and cognitive negative feedback independently in NT participants. In this task, participants were asked to send their profile picture to the researcher and were told that this picture would be judged by a panel of students from another university who would form first impressions of them. On the day of the experiment, participants were presented with the pictures of other students who they were told had already made a judgement about them based on the picture they sent. Then the participant guessed whether this person presented on the screen liked them or not. This was followed by feedback either indicating social acceptance – "Yes" or indicating social rejection by the other person – "No". In reality, nobody had seen the profile picture of the participants and all feedback was randomly generated by the computer. To make sure that this response was specific to social rejection/acceptance and not to general negative feedback processing, participants completed a control task where they guessed the age of the same faces/people – "Age Judgement Task" (AJT). Previous research using this paradigm has found that adults showed unique neural responses to unexpected negative social feedback (social rejection) compared to positive social feedback (social acceptance) and non-social negative feedback in the AJT, suggesting a specific mechanism responsible for detecting social rejection in neurotypical individuals (Somerville et al., 2006).

4.1.1. The SJT as a measure of social motivation

Typically, being involved in a social group is very important in evolutionary terms, and therefore people constantly pursue social acceptance by others while avoiding rejection (Baumeister & Leary, 1995; Baumeister, Brewer, Tice, & Twenge, 2007; Baumeister et al., 2008), to an extent that they display emotional, physical and social distress when they experience social rejection (Eisenberger & Lieberman, 2004; Eisenberger et al., 2006; Leary, Koch, & Hechenbleikner, 2006). Social rejection can also impact upon mental health, such as contributing to depression (Slavich et al., 2010) and anxiety (Baumeister & Tice, 1990). Therefore, to be judged as *unlikeable* by another person is a threatening situation to the survival and well-being of the individual (Leary et al., 2006). As discussed in Chapter 2, the SMT proposes that individuals with ASD would have reduced responses to social rejection compared to neurotypicals due to their diminished interest to engage and maintain relationships with others (Chevallier et al., 2012). Therefore, the rationale of the current study for using the SJT to probe social motivation was to explore how autistic young adults would respond to being rejected by other young adults.

Throughout evolution, the human brain has developed a special neural circuit to detect and cope with rejection by others (Lieberman, 2013). The negative effects of social rejection on neural and psychophysiological reactions have been consistently reported in the literature using the SJT. The first study that investigated the psychophysiological responses during SJT, which is also the study to be replicated in this chapter, recruited university students (n = 27, age range = 18-25 years) who believed they were being judged by their fellow students at the university (Gunther Moor, Crone, & van der Molen, 2010). The researchers used 120 pictures, which were taken from the students enrolled in another university. The participants were administered both the Social and Age Judgement Tasks as described above, in a counterbalanced fashion. In the SJT, participants were presented with the pictures of other university students and they guessed whether they liked them – 'Yes' or not – 'No'. The feedback was given following the response of the participant indicating either acceptance – 'Yes' or rejection – 'No'. The age judgement task was highly similar to the SJT except for the type of judgement made, as the participants guessed whether the person presented on the screen was 21 years old or older. Meantime, the behavioural (percentage of 'Yes' and 'No' trials) and cardiac responses (inter-beat intervals) of the participants were monitored in both tasks. All the feedback was given randomly by the computer resulting in 50% of 'Yes' and 50% 'No feedback. As a result of the combination between participants' responses and the feedback, there were four types of trials; No/No – expected rejection, Yes/No - unexpected rejection, No/Yes - unexpected acceptance, Yes/Yes - expected acceptance. The most interesting trials to test the effect of social rejection were 'Yes/No' trials in SJT as they indicated unexpected social rejection. These trials were compared to other 3 types of trials in SJT to test the unique effect of unexpected social rejection and they were also compared to non-social negative feedback in the AJT (i.e.'Yes/No' and 'No/Yes' trials) in order to test whether responses were more pronounced than to general negative cognitive feedback. The final analysis conducted with 22 participants demonstrated that university students showed transient heart rate slowing only during unexpected social rejection trials.

The researchers in this study explained their results in terms of the role of the parasympathetic nervous system in regulating stress to adapt functional behaviour. The autonomic nervous system (ANS) is involved in detecting subtle social rejection cues and activating an alarm system (Eisenberger & Lieberman, 2004; Porges, 2009). While sympathetic nervous system activation leads to faster heartbeats, the parasympathetic nervous system leads to slower heartbeats and is associated with parasympathetic vagal regulation, especially when encountered with stressful situations (Porges, 2001, 2003). The slowing of the heart rate as a response to negative affect serves a crucial regulatory function required to produce an adaptive behaviour (Thayer & Lane, 2000). For example, longer cardiovascular activation after negative but not positive emotions in NT adults (Brosschot & Thayer, 2003) and slower heartbeats during social challenge but not physical challenge in children (Heilman et al., 2008) support the role of cardiac deceleration in self-regulation following social distress (Appelhans & Luecken, 2006). Therefore, investigating the changes in individual heart beats (e.g. fastening or slowing) is an important psychophysiology measure to probe social information processing in neurotypical and atypical populations.

In a follow-up study by the same researchers using both HR and EEG measures, Gunther Moor and colleagues (2014) investigated the role of gender and developmental differences in social rejection sensitivity among children between 8 and 14 years old. The cardiac slowing response to unexpected social rejection occurred only among children 11-14 years old and females in this age range showed significant cardiac slowing to social rejection compared to boys of the same age. These results suggested that adolescents were more sensitive to peer rejection than younger children and that the effects were heightened in adolescent girls (Gunther Moor et al., 2014). Previous research with adult females using both heart rate and EEG measures has also reported cardiac slowing and larger P3 amplitudes as a response to unexpected social rejection (Dekkers et al., 2015; Van der Molen et al., 2014; Van der Veen et al., 2014). Given the role of P3 in orienting response to salient social stimuli (Hajcak et al., 2007), these results suggest that unexpected negative social feedback might attract more attention and lead to heightened electrocortical activity to process this social rejection (compared to social acceptance).

In addition to neural and psychophysiological responses to social rejection, the SJT provides behavioural data in terms of participants' judgements about their likeability by others. In the SJT, if the participants make "Yes" predictions more than 50% of the task, indicating a tendency to expect to be *liked*, it is classified as "positive expectation score", whereas making "No" predictions more than 50% of the task, indicating a tendency to expect to be *disliked*, is classified as "negative expectation score".

Previous studies found positive expectation scores in NT individuals suggesting that they more often predicted to be liked than not liked by others (Gunther Moor et al., 2010; Van der Molen et al., 2017; Van der Molen et al., 2014). However, one study did not show any differences between positive and negative expectation scores as participants equally expected to be liked and not liked (made 50% of "Yes" and "No" predictions; Van der Veen et al., 2014a). These results emphasized a general positive self-bias in neurotypical individuals, while there have not been any studies to show negative self-evaluation in neurotypical participants. However, there is some contrasting evidence for lack of positive self-bias in some studies which suggest that there might be individual differences in how individuals evaluate themselves and this might be impacted by other factors such as sensitivity to rejection and anxiety.

Overall, the studies of the SJT in NT adolescents and adults using psychophysiology and neural measures have consistently shown that unexpected social rejection is processed differently than non-social negative feedback and it evokes stress-related responses involved in processing and regulation of social threat. Therefore, the SJT is considered a valid measure to probe social rejection. However, to date, it has not been studied to probe social motivation or specifically responses to social rejection, in autistic individuals.

4.1.2. Responses to social judgements in ASD

Since the SJT has not been administered to autistic participants and there is not much research on how individuals with ASD predict others' judgements about themselves, our existing knowledge about social judgments in ASD comes from only a few studies. For example, individuals with autism had difficulties making accurate judgements when rating faces on trustworthiness (Adolphs, Sears, & Piven, 2001), approachability (Philip et al., 2010), and kindness (Forgeot d'Arc et al., 2016) compared to NT individuals. Moreover, one study found atypical psychophysiological responses when autistic adults make facial judgements of trustworthiness such that they had higher arousal throughout the face viewing time, unlike neurotypical participants whose arousal declined over stimuli repetition (Mathersul, McDonald, & Rushby, 2013). The atypical psychophysiological responses in this study occurred despite the similar behavioural ratings of autistic participants and controls. However, all these studies have investigated how individuals with ASD make judgements about others, which is qualitatively different than responding to being judged by others as making inferences about what another person thinks or believes about you requires meta-perception abilities (Kenny, 1994). There is only one study that has investigated how autistic individuals responded to the ways others judge them based on their personality traits (Sasson et al., 2018). The researchers found that autistic adults were less accurate in their predictions of how their own personality traits would be predicted by others, suggesting atypical attribution of mental states and emotional significance to others and impaired meta-perception (e.g. the ability to make inferences about what another person thinks about you). However, none of these studies has investigated how individuals with autism *react* when they believe that others are making judgements about *them* and what psychophysiological processes are involved in this process of social acceptance or social rejection.

Investigating how individuals with ASD respond to social judgements, especially when they are judged as *unlikeable* by another person, may be particularly relevant to ASD and the social experiences of young adults with this developmental disorder. Many autistic young adults experience loneliness, isolation, peer rejection, and bullying due to their difficulties with social skills and lack of a social support network (Chown & Bevan, 2012; Van Hees, Moyson, & Roeyers, 2015; White, Ollendick, & Bray, 2011; DeNigris et al., 2018). Moreover, as a result of having difficulty engaging in social interactions from a young age and failing to learn from them, adults with autism might be more vulnerable to peer rejection (Chevallier et al., 2012). In addition, due to the assumption of low social interest in ASD, neurotypical individuals might have lower expectations of inclusion and social reciprocity in their interactions with autistic individuals (Cage et al., 2013; also see section 2.8). For example, recent empirical research has shown that autistic adults were perceived less favourably by their NT peers, who also reported to be less willing to approach and maintain social interactions with autistic individuals (Sasson et al., 2017). The reason why individuals with ASD are perceived as unlikeable, and therefore more prone to social rejection, could be due to the fact that their mental states are found difficult to be read by others (Anders et al., 2016). According to recent empirical evidence, autistic individuals who were rated as difficult to read were also more likely to be rated as less favourable

(Alkhaldi, Sheppard, & Mitchell, 2019). Overall, frequent experiences of social rejection and being perceived less favourably by others might have an impact on autistic individuals' reactions to social judgements of likeability. For example, individuals with ASD might expect to be rejected more often and display atypical reactions to being rejected. Therefore, it is important to study reactions to social rejection in autistic individuals to understand whether their reactions would be different due to frequent experiences of social rejection in ASD.

4.1.3. Social rejection and mental health in ASD

As discussed in Chapter 2, mental health difficulties, especially social anxiety and depression, might have an impact upon social interactions and social experiences in autism. Alternatively, high rates of experiences of social rejection, bullying, and isolation might create a risk for developing anxiety or depression. Indeed, frequent experiences of social rejection and loneliness as mentioned above (McLeod, Meanwell, & Hawbaker, 2019) might explain high rates of depression and social anxiety in autistic individuals (Jackson et al., 2017; Storch et al., 2012). Given the moderating role of rejection sensitivity in developing depression and anxiety in NT individuals (Gao et al., 2017) and early life events of rejection leading to development of depression via changing the neurobiological responses (Slavich et al., 2010), it is crucial to investigate the associations between social rejection and mental health, such as social anxiety and depression, especially in young adults with and ASD.

There is only one study which investigated the role of social anxiety in social rejection by using the SJT in family members of individuals with social anxiety disorder (SAD) (Harrewijn et al., 2018). The researchers found different neural responses (e.g. hypervigilant) to unexpected social rejection in family members of individuals with SAD compared to participants with no family history of SAD. The hereditary link between social anxiety and social rejection as demonstrated in this study emphasized the important role of social anxiety in social rejection sensitivity, which has not been yet studied in ASD. The relationship between social anxiety and experiences of social rejection is especially relevant to ASD as autistic individuals have been reported to have higher social anxiety symptoms in previous studies and in Chapter 3 (see Section 3.3.1). Moreover, examining the association between mental health, especially social anxiety and depression, and social rejection would provide insights into understanding heterogeneity in social motivation, as discussed in Chapter 2. Therefore, the current study aimed to further examine the relationship between experiences of social rejection and mental health in individuals with and without ASD. Given the significantly higher social anxiety symptoms in the ASD group compared to the NT group, but not any group difference in depression symptoms in Chapter 3 (see Section 3.3.1), social anxiety was expected to have a bigger role in experiences of social rejection in the present sample.

4.1.4. Current Study

The current study was the first to investigate the behavioural and psychophysiological (heart rate) responses to social rejection to probe social motivation in young adults with and without ASD. To this end, the SJT as described in Gunther Moor et al. (2010) was used. Firstly, i) NT participants were expected to have higher positive expectation scores compared to participants with ASD. Given the frequent previous experiences of social rejection in ASD, ASD participants would have lower positive expectation scores in comparison to NT participants. In terms of heart rate responses, ii) we expected to replicate the results from Gunther Moor, et al. (2010) such that NT participants would show a specific cardiac slowing response to 'Yes/No' condition in SJT (unexpected *social rejection*), and iii) this response would be unique to social negative feedback and therefore would not occur during non-social cognitive negative feedback in the AJT. On the other hand, iv) it was expected that participants with ASD would respond less to unexpected social rejection, which would not be different than their responses to non-social negative feedback in the AJT, due to reduced social motivation for being liked by others and/or a reduced social prioritization in ASD, as suggested by the SMT. Lastly, v) the associations between the predictions of rejection (e.g. negative expectation scores) and psychophysiological responses to social rejection, autistic traits, social anxiety, and depressive symptoms were investigated across all participants. Similarly to Chapter 3, a neurodiverse approach including all participants was adapted to investigate the roles of other factors in experiences of social rejection, regardless of the diagnosis. Based on the previous literature, it was expected that higher autistic traits, social anxiety and depression symptoms would be associated with more predictions of being rejected by others in all participants.

4.2. Methods

4.2.1. Participants

The same participants as Chapter 3 were recruited for the current study (see Section 3.2.1 for participants' characteristics). As discussed in Chapter 3, one NT participant who had a DASS-21 score of 112 was excluded from the analysis. All the remaining participants completed both behavioural and psychophysiology measures, resulting in 20 participants with ASD (11 males, mean age = 23.58 years, SD = 4.33) and 39 NT participants (20 males, mean age = 22.86, SD = 4.17) in the final analysis. The same participant in the ASD group as Chapter 3 did not fill in the social anxiety questionnaire, and therefore was not included in the regression analysis. The participants performed the current study in the same testing session to Chapter 3.

4.2.3. Measures

Social Judgement Task (SJT)

An adapted version of the SJT used by Gunther Moor, Crone and Van Der Molen (2010) was administered. The SJT involves participants judging the photos of their "peers" in terms of whether they expect this person would like them or not. In order to do that, participants were asked to send a profile picture (e.g. a neutral expression head and shoulder shot), to the researcher approximately two weeks before the experiment. An example profile picture with a neutral expression on a white background was sent to the participant by email and participants were asked to provide a similar ID-style picture. Participants were told that their picture would be cropped to remove visible clothing. Participants were then told that their picture would be sent to a panel of university students who would judge whether they liked them or not based on the ID picture they sent. In reality, the pictures sent by the participants were not sent to anyone else and they were deleted immediately. There was not a panel to judge the picture of the participants either. Instead, 121 photos of faces (61 female and 60 male faces; 102 Caucasian, 4 African-American, 8 Asian, and 6 Hispanic) with neutral expressions on a white background (measuring 3.9 x 4.5 cm) were taken from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015) and used as a "peer group" in the experiment. The age (α = 0.896) and attractiveness (α = .998) of the pictures were all rated and the pictures standardized by the researchers who developed the database.

On the day of the experiment, participants were instructed that the current experiment was part of a big project about first impressions including likeability, age, ethnicity, etc. They were told that the first impressions are important because they influence our behaviour towards the other person, such as starting a conversation or not. In the first task – SJT –, participants were told that their peers from another university had seen their profile picture and made a judgement about whether they liked them or not. Now, they would be presented with the picture of their peers and they would estimate whether they liked them or not. And then, it would be their turn to make judgements about them.

The timeline of the paradigm can be found in Figure 4.1. Each trial started with a fixation point for 1000 ms. Then the picture (cue) was presented for 3000 ms and it stayed on the screen until the end of the trial. During the presentation of the picture, the question "Do you think this person liked you?" was presented on top of the picture. Participants responded 'Yes' by pressing on '1' to indicate that they thought the person in the picture liked them or 'No' by pressing '3' to indicate that they thought the person in the picture did not like them. The participants' response was shown on the left side of the picture. After a delay of 1000ms, the participants were provided with a 'Yes' (the person in the picture liked them – *acceptance*) or 'No' feedback (the person in the picture did not like them – *rejection*) presented on the right side of the picture. The feedback remained on the screen for 2000ms. If the participants did not respond within 3000ms, the feedback 'too late' was given.

Likeability ratings

Before and after the SJT, participants were asked to rate how they *would be* reviewed by others who saw their picture (before) and how they *had been* reviewed (after). They used the mouse to choose on a scale from 1 (*no one likes you*) to 10 (*everyone likes you*) to indicate their answer.

Age Judgement Task (AJT)

After the SJT, participants were reminded that this study was part of a larger project about first impressions and other judgements such as age and ethnicity were also important factors to create first impressions about others. They were then told that it was the participant's turn to make a judgement about the other person.

The AJT was very similar to SJT except for the type of judgement participants needed to make; the "age" of the person presented on the picture. The participants were presented with the same face stimuli as the SJT but this time they had to estimate whether the person in the picture was 21 years old or older. Therefore, the AJT required participants to make judgements about the other person, while the SJT required participants to make a judgement about how they feel the person in the picture is judging them. This difference between the tasks might imply that the SJT involved more meta-perception abilities than the AJT.

In the AJT, first, the participants were presented with the face stimuli for 3000ms and made a judgement about the age of the person in the picture. They responded 'Yes' by pressing on '1' to indicate that the person on the picture was 21 years old or older or 'No' by pressing '3' to indicate that the person on the picture was younger than 21 years old. As in the SJT, participant's responses were presented on the left-hand side of the screen. One thousand milliseconds after the participant's response, the 'Yes' (the person on the picture is 21 years old or older) or 'No' feedback (the person on the picture is younger than 21 years old) was provided on the screen for 2000ms (see Figure 4.1).

Experimental Design

All participants completed the SJT first and then the AJT. This decision was based on the cover story told in the beginning of the experiment, which stated that participants would first estimate the judgements of others (e.g. the SJT) and then they would judge the people who had already judged them before (e.g. the AJT) (see Appendix D for the full cover story). The feedback was randomly created by the computer programme such that there were 50% 'Yes' and 50% 'No' feedback trials in both tasks. The combination of these two feedback conditions and participants' responses resulted in four different conditions in both tasks. These were 'Yes/Yes', 'Yes/No', 'No/Yes', and 'No/No' trials. The negative feedback conditions in SJT were 'Yes/No' (when the participant anticipates *acceptance* but receives *rejection*) and 'No/No' trials (when the participant accepts *rejection* and receives *rejection*). The negative feedback conditions in AJT were slightly different: ‘Yes/No’ (when the participants thought the person on the picture was 21 years old or older but s/he was not) and ‘No/Yes’ trials (when the participants thought the person on the picture was younger than 21 years old but s/he was not).

Behavioural and psychophysiological data were collected throughout the two tasks. Behavioural data consisted of the percentage of 'Yes’ and ‘No’ responses given by the participants and they were used as the dependent variable (DV) in the behavioural analysis. If the participant made more than 50% of ‘Yes’ predictions, it would indicate a positive expectation score (that the participant expected to be liked) and if the participant made more than 50% of ‘No’ predictions, it would indicate a negative expectation scores (that the participant expected not to be liked). For the DV in the psychophysiology analysis, the mean of cardiac responses following the feedback was calculated and grouped under each feedback condition.

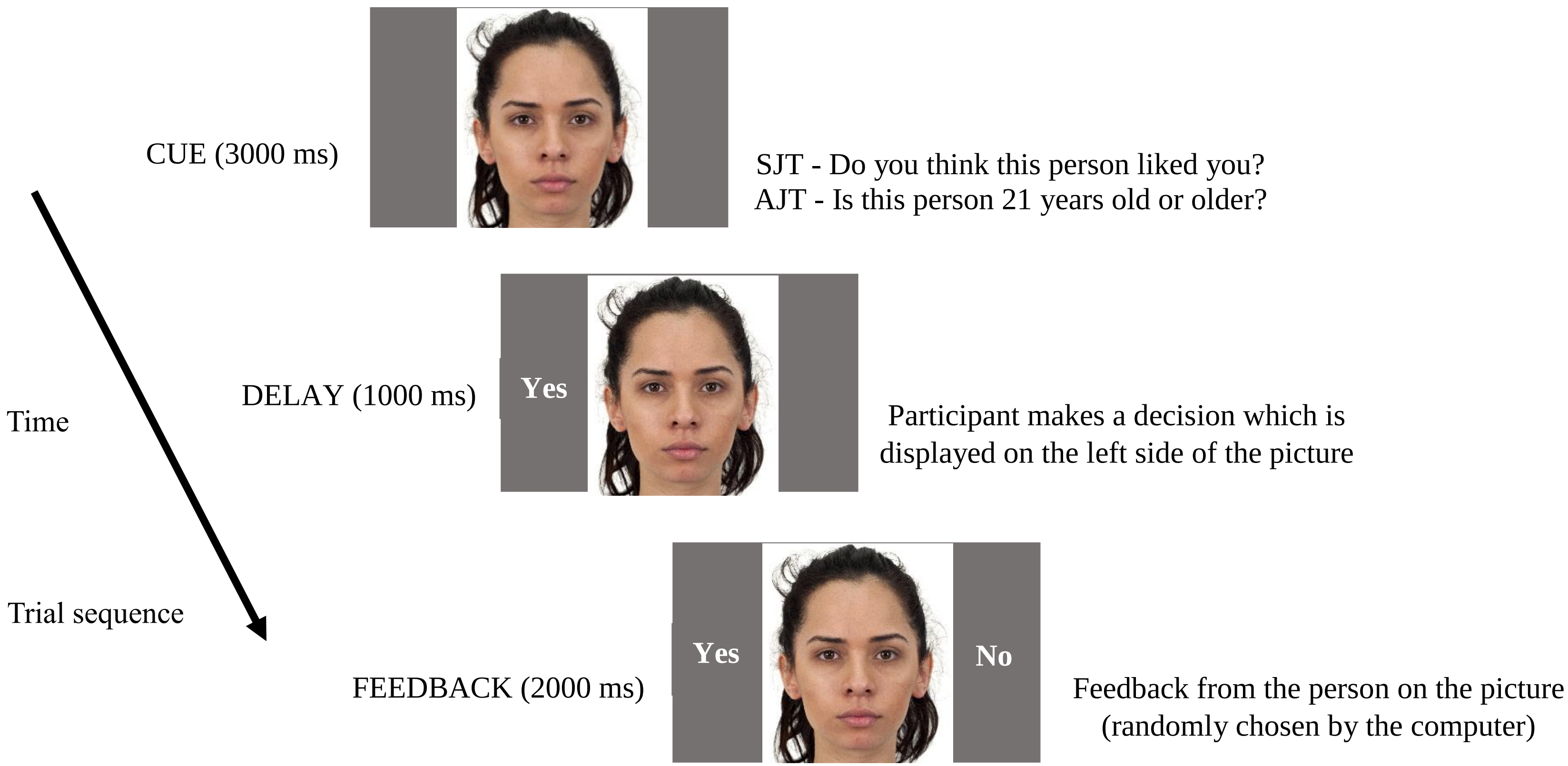


Figure 4.1. The timeline of the SJT and AJT. After a fixation point for 1000ms, the participant answered the question "Do you think this person liked you?" in the SJT or "Is this person 21 years old or older?" in the AJT. The response of the participant "Yes" or "No" was presented during the delay for 1000ms. The feedback from the person on the picture "Yes" or "No" was presented on the right side of the picture for 2000ms.

Self-report measures of social anxiety and depression

The same self-report measures of DASS-21 (Lovibond & Lovibond, 1995) and LSAS (Liebowitz, 1987) as Chapter 3 were administered in the current study (see section 3.3). As reported in Chapter 3, one neurotypical participant with DASS-21 score of 112 was excluded from the analysis.

4.2.4. Procedure

The participants completed two behavioural paradigms in one experiment session. The first paradigm – Cyberball – is reported in Chapter 3. Before the start of the experiment session, all participants signed the consent form and filled in a short demographic questionnaire. Then, the participants were prepared for psychophysiology assessment including all the measures used in Chapter 3 and Chapter 4. All experiment sessions were run in a quiet laboratory.

Before the second paradigm presented in the current Chapter, participants were given the cover story. The electrocardiogram (ECG) responses were recorded from two Ag-AgCL (silver-silver chloride) electrodes attached on the chest and the left rib. The participants completed the SJT followed by the AJT. Before each task, the participants were given verbal instructions on the task and they did 4 practice trials to familiarize with the task, which was followed by 121 trials in total, with a break after the 60th trial. After the experimental session, participants filled in self-report questionnaires including AQ, LSAS, and DASS-21 before they were debriefed about the task. In debriefing, it was clearly stated that their pictures were not sent to anybody and nobody made a judgement about them, and all the feedback was randomly created by the computer (see Appendix B for debrief). They were also asked whether they believed that the task was real. A few participants reported that they doubted it at the end, but they were not entirely sure. Therefore, none of the participants was excluded from the final analysis.

4.2.5. Data analysis

Preparation of Psychophysiology Data

Throughout the experiment, the ECG responses were recorded by using *Acqknowledge* software 4.1 (Biopac System Inc.) at a sampling rate of 1000 Hz. In order to reduce noise and artefacts in the signal, the recorded heartbeats were filtered using a low pass filter with a cut-off frequency of 35 Hz. After identifying the peaks for each heartbeat (defined as QRS peaks), the time period from one peak to the next was calculated and defined as inter-beat intervals (IBIs). 6 IBIs were detected for each trial; one before the feedback (IBI-1), one during the feedback (IBI0), and four after the feedback (IBI1-IBI4). IBI-1 was used as a reference and the change scores were calculated by subtracting each following IBI from IBI-1, resulting in difference scores for IBI0, IBI1, IBI2, IBI3, and IBI4. In order to check whether participants went back to baseline before they started each trial, statistical analyses on IBI-1values before the feedback were conducted and no differences were found between the feedback conditions in either tasks (*p*s >.11), therefore they were not included in the data analysis.

Data Analysis Plan

As the first aim of the current study was to test whether the NT group or the ASD group would have higher positive prediction scores, one-sample *t*-tests were carried out with each group separately to check whether the expectation score differed significantly from 50% (Kortink et al. 2018; Dekkers et al. 2015; van der Veen et al. 2014). The likeability ratings before and after the social judgement task were also analysed by performing mixed-model repeated-measures analysis of variances (RM ANOVA) with the within-subject factor of Time (2; before, after) and the between-subject factor of Group (2; ASD, NT). Alpha level of $p < .05$ was applied. Bonferroni correction was used for post hoc analyses and Huynh-Feldt corrections for violations of the assumptions of sphericity were used when necessary (Vasey & Thayer, 1987).

The main aim of the current study was to investigate the differences in cardiac responses to unexpected social rejection between the NT and ASD group. To this end, a mixed-model RM ANOVA with the within-subject factor of Feedback (4; no/no, yes/no, no/yes, yes/yes) and between-subject factor of Group (2; ASD and NT) was run to investigate group differences in cardiac responses during each feedback condition. The cardiac responses that went into the RM ANOVA as the dependent variable were defined by averaging the IBI responses associated with each feedback condition. The same RM ANOVA was repeated for the AJT. The main and interaction effects were followed up by post hoc analyses with Bonferroni corrections. In order to test whether responses to unexpected social rejection in the SJT could not be explained by responses to any negative feedback (e.g. non-social feedback) in the AJT, the following two comparisons were made for each group; mean of IBI responses during the 'Yes/No' feedback condition in the SJT to (1) mean of IBI responses during the 'Yes/No' and (2) 'No/Yes' feedback condition in the AJT.

As the last aim of the current study was to understand the roles of other factors in experiences of social rejection adapting a neurodiverse approach, Pearson bivariate correlations between negative expectation scores, cardiac slowing to unexpected social rejection, AQ, LSAS, and DASS-21 depression scores were calculated across participants. After correction for multiple correlations, hierarchical regression analyses were performed to examine whether AQ, LSAS, and DASS-21 depression scores would predict behavioural and psychophysiological responses to social rejection across participants.

4.3. Results

4.3.1. Group comparisons in self-report measures

See Chapter 3 (section 3.3.1.) for group means and differences in AQ, LSAS, and DASS-21 total scores. The ASD group had higher AQ and LSAS scores compared to the NT group, however the DASS-21 depression scores did not differ between the two groups.

4.3.2. Behavioural Checks

To check whether there were similar number of trials for each feedback condition, which would allow to make comparisons between the feedback conditions in each task, a RM ANOVA with within-group factors of Task (2; SJT, AJT) and Feedback type (4; No/No, No/Yes, Yes/No, Yes/Yes) was conducted. The main effect of Feedback type was not significant, assuring that comparisons could be made between the feedback conditions in subsequent analysis, $F(3, 174) = 1.500$, $p = .23$, $\eta_p^2 = .025$. There was a significant main effect of Task, $F(1, 58) = 4.856$, $p = .032$, $\eta_p^2 = .077$, such that there were more 'No/Yes' trials in the SJT compared to the AJT ($p = .023$)

and there were more Yes/Yes trials in the AJT compared to the SJT (p = .003). The number of No/No and Yes/No trials did not differ between the tasks. The mean and SD of trial numbers for each feedback type and task are presented in Table 4.1.

Table 4.1. Mean and SD of number of trials per feedback condition for the Social Judgement Task and Age Judgement Task

Feedback type	SJT	AJT	Between task differences (*p*-value)
No/No	30.20 (8.80)	27.78 (6.54)	.094
No/Yes	30.78 (8.82)	27.51 (7.08)	.023
Yes/No	29.97 (8.58)	31.88 (7.24)	.168
Yes/Yes	28.83 (9.01)	33.08 (7.30)	.003

4.3.3. Behavioural Results

Social Judgement Task

First, the positive expectation scores were investigated (as described in detail in section 4.2.5.2.). The results showed that there was not a positive expectation bias (the tendency to predict acceptance) in the NT group, $t(38) = .754$, $p = .456$, $d = 0.12$ and neither was there a negative expectation bias as the group mean was not significantly different from 50% (see Table 4.2). In the ASD group, the participants were less likely to make 'Yes' predictions (44.25%) compared to the NT group (51.45%), however, this was also not significantly different than 50% indicating neither a positive nor negative expectation bias, even though the effect size was medium, $t(19) = -1.789$, $p = .09$, $d = 0.40$. Therefore, there was not a positive expectation bias during the social judgement task in either of the groups.

The results of mixed-model RM ANOVA with likeability ratings before and after the social judgement task showed a significant main effect of Time, $F(1,57) = 11.140$, $p = .001$, $\eta_p^2 = .163$ with lower scores after the SJT, a significant main effect of Group, $F(1,57) = 4.676$, $p = .035$, $\eta_p^2 = .076$ with lower likeability scores from ASD participants, and a significant interaction effect of Time and Group, $F(1,57) = 5.837$, $p = .019$, $\eta_p^2 = .093$. Following the interaction effect of time and group, one-way ANOVAs for each group separately showed that NT participants had significantly higher likeability ratings before the SJT compared to after it, $F(1,38) = 22.710$, p <

.001, η_p^2 = .374. However, the likeability ratings of autistic participants did not significantly change from before the SJT to after the SJT, $F(1,19) = .378$, $p = .546$, η_p^2 = .020 (see Table 4.2). Therefore, the likeability ratings were affected differently by the SJT for the NT and ASD groups.

Age judgement task

The percentage of 'Yes' responses made by neurotypical participants was significantly higher compared to a no bias baseline of 50%, $t(38) = 2.995$, $p = .005$, $d = 0.48$, however participants in the ASD group did not show any bias in AJT, $t(19) = .818$, $p = .423$, $d = 0.18$. These results suggested that NT participants considered the people in the pictures to be older than the autistic participants.

Table 4.2. Behavioural results of social and age judgement tasks

Task	Responses (SD)	ASD	NT
AJT	% of 'Yes' judgements	51.70 (9.32)	54.97 (10.36)
SJT	% of 'Yes' judgements	44.25 (14.38)	51.45 (12.02)
	Likeability ratings before the SJT	4.82 (1.42)	6.01 (1.46)
	Likeability ratings after the SJT	4.66 (1.30)	5.3 1.45)

4.3.4. Psychophysiology Results

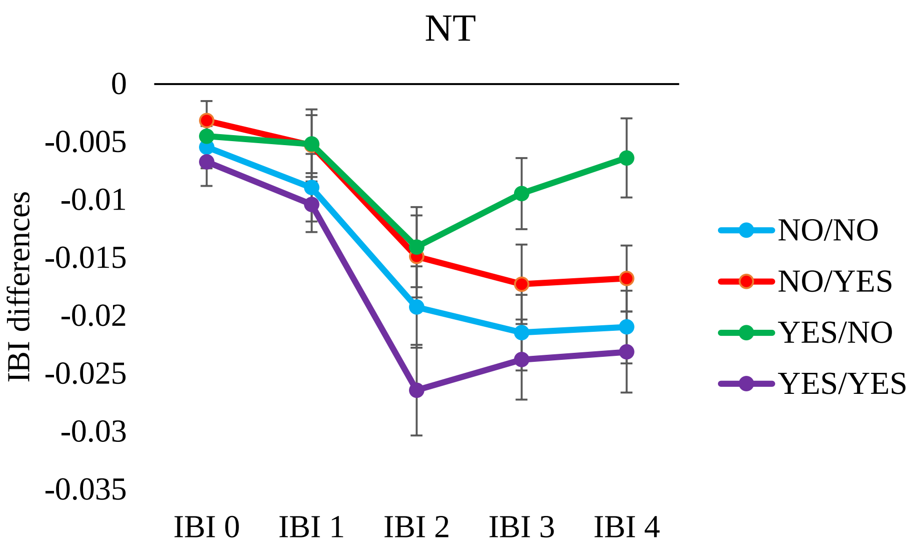
Social Judgement Task

The main goal of the current study was to investigate whether autistic participants responded differently to unexpected social rejection compared to NT participants by examining their cardiac responses. Figure 4.2 illustrates IBI responses associated with feedback processing in the SJT in the NT (Figure 4.2A) and the ASD sample (Figure 4.2B). This figure shows, as expected, cardiac responses were lengthened following feedback at IBI0 (cardiac slowing), followed by a recovery as the IBI responses got shorter again (cardiac fastening). More importantly, cardiac responses at IBI3 and IBI4 during the 'Yes/No' feedback trials in the NT group were longer, indicating more cardiac slowing to unexpected social rejection (see Figure 4.2A), while cardiac responses of IBI3 and IBI4 during both 'Yes/No' and 'No/No' feedback trials were longer in the ASD group (see Figure 4.2B).

Based on the previous literature (Gunther Moor et al., 2014; Gunther Moor, Crone, & Van der Molen, 2010; Van der Veen et al., 2014) and current findings as presented in Figure 4.2., the mean of IBI3 and IBI4 was used as the DV in the psychophysiology analysis. Therefore, the main hypothesis of group differences in cardiac responses to unexpected social rejection was tested by conducting a mixed-model RM ANOVA with mean of IBI3 and IBI4 associated with each Feedback type (4; No/No, Yes/No, No/Yes, Yes/Yes) as within-subject factors and Group (2; ASD, NT) as between-subject factor.

The results revealed a main effect of Feedback type, $F(3, 171) = 13.361$, $p < .001$, $\eta_p^2 =.190$, and a significant interaction effect of Feedback type and Group, $F(3, 171) = 3.224$, $p = .024$, $\eta_p^2 = .054$, however this effect was small. The main effect of Group was not significant with a very small effect size, $F(1, 57) = .028$, $p = .867$, $\eta_p^2 < .001$. The interaction effect of Feedback type and Group was followed up by carrying out ANOVAs with each feedback type for each group separately. In both groups, there was a main effect of Feedback type, ASD; $F(3,57) = 8.701$, $p < .001$, $\eta_p^2 = .314$, NT; $F(3,114) = 10.852$, $p < .001$, $\eta_p^2 = .222$. Bonferroni corrected post hoc comparisons revealed that the cardiac responses for the 'Yes/No' condition (unexpected social rejection) in the NT group were significantly longer compared to all other feedback conditions (all *ps* < .01) and there were not any significant differences between any other feedback conditions (all *ps* > .05). In the ASD group, cardiac responses for the ‘Yes/No’ condition was significantly longer than ‘No/Yes’ ($p = .002$) and ‘Yes/Yes’ conditions ($p = .002$). However, there was not a significant difference in cardiac responses between the ‘Yes/No’ condition and ‘No/No’ condition ($p > .999$). Cardiac responses during ‘No/No’ condition were also significantly longer compared to ‘No/Yes’ ($p = .031$) and ‘Yes/Yes’ conditions ($p = .043$). These results suggested that cardiac slowing was observed specifically during unexpected social rejection in the NT group, however, both unexpected and expected social rejection lead to a cardiac slowing in the ASD group.

A



B

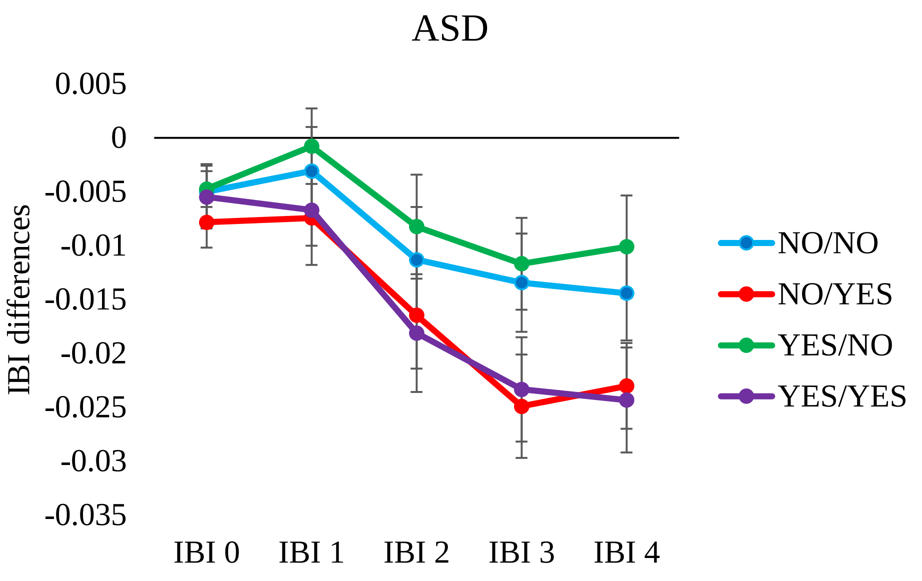


Figure 4.2. Cardiac responses indicated by the IBI difference scores in the SJT. A: Cardiac responses in the NT group (N = 39) for each feedback type. B: Cardiac responses in the ASD group (N = 20) for each feedback type. Error bars indicate the standard error of the mean. The graph shows that autistic participants did not show cardiac slowing during Yes/No trials while NT participants had slower heart rates, revealed by larger IBI3 and IBI4 differences.

Age Judgement Task

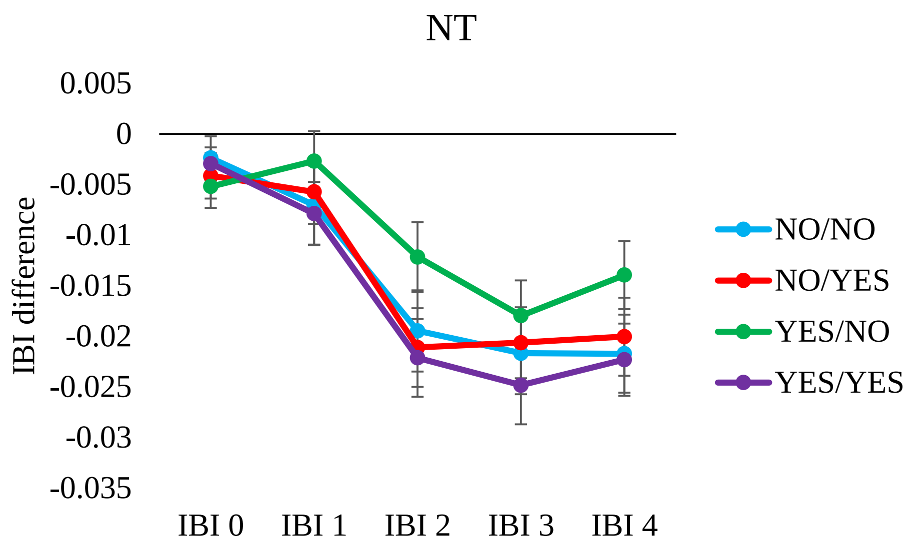
To test whether the cardiac responses to SJT were specific to social rejection and not to negative cognitive feedback, the same analysis was repeated using the data from the AJT. Figure 4.3 illustrates the IBI responses associated with feedback processing in the AJT in the NT (Figure 4.3A.) and the ASD group (Figure 4.3B.). As expected, the cardiac responses were lengthened following feedback (IBI0) and recovered again when they were shortened towards the end of the trial.

The same mixed-model RM ANOVA with the within-subject factor of mean scores of IBI3 and IBI4 associated with each Feedback type (4; No/No, Yes/No, No/Yes, Yes/Yes) and between-subject factor of Group (2; ASD, NT) was performed using the data from the AJT. The results showed that there was not a main effect of Feedback type $F(3, 171) = 3.015$, $p = .088$, $\eta_p^2 = .050$, or an interaction effect of Feedback type and Group as expected, $F(3, 171) = .443$, $p = .722$, $\eta_p^2 = .008$. The results did not find a significant main effect of Group, either, $F(1, 57) = .946$, $p = .335$, $\eta_p^2 = .016$. These results suggested that the feedback conditions in the AJT were not associated with different patterns of cardiac responses in either group.

Comparing cardiac responses between SJT and AJT

Subsequent analyses were conducted to test whether the cardiac responses to unexpected social rejection (e.g. social judgement) were more pronounced than the responses to cognitive negative feedback processing (e.g. age judgement). In order to test this prediction, cardiac responses to unexpected social rejection ('Yes/No' feedback condition) in the SJT were compared with the cardiac responses to negative feedback in the AJT; 'Yes/No' (incongruent older) and 'No/Yes' (incongruent younger) for each group separately. Cardiac responses of NT participants to unexpected social rejection were significantly longer than the cardiac responses to 'Yes/No' condition, $F(1, 38) = 9.281$, $p = .004$, $\eta_p^2 = .196$ and 'No/Yes' condition in the AJT, $F(1, 38) = 9.817$, $p = .003$, $\eta_p^2 = .206$. Therefore, the additional cardiac slowing in NT participants was specific for unexpected social rejection. However, these comparisons did not differ from each other in the ASD group; comparing 'Yes/No' condition in the SJT to Yes/No condition, $F(1, 19) = .091$, $p = .766$, $\eta_p^2 = .005$, and 'No/Yes' condition, $F(1, 19) = .148$, $p = .705$, $\eta_p^2 = .008$ in the AJT.

A



B

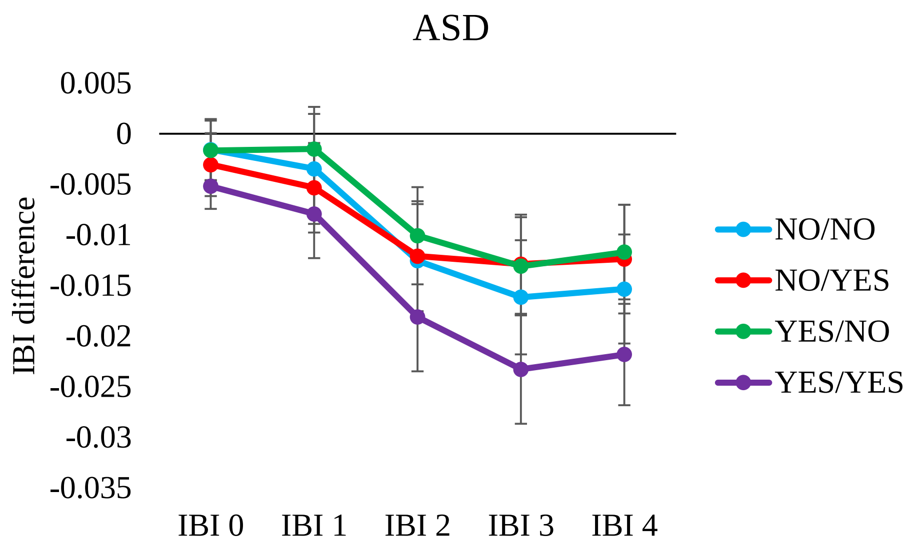


Figure 4.3. Cardiac responses indicated by the IBI difference scores in AJT. A: Cardiac responses in the NT group (n = 39) for each feedback type. B: Cardiac responses in the ASD group (n = 20) for each feedback type. Error bars indicate the standard error of the mean.

4.3.5. Individual differences in experiences of social rejection

In order to test whether behavioural and psychophysiological responses to social rejection were associated with autistic traits, social anxiety, and depression scores across participants, Pearson correlations were performed. As can be seen in Table 4.3, negative expectation scores indicated by percentage of 'No' responses were significantly correlated with autistic traits (r = .356, p = .006), social anxiety (r = .507, p < .001), and depression scores (r = .374, p = .004). Participants with a higher tendency to predict being rejected/disliked by others were more likely to report higher autistic traits, higher social anxiety, and more depression symptoms. On the other hand, cardiac responses to unexpected social rejection were not correlated with any of the self-report measures.

Hierarchical regression with AQ, LSAS, DASS-21 depression scores and cardiac responses to unexpected social rejection as predictors of negative expectation scores found only social anxiety as a significant predictor, β = .507, t(57) = 4.402, p < .001, accounting for 24.4% of the variance. Thus, higher self-reported social anxiety significantly predicted a higher tendency to expect being rejected by others. Adding depression symptoms, autistic traits, and cardiac responses to unexpected social rejection did not improve the model as they were not significant predictors of negative prediction scores (DASS-21 depression subscale; β = .231, t(57) = 1.806, p = .076, AQ; β = -.013, t(57) = -.075, p = .941, cardiac responses to unexpected social rejection; β = .070, t(57) = .582, p = .563). Therefore, while social anxiety might predict approximately 24% of the variance in the expectation of rejection, over 75% of the variance was not predicted by concepts measured here.

Table 4.3. Correlations between experiences of social rejection and autistic traits, social anxiety, and depression symptoms across participants (n = 58)

Variables	1	2	3	4	5
1. Negative expectation score	1	-.037	.356**	.507**	.374**
2. Cardiac responses to Yes/No condition in the SJT		1	.019	-.175	-.170

3. AQ total score	1	.760**	.379**
4. LSAS total score		1	.471**
5. DASS-21 depression			1

** Correlation is significant at the 0.01 level (2-tailed).

4.4. Discussion

4.4.1. Behavioural responses to social rejection in ASD and NT participants

The aim of the current study was to understand how young adults with ASD would respond to being rejected by others compared to their NT peers. In order to answer this question, a validated paradigm was administered to an autistic population. The two tasks, social and age judgement tasks, were identical except for the type of judgement made in each one; social likeability and age, respectively. Following the first hypothesis in the current study, in terms of group averages, neither autistic nor NT participants reported any positive or negative prediction scores, indicating a lack of positive or negative self-evaluation bias. These results demonstrated that autistic and NT young adults might not expect to be liked more or less by other young adults. The lack of positive bias in neurotypical participants in the current study was an unexpected finding as all (Gunther Moor, Crone, & Van der Molen, 2010; Gunther Moor et al., 2014; Van der Molen et al., 2013; van der Veen et al., 2014; 2016) but one previous study has shown a positive expectation (no positive bias found by Van der Veen et al., 2014). These results could be explained by individual differences in self-evaluation bias in the current sample, which was further investigated later in the present study. On the other hand, we expected to find more negative self-evaluation bias in autistic individuals given the literature on frequent social rejection experiences in this group, however, on average, they also did not expect to be disliked more frequently by other young adults. Lack of negative evaluation bias in the ASD group could also be due to huge variability in their responses, which warrants further investigation with a larger sample.

In terms of the likeability ratings, when asked before the SJT, individuals with ASD predicted overall lower ratings of their own potential likeability compared to their NT peers. The autistic group did not change their personal ratings of their likeability after completing the task. However, the NT group had higher ratings of likeability before the SJT, which significantly declined after task completion. These likeability results in both groups were different than the results regarding their self-evaluation bias. In the NT group, even though the participants did not have a positive self-evaluation bias, they had higher ratings of their own likeability before the task, which decreased after the task. These results could be explained by the fact that, NT participants expected to be liked by others at the beginning, but they were more sensitive to being rejected throughout the game and changed their predictions of likeability over time. On the other hand, individuals with ASD were less sensitive to the social rejection in the task and overall expected to be liked less by others. This is an important finding to show that, due to social rejection experiences of autistic individuals in the past, they might be more likely to expect rejection and be more resistant to change their own potential likeability based on their recent experiences. These results imply that experiences of social rejection in ASD might be qualitatively different and have different impact upon their social interactions with others (e.g. friendships) in comparison to NT individuals, which would be further investigated in Chapter 7.

4.4.2. Cardiac responses to social rejection in ASD and NT participants

The main aim of the current study was to investigate whether young adults with ASD would respond differently to being rejected by others compared to NT individuals. In order to do that, cardiac responses during the SJT were investigated as a way to probe social motivation in autistic young adults. According to the SMT and previous literature, autistic individuals were expected to display reduced psychophysiological responses to being rejected by other young adults compared to NT individuals, who would show a specific psychophysiological response to social rejection, but not to non-social negative feedback. Thus, it was hypothesized that NT young adults would display transient cardiac slowing to unexpected social rejection, as consistently shown in previous studies (Gunther Moor et al., 2010; 2014; Van der Veen et al., 2014, 2016; Dekkers at el., 2015). On the other hand, autistic participants were expected to show reduced cardiac slowing to unexpected social rejection due to the diminished value of social inclusion in ASD (Chevallier et al., 2012). Longer IBIs as a response to feedback in the current study indicated cardiac slowing which was associated with processing threatening social cues in the environment (Woody & Szechtman, 2011).

Regarding the second hypothesis in the current study, neurotypical participants showed cardiac slowing specifically to unexpected social rejection, which was more pronounced than the non-social negative feedback conditions in the AJT. Therefore, the current results in the NT group replicated the previous studies which have consistently reported a delayed recovery of cardiac responses to baseline following unexpected social rejection in NT adults (Gunther Moor et al., 2010; 2014; Van der Veen et al., 2014, 2016; Dekkers et al., 2015). If we assume that unexpected social rejection indicates threat for the social well-being of the individual, the cardiac deceleration to unexpected social rejection might play an important role in regulating social and emotional behaviour in order to develop an appropriate social response (Gyurak & Ayduk, 2008; Porges, 2003). Therefore, the current findings from neurotypical participants were consistent with previous findings of cardiac slowing responses to social rejection and demonstrated further evidence for parasympathetic nervous system engagement in processing social threat.

The primary aim of the current study was to examine the cardiac responses to social rejection in young adults with ASD to probe social motivation. As expected, the cardiac responses in the ASD group showed a different pattern compared to neurotypical participants. First of all, autistic participants showed cardiac slowing to both expected and unexpected social rejection, indicating a lack of specific cardiac deceleration to unexpected social rejection. More importantly, cardiac responses to unexpected social rejection in autistic participants were not different than the cardiac responses to non-social negative feedback, suggesting that autistic individuals showed cardiac slowing to general negative feedback, with no differentiation between the social and non-social aspects of the task. These results are in line with the SMT as they demonstrated lack of specific cardiac slowing to unexpected social rejection and similar responses to both social and non-social negative feedback in the ASD group, suggesting reduced reward value of social stimuli in ASD (Chevallier et al., 2012). Therefore, it could be speculated that individuals with ASD do not prioritize social stimuli over non-social stimuli and they experience the adverse effects of social rejection to a lesser extent in comparison to NT individuals. Reduced responses to social rejection in ASD have been reported in previous studies using other social exclusion tasks (e.g. Cyberball). For example, reduced neural activity (Masten et al., 2011; Bolling et al., 2011) and lack of mood change (Sebastian, Blakemore, & Charman, 2009) following social exclusion have been shown in autistic individuals. These results together with the current findings are in line with the SMT, suggesting that if individuals with autism had reduced reward value for social stimuli, we would expect them to show less response to being rejected/excluded by others (Chevallier et al., 2012). The current results support this claim by showing cardiac deceleration to general negative feedback, regardless of being social or non-social, in autism.

However, an alternative explanation for atypical processing of social rejection in ASD might be social rejection experiences in the past, which could lead to cognitive, emotional, and biological changes over time (Slavich et al., 2010). As discussed earlier (see Section 4.1.2), experiences of peer rejection are known to be more prevalent among adolescents and adults with ASD (Little, 2001; 2002). Moreover, recent empirical evidence showed that NT individuals made more negative judgements about autistic individuals (Grossman, Mertens, & Zane, 2019; Sasson et al., 2017), which might also explain lower likeability ratings in the ASD group in the current study. Therefore, the lack of response differentiation to unexpected social rejection in autistic participants might alternatively indicate a learnt response as a result of continuous negative past experiences, especially peer rejection, in young adults with ASD. Similarly, previous research has shown that individuals with alexithymia showed blunted neural responses during a social rejection task, which occurred together with high levels of daily social rejection (Chester, Pond, & DeWall, 2014). Moreover, children and adolescents with early life stress were found to respond less to social stress, indicated by blunted HR and cortisol activity (Lovallo et al., 2012). Further research is required to understand how negative experiences of peer rejection influence future social experiences and interactions with others (e.g. friendships) in ASD. This question will be further examined in Chapter 7.

4.4.3. Individual differences in experiences of social rejection across participants

The last aim of the current study was to examine whether the behavioural and psychophysiological responses associated with social rejection would be related to autistic traits, social anxiety, and depression symptoms. Given the huge variability in experiences of rejection in the present sample (indicated by wide range of expectation scores; see Section 4.3.3), it is crucial to understand the role of other factors that might have an impact on experiences of social rejection in individuals with and without ASD. The current result demonstrated that negative expectation scores were associated with higher self-reported autistic traits, social anxiety and depression symptoms. The participants who more often expected rejection had higher autistic traits, higher social anxiety, and more depressive symptoms. Subsequent regression analyses demonstrated that social anxiety predicted higher expectations of rejection across participants, irrespective of autistic traits. These results suggest that, when investigated in neurodiverse populations, social anxiety is a critical factor in experiences of social rejection, even more so than autistic traits. Individuals who have higher social anxiety might be more prone to experience social rejection, irrespective of their diagnosis of ASD. This is a very critical finding and it has important implications for the SMT, such that social rejection experiences in both autistic and NT individuals are related to social anxiety, but not reduced motivation for social interactions. This relationship between social anxiety and negative self-evaluation bias has been showed in a group level using individuals with Social Anxiety Disorders (Harrewijn et al. 2018). As discussed above, the negative self-evaluation bias among socially anxious individuals could be due to learned experiences from frequent social rejection in the past (Levinson, Langer, & Rodebaugh, 2013). Moreover, social anxiety and negative self-perception (e.g. "I am undesirable") may lead to withdrawal from social interactions resulting in further isolation or depression (Downey & Feldman, 1996; Slavich et al., 2010). Social anxiety is not specific to ASD, and therefore it should be taken into consideration in understanding of negative social experiences, particularly social rejection, in individuals with and without ASD. However, given the high levels of social anxiety in ASD in previous literature and the current study, it is especially important to examine the relationship between social anxiety and social experiences of rejection and isolation in ASD.

In terms of psychophysiological responses, no correlations were found between cardiac responses to unexpected social rejection and negative-evaluation bias, autistic traits, social anxiety, and depression symptoms. The lack of associations could be due to the differences in types of data between implicit cardiac responses and explicit self-reports. Another possibility is the heterogeneity of cardiac responses (see Figure 4.2

for error bars), which indicates huge individual differences in responses to social judgements. Previous studies administering the SJT have not shown any correlations between physiological and neural responses to social rejection and self-report measures of fear of negative evaluation and self-esteem (Kortink et al., 2018), depressive symptoms (measured by the Beck Depression Inventory; Van Der Veen et al. 2016), and social anxiety (measured by the LSAS; Van der Molen et al. 2014; Via et al. 2015). However, even if Van der Veen et al. (2016) could not find any relationship between depressive symptoms and psychophysiological responses, they showed that higher neuroticism traits were correlated with more negative self-evaluation bias and smaller cardiac deceleration to social rejection. The lack of correlations in previous studies and the current study could be due to high heterogeneity in cardiac responses and also non-clinical nature of the studied groups. Therefore, future studies should investigate the role of mental health in experiences of social rejection using a larger sample with comorbid mental disorders or wider distribution of mental health symptoms.

4.4.4. Limitations

There are several methodological limitations in the current study. First, the ASD sample (n = 20) was smaller than the NT sample (n = 39) and autistic participants self-reported their ASD diagnosis. It would be better to use a larger sample of autistic individuals in future research and to include a clinical measure of functioning. This might also help to reveal some of the group differences observed as a trend in the current data (e.g. negative self-bias in the autistic group). The second limitation is the potential gender differences in social rejection sensitivity. The role of gender in responses to social rejection was not examined in the current study, however, given the significant current interest in females with ASD, this would be an interesting factor to consider in future research. Previous studies have reported gender differences in social judgement task such that females were more responsive to unexpected social rejection compared to males (Gunther Moor et al., 2014; Van Der Veen et al., 2016). Therefore, it is important to examine whether autistic females and males would react differently to social rejection and whether these responses are differently linked to anxiety and depression.

Since the current study was administered together with the Cyberball study as described in Chapter 3, some limitations could apply to both. As mentioned in Chapter 3 (see Section 3.4.4), the reliance on self-reports to measure autistic traits and mental health and use of those scores in predicting experiences of social rejection might be problematic in the current chapter, as well. Therefore, more objective measures of social anxiety and depression could allow us to investigate their impact upon responses to social rejection. Moreover, adding a state measure of social anxiety after the SJT could give more insight into experiences of immediate distress following social rejection in neurotypical and autistic participants. This could also help us to understand individual differences in experiences of social rejection across participants.

4.4.5. Conclusions

This was the first study to administer the Social Judgement Task to young adults with ASD, using cardiac and behavioural responses to probe experiences of social rejection as an indicator of social motivation. The results demonstrated that even if autistic participants rated themselves less likeable by others before the SJT, neither of the groups had particularly strong or negative prediction scores. In terms of psychophysiology, autistic participants did show cardiac deceleration to all negative feedback without a differentiating response between social (both expected and unexpected) and non-social feedback, whilst NT individuals displayed a specific cardiac slowing only to unexpected social rejection and this response was more pronounced than responses to cognitive negative feedback. The lack of specific cardiac responses to social rejection in autism could be explained by either reduced social motivation (Chevallier et al., 2012) or by a compensatory down-regulation system to cope with frequent social rejection experiences in autism (Levine et al., 2012). The latter might also explain the finding that social anxiety was a significant predictor of negative self-evaluation bias in all participants, irrespective of ASD diagnosis. Understanding the reasons behind high expectations of social rejection and whether it is associated with negative past experiences is a very critical question to improve well-being of young adults with and without ASD.

The experimental studies discussed in the previous (Chapter 3) and current chapter aimed to understand social experiences in ASD in relation to social motivation. When compared with the Cyberball study in Chapter 3, the SJT investigated the phasic responses to social rejection, not continuous responses, and heart rate responses were monitored to reflect negative effects of social rejection, not SCLs. The current results in NT participants suggested that the SJT could be a more reliable measure to elicit feelings of social rejection compared to Cyberball. More importantly, autistic individuals displayed atypical responses to being rejected by others in a way that their cardiac responses did not distinguish between social rejection and non-social negative feedback. These results were discussed in the light of the SMT and the frequent experiences of social rejection in ASD. In both studies, social anxiety predicted experiences of exclusion in Cyberball and rejection in the SJT across participants, irrespective of ASD diagnosis. One important thing to consider is huge variability in responses to social exclusion and rejection, especially in individuals with ASD. Considering high individual differences in social experiences together with the role of mental health in young adults with and without ASD, the next chapter will investigate the social experiences of students with ASD at university in comparison to NT students by using both quantitative and qualitative measures. Combining qualitative measures with behavioural experiments is essential to explain the individual differences observed in the experimental data and fully characterise unique social experiences in ASD.

Chapter Five: University Students with autism: The Social and Academic Experiences of University in the UK

Chapter 3 and 4 have provided behavioural and psychophysiological insights into the experiences of social exclusion and social rejection in young adults with ASD and their NT peers. Although there was a huge variability, behaviourally, autistic individuals reported similar experiences of exclusion as NT individuals (Chapter 3) and higher expectations of rejection in comparison to NT individuals (Chapter 4). In terms of psychophysiological responses, individuals with ASD displayed overall higher arousal levels, especially during exclusion, while the arousal levels of NT individuals decreased significantly from inclusion to exclusion (Chapter 3). Using another paradigm with phasic responses to social and non-social judgements, the cardiac responses of autistic individuals did not distinguish between social and non-social rejection, unlike the responses of NT individuals who showed a specific cardiac slowing to unexpected social rejection (Chapter 4). Furthermore, in an attempt to understand some of the predictors of performance in Chapters 3 and 4, social anxiety was shown to be higher among individuals with ASD (than NT individuals), and was linked to both increased feelings of exclusion (Chapter 3) and higher expectations of rejection (Chapter 4) across participants.

The first part of this thesis including studies in Chapter 3 and 4 focused on social experiences using quantitative measures, which might be lacking insight into unique experiences in autistic young adults (see Section 2.8.3). Experiences during young adulthood are especially important to examine as transitioning to adulthood is one of the most challenging periods of autistic individuals due to increasing demands in social relationships, academic life, employment, and independent living (Kapp, Gantman, & Laugeson, 2011; Tantam, 2003). In addition to these challenges, the high rates of mental health comorbidity (Buck et al., 2014) along with suspension/lack of support (Wehman et al., 2014) might worsen the social functioning of autistic individuals (Griffith, Nash, & Hastings, 2011). Despite these challenges, the number of university students with ASD is increasing, and hence the interest in their academic and social experiences at university (Newman et al., 2011). Therefore, Chapter 5 will focus on the first-hand experiences of university students with ASD in order to understand the heterogeneous social behaviour and role of mental health in university experiences of students with ASD. This chapter will add to the behavioural and psychophysiological data in Chapter 3 and 4 by providing insights into the first-hand experiences of autistic students at university using both quantitative and qualitative questionnaires.

This chapter includes one published paper that has appeared as:

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5.1. Introduction

Autism Spectrum Disorders (ASDs) are complex neurodevelopmental disorders with lifelong impacts on social communication, alongside the presence of repetitive and restrictive behaviours (American Psychiatric Association, 2013). ASD can occur with, or without, intellectual disability and cognitively able autistic individuals can still experience a number of social challenges that map on to the ASD diagnostic criteria (Eaves & Ho, 2008; Bellini, 2004). It is important to understand the life experiences of university students with autism to best appreciate how to provide support and develop opportunities to increase both societal engagement and quality of life (Van Heijst & Geurts, 2015).

Research has shown that employment rates for autistic adults are as low as 4.1% (Taylor & Seltzer, 2011). Furthermore, fewer autistic individuals are likely to continue into further or higher education (Shattuck et al., 2012). However, this picture is changing and this is partly due to investment in equality and diversity programmes and widening participation agendas. The number of students with autism completing a higher education qualification is increasing; in the US the number of autistic students at University is between 0.7% and 1.9% of the student population (White et al., 2011) and in the UK rates are reported slightly higher having increased from 1.8% in 2004 to 2.4% of the student population in 2008 (Macleod & Green, 2009). These numbers are expected to have increased even further since these data became available and therefore there is a timely need to consider the specific requirements of autistic students (Friedman, Erickson, & Parish, 2013). This becomes especially important given evidence that less than 40% of autistic students successfully complete their studies (Vanbergeijk et al., 2008; Newman et al., 2011).

5.1.2. Social aspects of University for autistic students

There are several reasons why students with autism may find University life challenging, and more so than students without autism, especially considering combined social and academic demands. Three systematic reviews of research involving autistic University students all reported widespread social challenges (e.g. lack of social participation) and increased mental health concerns (e.g. stress, anxiety, and depression), with a further emphasis on the lack of support targeted towards non-academic issues (Gelbar, Smith, & Reichow, 2014; Anderson, Stephenson, & Carter, 2017b; Jansen et al., 2018). There was an array of social challenges reported that included generalised difficulties with social skills, plus stress and anxiety in social situations (Accardo, 2017), difficulties making friends (Gelbar, Shefcyk, & Reichow, 2015; Jackson et al., 2018), problems managing emotions, self-determination (White et al., 2016), and self-advocacy difficulties (Elias & White, 2018).

The reported social challenges could be related to the core deficits associated with ASD (e.g. including the role of theory of mind in understanding their peers) and therefore it is important to interpret the findings within a wider conceptual theoretical framework of autism (Gobbo & Shmulsky, 2014). Indeed at the very core of ASD are the social and communicative difficulties that individuals experience throughout development; for example, difficulties with interpersonal skills, self-regulation, lower self-esteem, and a possible atypical social motivation that may impact upon learning social expertise from an early age (Myles & Simpson, 2002; Dijkhuis et al., 2017; Matthews et al., 2015; White et al., 2016; Chevalier et al., 2012). Moreover, coping with independent living and new routines while adapting to a large number of new challenges, can also feed into difficulties for these students (Vincent et al., 2017; Jackson et al., 2018; Van Hees et al., 2015). As a result of this constellation of challenges, it has been reported that autistic students can experience heightened social isolation, loneliness, bullying, and stigmatization compared to their peers (Vanbergeijk, Klin, & Volkmar, 2008; Madriaga et al., 2010; Gelbar, Smith, & Reichow, 2014). Moreover, depression and anxiety are reported as the most common mental health challenges for young adults with autism (Lugnegard et al., 2011; Volkmar, Jackson, & Hart, 2017) and these could be seen as both a consequence and a contributor to the issues noted above (Accardo, 2017).

While some of these issues appear negative in nature, students with autism have several personal qualities that could help them in social situations when commencing

University. Van Hees et al. (2015) interviewed 23 autistic university students who reported sincerity, fairness, and willingness to listen to others as personal strengths. Furthermore, some autistic students perceive the new and challenging social situation of University life as an opportunity to try and test their personal abilities, which indicates a very positive and flexible approach (Vincent et al., 2017). Therefore understanding how to capitalise on these strengths is crucial.

The previous studies identify the social aspects of university as particularly challenging for students with autism and it has therefore been proposed that providing appropriate social support is essential (Zeedyk et al., 2016; Kuder & Accardo, 2018). Furthermore, such support can have a positive consequence of improving quality of life and improving academic outcomes (Tobin, Drager, & Richardson, 2014) and it should incorporate the strengths mentioned above. Therefore, there is a timely need to increase the evidence-base in order to provide the most relevant support networks and capture insights from students in the UK.

5.1.3. Academic aspects of University for autistic students

According to a recent study, 48% of autistic university students were happy with their academic workload and considered themselves academically successful (Jackson et al., 2018; Gelbar, Shefcyk, & Reichow, 2015). However self-reported experiences of autistic students have indicated that information processing speed, time management, group work, presentations, motivation to study, following lectures, and asking questions can all be significant challenges (Macleod & Green, 2009; Van Hees et al., 2015; Anderson, Carter & Stephenson, 2017a; Jansen et al., 2016; White et al., 2017). These academic challenges may be linked to ASD related issues such as executive function abilities and weak central coherence (Gobbo & Shmulsky, 2014; Vanbergeijk, Klin, & Volkmar, 2008), as well as linking to some of the social aspects mentioned above (e.g. group work). In particular, switching from one task to another, prioritising knowledge for a specific assessment, and monitoring progress are all important skills. Touching on these issue, executive function training has recently been suggested as a potential target for intervention and support by the parents of university students with autism (Elias & White, 2018).

Autistic students have reported that structure in academic settings, concrete instructions and smaller assignments helped them to deal with some of the academic challenges (Cai & Richdale, 2016; Knott & Taylor, 2014). They also mentioned many strengths such as proficient memory skills, a focus in detail, original and creative thoughts, passionate interests, the desire to acquire accurate knowledge, and adherence to rules when clear structure is provided. These skills can positively impact academic experiences and outcomes for autistic students (Anderson, Carter, & Stephenson, 2017a; Gobbo & Shmulsky, 2014; Van Hees et al., 2015; Drake, 2014). Intervention and support mechanisms should capitalise on such competencies.

5.1.4. Other ASD-related issues

Of course the challenges for students with autism are unlikely to be isolated to social and academic issues and additional challenges may be associated with sensory processing, fine-motor skills, and intolerance to changing routines, to mention a few (VanBergeijk et al., 2008; Gelbar, Smith, & Reichow, 2014; Anderson, Carter, & Stephenson, 2017a; Morrison, Sansosti, & Hadley, 2009). These ASD-related issues could influence the ability to navigate social environments, to adapt to new and fluctuating routines, to manage daily living activities, and therefore further determine well-being (Volkmar, Jackson, & Hart, 2017). In addition, both environmental and personal factors can influence students. For example, a lack of understanding and appreciation of differences among students, stigmatization and discriminatory practices on campus could prevent students with autism from disclosing their diagnosis and subsequently seeking support (Cox et al., 2017; Vincent et al., 2017; Sarrett, 2018). Taking a comprehensive approach across domains of potential need, and considering strengths as well as challenges, is crucial to develop appropriate interventions and support.

5.1.5. Current study

The first-person accounts of students with autism have provided valuable insights into their University experiences (Gelbar, Smith, & Reichow7 2014; Vincent et al.7 2017; Sarrett, 2018). However, the majority of existing evidence comes from academics (Gobbo & Shmulsky, 2014), or family members (Cai et al., 2016), rather than directly from autistic students. Published studies that have involved students have either had exceptionally small sample sizes (*n* = 5; White et al., 2016) or have been entirely qualitative in nature (Gelbar, Smith, & Reichow, 2014). To date there have been three quantitative questionnaire studies; two from the US (Gelbar, Shefcyk, & Reichow, 2015; Jackson et al., 2018) and one from Australia (Anderson, Carter, & Stephenson, 2017a), but none from the UK. Only two studies have combined qualitative and quantitative measures, both in the US (White et al., 2016; Accardo, Kuder, & Woodruff, 2018). None of the existing published studies have included students without autism as a comparison to know whether the issues and challenges are heightened, reduced, or similar in nature, for students with and without autism. Therefore, the current study is the first to i) explore the first-hand social and academic experiences of university students with autism in the UK using a systematic approach including both qualitative and quantitative data, and ii) include both students with autism and those without autism for comparison (age and study-matched typically developing students; non-autistic group). The current study aims to i) understand self-reported social challenges as well as social strengths for students with and without autism, (ii) understand self-reported academic challenges as well as potential academic strengths for students with and without autism, (3) understand the formal (professional) and informal support received and reported by autistic students, and (4) understand self-reflections about having autism and being a university student (including opinions of awareness and acceptance of ASD by others). Based on the existing evidence, we hypothesize that students with autism will report more social challenges (and fewer social strengths) than their non-autistic peers, alongside more prevalent mental health issues. We also expect autistic students to self-report potential academic strengths, even alongside social needs. It is expected that students with autism will raise issues with the availability of specialised support, especially in social domains. Lastly, the students will mention identity and disclosure issues associated with having autism and being a university student.

5.2. Methods

5.2.1. Participants

Twenty-six students with autism (14 male, 10 female, 2 other) and 158 typically developing (non-autistic) students (51 male, 99 female, 3 other; 5 missing data) participated in completing the online questionnaire. The autistic students self-reported their age of diagnosis and over 70% reported that this occurred after 16-years of age. There was no difference between groups in the mean age of the students at the time of participating in the study, $t(182) = 1.701$, $p = .091$. All participants were currently enrolled in higher education and studying at a university in the UK (across a variety of Universities, not named for anonymity and confidentiality of participants). For the sample as a whole, 50% were undergraduate students, 23% were studying for a Masters degree, and the remainder were studying at PhD level. For the students with autism, 89% were studying for a full-time degree, whereas 11% were studying part time. For the non-autistic students, 91% were studying full time and 9% were studying on a part time basis. Across groups, most students were studying science subjects, followed by social science or health subjects, and then arts and humanities. Table 5.1 presents the demographic data obtained from autistic and non-autistic students.

Participants were asked whether they had a current mental health diagnosis (for example depression or anxiety). 54% of students with autism self-reported a diagnosed mental health condition (in addition to having an autism diagnosis), with anxiety and depression most commonly specified (46%). In comparison, 17% of non-autistic students self-reported a mental health diagnosis (14% for anxiety and depression; see Table 5.1).

Table 5.1. Demographics of the student groups with and without autism

Variables	Categories	ASD (%)	TD (%)
Gender	Male	53.8	33.3
	Female	38.5	64.7
	Others	7.7	1.9
	Did not report	0	3.2
Age (mean and SD in years)		26.35 (10.02)	23.96 (10.54)
Current Level of Study	Undergraduate	69.2	46.2
	Masters	19.2	24.1
	PhD	11.5	27.8
	Other	0	1.9
Type of Study	Arts and Humanities	11.5	19
	Science	65.4	43
	Social Science & Health	23.1	36.7
Mental Health Diagnosis	Anxiety/Depression	46	14
	Other	8	3
	Total	54	17

5.2.2. Materials

To understand the social and academic experiences of autistic students an online questionnaire was developed. After reviewing the literature, themes and issues emerged as particularly relevant to address, such as social skills, social motivation, isolation and loneliness, academic challenges, and adaptation to university life (Anderson, Stephenson, & Carter, 2017b; Chevallier et al., 2012; Jackson et al., 2018). Therefore, we looked to relevant items from existing validated questionnaires on these issues, such as the Friendship Motivation Questionnaire showing a good test–retest reliability (r = 0.7) and internal consistency (Cronbach's α = 0.75; Richard &

Schneider, 2005), UCLA Loneliness Scale with an internal consistency ranging from α = .89 to .94 (version 3; Russell, 1996), and Rasch-type Loneliness Scale (De Jong-Gierveld, 1985) with a reliability range of α = .81 - .95 (De Jong Gierveld & Van Tilburg, 2010). Two other questionnaires developed for students; Student Adaptation to College Questionnaire (Baker & Siryk, 1989) proving a high internal consistency (α > .80; Beyers & Goossens, 2002) and the Survey of Current and Former College Students with autism (Gelbar, Shefcyk, & Reichow, 2015) were reviewed for relevant items to be used in the current study. We adapted the wording of some questions to be culturally appropriate for a UK sample (e.g. changing 'college' to 'university'). We also developed new questionnaire items on social motivation as this appeared as a key issue in previous studies but could not be fully captured with the existing measures.

The final 57 items that were used were Likert-scale questions answered on a 5-point scale from strongly disagree "5" to strongly agree "1" (see Appendix E). They included questions about social functioning at University "I often feel I am involved in socializing with others", social skills "I often find it difficult to socialize with others", social motivation "I often get excited when I see an opportunity for meeting a new person I like", motivation for friendship "I think that having friends does not bring much to my life", academic functioning "I am enjoying my academic work", satisfaction about academic performance "I am satisfied with the level at which I am performing academically", and adaptations to the current institution "I have thoughts of withdrawing from my institution/course".

In order to further capture some of these challenges, together with the strengths of students with autism, we included 7 open-ended questions where autistic students provided first-hand accounts of their experiences at university (see Table 5.2). These questions probed the support received at university, social and academic experiences as an autistic student, the biggest challenges encountered, helpful support they received, potential strengths, and finally the most important thing to know about being a university student with autism. These 7 questions would only be answered by the students with autism (and not by non-autistic students).

The demographics section of the questionnaire included questions about age, gender, the name of the institution, the level of study, the subject of study, highest qualification achieved, enrolment type, nationality, relationship status, native language, age of diagnoses, other current diagnoses, anyone else in the family diagnosed with autism and their relationship to the participant, and finally the disclosure of autism to the current institution.

As a result, the final questionnaire consisted of both quantitative and qualitative items which was important for gaining rich and informative data. The entire questionnaire included 15 questions concerning sample demographics, 57 Likert-scale items and 7 open-ended questions probing social and academic experiences. The questionnaire was hosted via www.onlinesurveys.ac.uk.

Table 5.2. Open-ended questions answered only by the autistic students

Questions
1. What kind of additional support services and accommodation did you receive at your institution (e.g. college/university) due of your diagnosis of an ASD?
2. What do you think are the most important issues about the social experience of being a college/university student with an ASD?
3. What do you think are the most important issues about the academic experience of being a college/university student with an ASD?
4. What are the biggest challenges you face as a student with an ASD?
5. What has helped you most during the transition from secondary school to higher-education?
6. In your opinion, in what areas are you most successful as a student?
7. In your opinion, what is the most important thing we should know about being a student with an ASD in higher education?

5.2.3. Recruitment and Procedure

Following ethics approval by the local ethics committee, individuals were approached via advertisements sent to a number of UK universities, University colleges, several organizations in UK working with autistic university students, and University Disability Services. The advertisement was also posted on a variety of social media outlets. The online link included information about the study, the consent form, and the online questionnaire. Autistic students self-reported a previous diagnosis of autism and non-autistic students reported no developmental issues. The questionnaire was anonymous and all answers were confidential. Participants were told they had the right to omit any questions they did not wish to answer and could withdraw their data from the study at any point until data analysis. At the end of the online questionnaire, participants were presented with the debrief page explaining the rationale and aim of the study and had the opportunity to enter a prize draw.

5.2.4. Data analysis strategy

Principal Component Analysis (Jolliffe, 2002) was applied to the 57 Likert-scale items to investigate the factor structure of the data. In order to extract components, the Kaiser (1960) criteria and scree tests were used, with Varimax rotations applied. Items that loaded on components with values > .40 were retained (Pedhazur, Pedhazur, & Schmelkin, 1991). Finally, meaningful labels were given to each component.

The open-ended questions were analysed using data-driven thematic analysis to identify relevant themes for each question (Braun & Clark, 2006). Initial codes were created by grouping the relevant data into smaller chunks and codes were then collated into potential themes. Twenty percent of the data was double-coded by an independent researcher and the inter-rater agreement level of 100% was obtained.

5.3. Results

5.3.1. PCA analysis of questionnaire items

The check for multicollinearity as indicated by the Determinant was lower than 0.00001. The measure of sampling adequacy (Kaiser-Meyer-Olkin) was .83, which is recommended to be above 0.5. The Bartlett's test of sphericity was significant, $\chi2$ (1596) = 5264.061, $p < .001$, suggesting there were substantial relationships between variables and therefore it was possible to run the PCA analysis. Overall, the PCA was found suitable to run with 57 items.

Initial PCA with all the Likert-scale items resulted in 14 factors with Eigenvalues > 1, accounting for 69% of variance in the data. According to the scree plot, 4 factors were identified with 44% of variance explained. However, the last component had two items and only explained 4% of the total variance. Solutions for four, three, and two factors were each examined using Varimax rotations and items with loadings on components at or above .40 were extracted. A two-factor structure was chosen because each component explained the highest variance (24%, 10% respectively) and the third and fourth factors were not strong enough to be included as there were not enough items (Costello & Osborne, 2005). In the final structure, 23 items loaded on the first component and 15 items loaded on the second component (see Table 5.3), 5 items loaded on both components. After investigating each cross-loading item conceptually, it was decided all 5 of them belong to the first component. Finally, the first component with 28 items in total was labelled as social functioning (α =.80), and the second component with 15 items was labelled as academic functioning (α = .89).

The content of the social functioning component included socialisation, social skills, friendship, and social motivation. The content of the academic functioning component included academic skills (e.g. time management), satisfaction about the academic performance, and adaption to the institution (e.g. thoughts of withdrawing). Higher scores on each factor indicated better functioning. Compared to the non-autistic students, those with autism had significantly lower scores both in social ($p < .001$) and academic components ($p < .001$). The individual items that loaded on the social functioning component indicated that compared to non-autistic students, students with autism had more difficulties in socialising and making friends, they were less involved in social activities, they preferred to be alone, and they did not believe that their relationships with others were as meaningful. Nevertheless, they reported similar motivation to form friendships as their non-autistic peers (see Table 5.3).

For the academic functioning component, students with autism reported enjoyment in their academic work, good academic grades, and they believed they had the necessary academic skills to succeed as much as other students without autism. On the other hand, they reported more adjustment problems, more frequent thoughts of withdrawal, and difficulties with academic motivation. Moreover, 35% of the autistic students reported to not feel confident to cope with the future challenges, compared to only 7% of non-autistic students (Table 5.3).

Table 5.3. PCA results and the percentage of students with and without autism who agreed with the corresponding questionnaire item

Factor	Items	Varimax Rotations	ASD %	non-autistic %
1	***Social Functioning***			
	I often find it difficult to socialize with others.	.787	70.5	34.1
	I often feel I am involved in socializing with others.	.785	12	57.4
	I often feel outgoing and friendly.	.751	20	50.3
	I often feel I don't have any friends.	.687	65.4	19
	I often feel left out.	.674	69.3	33.6
	I often find it difficult to introduce myself to others.	.659	77	45.5
	I often feel I prefer to be alone.	.657	76	42
	I often feel shy.	.643	69.3	43.1
	I often get excited when I see an opportunity for meeting a new person I like.	.631	23	66.5
	I have the social skills to succeed at my institution.	.619	28	70

I often feel that I have a lot in common with the people around me.	.611	23.1	47.5
I think that having friends does not bring much to my life.	.598	19.2	3.8
My motivation to have friends is the pleasure I get by talking to friends.	.568	69.2	88.6
My motivation to have friends is the fun moments I have with friends	.564	76.9	89.2
I am involved in social activities at my institution.	.560	20	53.5
I often feel willing to maintain my current friendships.	.558	64	83.5
I often feel that my relationships with others are not meaningful.	.555	72	29.8
I often feel alone.	.554	76.9	39.9
I prefer to spend time in quiet places on campus.	.536	80	56.7
My motivation to have friends is the fun of doing interesting things with friends.	.492	80	91.1
I feel like people ignore me.	.479	60	21
I often find it difficult to express my opinions to others.	.464	53.8	29.8
My motivation to have friends is that friends make me feel better when I am sad.	.453	56	57.7

	I am better able to express myself with friends.	.406	42.3	47.7
	I have some good friends or acquaintances on my course with whom I can talk about any problems I may have.	.458	38.5	68.2
	I often feel like I get enough fun and enjoyment out of life.	.416	40	55.7
	I am having difficulty feeling at ease with other people on my course.	.440	68	26.2
	I feel I am very different from other students in ways that I don't like.	.493	64	24.5
2	***Academic Functioning***			
	I am enjoying my academic work.	.756	64	67.5
	I am quite satisfied with my academic situation at my institution.	.751	44	63.4
	I am adjusting well to my institution.	.737	40	82.7
	I feel confident that I will be able to deal in a satisfactory manner with future challenges here at my institution.	.691	38.4	76.6
	I have thoughts of withdrawing from my institution/course.	.667	56	15.3
	I get good grades.	.667	65.4	68.3
	I am pleased about my decision to go to higher education.	.650	76	89.8

I really haven't had much motivation for studying lately.	.643	60	30.6
My academic goals and purposes are well defined.	.604	60	65
I have the academic skills to succeed in my institution.	.584	70.9	78.4
I am satisfied with the level at which I am performing academically.	.579	48	57.4
I find it easy to focus when I am studying.	.518	32	37.6
I have good study habits in terms of the time and activity I allocate to studying.	.497	50	50.4
I find myself giving considerable thought to taking time off from my current institution and finishing later.	.482	40	12.7
Lately I have been having doubts regarding the value of university education to me.	.477	28	14.7

The correlation between *social functioning* score and *academic functioning* score was studied in each group (with some caution for sample size of the autism group where $n = 26$). The relationship between social and academic functioning was significant in both groups (non-autistic students $r = .301$, $p < .001$; autistic students $r = .589$, $p = .002$).

5.3.2. Thematic Analysis

Four main themes emerged from 7 open-ended questions answered by the autistic students; social functioning (1), academic functioning (2), ASD-related issues (3), and support and awareness of ASD by others (4). All of these themes contributed to the experience of autistic students (only the students with autism completed these questions). The following section discusses each sub-theme and provides student quotes to illustrate the theme / sub-theme. The numbers of students mentioned the corresponding sub-theme is provided in Table 5.4 alongside examples.

Theme: Social functioning

The questions regarding social functioning asked about the biggest challenges autistic students faced and the most important issues about the social experience of being an autistic student. As a result, two sub-themes were identified: *social skills* and *social activities.*

Social Skills: The students self-reported that they found it hard to initiate a social interaction, to express themselves to others, and to make new friends. They also mentioned that they felt anxious in social situations. As a result, 11 of the students (42% of the autism group) self-reported that they experienced social isolation and loneliness during their university years, though there were 58% of the students with autism who did not mention this as an issue (individual variability is evident throughout the data). Students commented on their biggest challenges as an autistic student:

Example: "*Socialising with people with different interests/personalities - but met people with similar interests so it wasn't so bad.*"

Social activities: 8 autistic students (31% of the autism group) reported that they found social activities forced, unnecessary, and not very diverse for people with different interests.

Example: "*I don't like how there are seemingly hundreds of parties or other alcohol-consumption related events being thrown in your face every 10 minutes. I would be happy to not partake in the "social experience" and mind my own business but I can't even walk to lectures without people trying to give me flyers or talk to me about some "very fun" thing they are trying to get people to do and appear to judge me for not being interested in their parties when I reject them.*"

The other difficulties with engaging in social activities were their unpredictable and overwhelming nature. This is very important for students with autism due to difficulties with new environments and a new, or changing, routines which might further increase stress levels when engaging in social situations.

Example: "*Difficulty being included in social activities due to other people not understanding you need help being included in activities. Lots of stuff revolves around "going out" and drinking which is often too loud/crowded and may not want to drink. Also can be difficult to attend society events because not enough information is provided so you can't prepare and it's too scary.*"

Theme: Academic functioning

Academic skills were investigated by asking about the most important issues and most successful academic experiences as an autistic student. These two questions resulted in two sub-themes; *academic challenges* and *academic strengths*.

Academic Challenges: Many students with autism reported similar challenges that influence their academic functioning. The most frequent challenges that were reported were the absorption in one subject at the cost of others (n = 8; 31%) which might lead to burnout in some circumstances as a small number of students self-reported that they did not know how to pace them self (n = 2; 8%) and a larger number self-reported that they often lack clear instructions of what was expected of them (n = 7; 27%).

Example: "*Knowing what's expected of you. Lecturers take it for granted that you'll understand what they've said or what they want, or that you'll do something without being told to.*"

The other issue that a small number of autistic students self-reported was perfectionism (*n* = 3; 12%) and as a result these students reported that they had a constant binary feeling of failure or success. They self-reported that it was hard to know whether the work they completed was good enough, which could also cause exhaustion.

Example: *"It is easy not to pace yourself. Partly I think I enjoyed my subject so was happy to spend more time than most studying, but also a pursuit for perfection or feeling that you failed is an unhealthy motivation. I think high grades are often taken to show you don't need academic support, when really extremes on both sides (very high or very low marks) can flag extreme and unhealthy practices. So I think more support is necessary to ensure autistic students pace themselves and don't burn out or feel that they have failed even if they have done well by more normal standards."*

Other academic challenges were working in groups, time management (e.g. procrastination), processing speed, organizational skills (e.g. including life-work balance), attentional skills, and motivation for studying or attending lectures.

Example: "*Course elements which require interacting with people when individual tasks could achieve the same purpose. For example, my programme contains a "Research Ethics" module in which all activities are group-based discussions and such, but this could just as easily be assessed with an individual piece of writing, and having this option for students with social or communication difficulties should be possible. I feel largely the administration ignores that these issues exist and/or feel that one should just have to put up with some discomfort from time to time*."

Academic Strengths: Alongside the academic challenges, students with autism self-reported that they felt they had a number of academic strengths. Students stated that they could study for long hours (*n* = 3; 12%), focus in detail on one subject (*n* = 4; 15%), and could use critical thinking and understand complex ideas (*n* = 4; 15%) and academic writing and research skills (*n* = 9; 35%). Naturally there was individual variability of the strengths that were mentioned.

Example: *"If I can get myself focused on a topic then I will go into much more detail and learn much more about it than other students."*

Interestingly, a small number of students mentioned that their difficulties could be underestimated due to their high academic grades, and indeed the social challenges may be masked by strong academic performance.

Example 1: "*The academic side of things, for me, is easy. The biggest challenges are the social aspects I put above."*

Example 2: "…*being expected to participate in activities/assessment formats which cause extreme distress e.g. oral presentations and lecturers being certain I will manage because my grades are good and downplay the anxiety I have about these types of assessments."*

Theme: ASD-related issues

Sensory overload and sensitivity to change: Individuals with autism can be sensitive to sensory stimuli in the environment and this may also impact their experiences at University. More than half of the autistic students reported issues with the sensory overload (hyper-sensitivity to sensory input) and noted that this affected both their academic performance and their motivation to participate in social events.

Example: *"Lectures and tutorials are noisy and crowded; I often become anxious and struggle to process the content above the background noise. The biggest challenge was being able to find a quiet place to work and revise (very distracted by noise) but I live near home so moved home during exam time."*

The other core feature of ASD that was reported by the students was sensitivity to changes in the routine. This could also be related to their need for clear structure on assessment and their reluctance to engage in new environments.

Mental health challenges: As previously noted, 54% of the current sample reported having mental health issues and many students (*n* = 10; 38%) reported difficulties navigating their social and academic world due to their mental health challenges. Please see Table 5.4 for example quotes.

Theme: Support and Awareness of ASD

The participants answered two broad questions to probe the support they received and what helped them the most in their transition to University life. Finally, participants were asked about the most important thing we should know about being a University student with autism. The responses to these questions resulted in two sub-themes of *support* and *awareness of ASD by others*.

Support: Autistic students (*n* = 16; 62%) reported that they received support from their institution and the types of support that were explicitly mentioned included mentoring (*n* =6; 23%) disability services support (*n* = 4; 15%) and study tutors (*n* = 2; 8%). Moreover, accommodations such as exam allowances (e.g. extra time, extensions), use of a dictaphone or a note-taker in lectures, alternative assessments methods, and specialised rooms were provided for students. However, 5 students (19%) stated that they did not receive any support (even when requested) and 2 students (8%) reported that they did not ask for help or support thinking that it would not be useful (as illustrated in the example below):

Example: *"Nothing, but I have not requested or looked into receiving any additional support as I feel it's largely unneeded. Most of the things that such services offer are probably of little help for my particular case. I don't want help making friends for a rich social life, or special activities for the disabled, etc. I want to be able to manage my anxiety enough to function professionally (for which I have had out-of-university Cognitive Behavioural Therapy) and be left alone as much as possible beyond that.*"

In addition to professional support, some students reported professional support at their institution, social support (e.g. family friends, partners) along with several personal qualities such as independence and confidence, which helped them in their transition from school to university (see Table 5.4 for more examples).

Example: *"I disliked secondary school because I never accepted that parents or teachers had authority over me, and I was never willing to obey unreasonable rules. I enjoyed the freedom to pursue a subject I was very interested in, and to be captain of my own ship."*

Awareness of ASD by others: 12 students (46%) stated that society should better understand the challenges experienced by autistic individuals, especially in social situations, and approach them without being stigmatizing or patronising. Students also emphasized the importance of the diversity and heterogeneity among individuals with autism and they mentioned that they do not want to be perceived or treated differently (n = 5; 19%). Indeed awareness and training in ASD awareness were important to the views expressed by the students with autism and to encourage the involvement of autistic students and be more accessible.

Example: *"Every ASD person is different in how much attention and social enrichment they want or need. Everyone's experience is different, and no two students will face the same difficulties. Understanding without being patronising is key, and the condition can be both a blessing and a curse at this level."*

Table 5.4. Thematic analysis results including the frequency of themes and subthemes for the autistic students (n = 26)

Themes	Subthemes		n	Example quotes
Social Functioning	Social skills	Socialisation/making friends Difficulty expressing yourself Self-advocacy and awareness of problems	23	*"Knowing the right level of chilled/excited with friends… It is incredibly isolating and lonely, and for me personally, has been a very destructive process."*
	Social activities	Organizing a life-work balance Unpredictable and anxiety provoking Hard to initiate and be involved Forced and not diverse Hard to find people with similar interests	17	*"If you don't drink or find clubs/bars/etc nightmarish, there are virtually no opportunities for you to socialise, especially if you're also frightened off by societies like I am. I haven't gone out and been social once in my entire first year here, and have talked to maybe a maximum of three other people on my course."*
Academic Functioning	Academic Challenges	Need for guidance and clear instructions Not knowing how to pace Absorption in one subject Processing time Organizational skills Attention problems Group work and supervisor relationships Visualising abstract concepts/ Motivation/procrastination Critical/creative thinking Research/data analysis	12	*"The temptation to delve into all the new and interesting academic information to hide from having to socialise. The urge to study ALL THE THINGS, ending up not covering enough material to a superficial level."*
	Academic Strengths	Academic and critical writing Ability to work long hours Understand complex ideas Memory	20	*"Academically, I came top on my course in terms of grades, so it's hard to beat that. I don't think I was the cleverest, nor the most innovative, but I have an excellent memory and was willing to just write whatever*

				argument I thought the lecturer marking would want to see, and most of the time that was all that was required."
ASD related issues	Sensory overload and sensitivity to change	Noisy environments in the campus Harder to calm in new environments Hard to build routines	13	*"The social activities can be unsettling as this is a change of routine. When I get settled into them, they are quite enjoyable, but it is working out how to fit in."*
	Mental Health Challenges	High level of comorbidity Isolation/loneliness Daily activities being very stressful and anxiety eliciting	16	*"The sheer quantity of new things (especially new people) causes brain overload and anxiety. I find many everyday activities more difficult and stressful than other people do, but this is not always obvious to those around me."*
Support and Awareness of ASD	Support	Academic support Non-academic support Accommodations Personal strengths	16	*"A strong confidence and ability to get on with things when I need to helped me the most during university."*
	Awareness of ASD from others	Understanding their challenges/needs Heterogeneity among the students Stigmatization/different attitude	18	*"I think society executives should have some form of awareness training about how to include people with ASD and be more accessible. Especially as joining societies may be the only way to meet people. Understand that people with ASD won't necessarily ask for help when they need it, either because they don't know how to or they don't know that they should."*

5.4. Discussion

The current study investigated the social and academic experiences of current university students with and without autism in the UK. The systematic analysis of qualitative and quantitative data indicated both social and academic challenges for students with autism compared to non-autistic students, supporting the core hypotheses and previously published research from students in the US (Gelbar, Shefcyk, & Reichow, 2015; Anderson, Stephenson, & Carter, 2017b; Jackson et al., 2018; Sarrett, 2018). Moreover, high rates of self-reported mental health issues were evident and these were higher than those reported by non-autistic students. Several themes emerged from the qualitative data provided by the autistic students which supported the data from the Likert-scale items of the questionnaire. These additional qualitative insights provide rich illustrations of the experiences of students with autism at university. Indeed, the current study is the first to combine insights from autistic and non-autistic students for direct comparison, while using both qualitative and quantitative data to understand University experiences in the UK.

The first aim of the study was to understand the social challenges and strengths of students with and without autism. Overall, the students with autism self-reported poorer social skills compared to non-autistic students. It was clear from the questionnaire items that the biggest challenges were difficulties with social interactions, loneliness, and lack of interpersonal skills, though there was naturally individual variability in the challenges that were reported. In fact, students with and without autism reported similar motivation levels for friendships such as pleasure talking to friends (70% in ASD; 88.5% in TD) and having fun times being with friends (77% in ASD; 89% in TD). The desire to form and maintain friendships in ASD supports previous studies (Sumiya, Igarashi, & Miyahara, 2018; O'hagan & Hebron, 2017; Mazurek, 2014). The research, however, showed that the autistic individuals might not put their knowledge about friendships into practice (Calder, Hill, & Pellicano, 2013) due to broader social skill difficulties (Sedgewick et al., 2016). This could explain why 72% of the autism group did not find their relationships with others meaningful, and 66% reported having no friends. This is in line with the previous research suggesting social challenges (Gelbar, Shefcyk, & Reichow, 2015; Knott &

Taylor 2014; Cai & Richdale, 2016; Tobin et al., 2014; Müller, 2008). Supporting the quantitative data, the qualitative insights emphasised similar social challenges which could lead to social isolation and loneliness in some cases. Indeed, social activities were considered as overwhelming, unpredictable, and superficial. Importantly, there were large individual differences shown by the students with autism, with significant variation expressed in the desire for social interactions, and the degree of social challenges experienced. It is highly relevant that social participation is a central facet of the university life (Orsmond et al., 2013) and the current research suggests that providing further support for the social challenges experienced by some (but not necessarily all) autistic students could go some way to easing the transition from school to university (e.g. see Wehman et al., 2014). Considering the diverse social opportunities available to students would also be beneficial because many autistic adults show a motivation towards having friends, enjoy social activities (Sarrett, 2018; Van Hees et al., 2015), and are willing to participate in social opportunities (Orsmond, Krauss, & Seltzer, 2004), therefore providing activities with more structure and a more diverse range of activities may facilitate higher engagement levels (and reduce the potential for social isolation; Sosnowy et al., 2018).

The second aim was to identify the self-reported academic strengths and challenges of university students with and without autism. Overall, the students with autism reported enjoyment in their academic work, said they received good academic grades, or had good study habits (e.g. academic focus) in line with previous research (Gelbar, Shefcyk, & Reichow, 2015; Jackson et al., 2018). However, these positive experiences of academic life occurred together with some challenges and adaptation difficulties. A significant proportion of the autistic students reported that they had difficulty adjusting to their institution and 56% reported that they had considered withdrawing or taking a break from their studies, which was significantly more than reported by the non-autistic students. These issues for the students with autism could be explained by a lack of confidence in dealing with the future challenges, and difficulties finding the motivation to study (both issues reported in the current study by autistic students). The qualitative analysis included reports of 'poorer' academic functioning, difficulties working in groups, over-absorption in one subject, pursuit of perfection, reduced processing speed, time management difficulties and a lack of organizational skills.

Some of these challenges have also been reported in previous studies (Van Hees et al., 2015; Knott & Taylor, 2014) and this suggests that these may be consistent features for students with autism that warrant support for academic services within Universities (Barnhill, 2016). Importantly, we need to consider the opportunity to capitalise on academic strengths of autistic students and these were self-reported in their research skills, written abilities, analytical thinking, understanding complex ideas, and an ambition to learn their subject of interest. Similar strengths and factors to promote success among autistic university students (e.g. self-determination) have been identified in previous studies (Drake, 2014; Gobbo & Shmulsky, 2014; Accardo, 2017) and again it has been previously suggested that these strengths could be capitalised to enhance academic outcomes (Iovannone et al., 2003) but this approach has not yet been applied to higher-education students with autism. Taking into account personal strengths when developing support strategies would help students achieve their full academic potential.

Both social and academic challenges reported by the autistic students could derive from broader ASD-related issues. For instance, students with autism reported difficulties in building relationships with the supervisors and working in groups. Both these situations require social interaction skills. These two issues could be underlined by the core features of social communication and aspects of Theory of Mind difficulty associated with ASD (Marans, Rubin, & Laurent, 2005). In a similar way, other ASD-related symptoms such as responses to overwhelming sensory stimuli, and sensitivity to changes in routine, could also influence the ability to adapt and navigate in social and academic environments at University (Grapel, Cicchetti, & Volkmar, 2015; Bodfish, 1999). This is supported in the current study, where students with autism reported problems with adapting to changes in class and being overwhelmed by noisy and crowded lectures. So, while there will be significant individual differences, there is also a need to incorporate understanding of the core features of the autism spectrum into support for these students.

The third aim was to identify the support that students with autism received and explore how this could be improved. Even though students reported that they received professional support (e.g. study advisor, mentor, disability service), there were 6 students (23%) who did not receive any support. Equally, in some cases the offered support was entirely for academic functioning, but the main areas of need were non-academic in nature (e.g. social communication). With this in mind, some students reported the need for more expertise in understanding ASD and feeding this knowledge into planned support, which is also addressed in previous research (Ashbaugh, Koegel, & Koegel, 2017). Many students commented on how it could currently be very difficult to ask for a help, or they would sometimes not recognize when they needed help. Therefore, it is important for people working with autistic students to be aware of potential difficulties with self-identifying issues and requesting support in a proactive manner. This requires an easily accessible support system with regularly scheduled support opportunities / meetings. A support group model with regular meetings integrated into the curriculum has previously been found to be efficient in improving both social and academic functioning of students with autism in the US, and reducing anxiety and depression (Hillier et al., 2017). This latter issue is crucial given the high self-reports of anxiety and depression in the current sample. So therefore, it is crucial for professional support staff within Universities to understand the cognitive and social experiences associated with a diagnosis of ASD and to use this understanding to help plan effective support (Rodgers & Ofield, 2018).

The autistic students self-reported a wide array of challenges and needs, indicating significant heterogeneity in their experiences and proficiencies. This heterogeneity adds a further challenge for support services. A personalized support system would be more beneficial to track individual needs and intervene accordingly. A recent pilot study with Australian university students with autism investigated the effect of specialized peer-mentoring with flexible and individualised support (Siew et al., 2017). The researchers found that students performed better academically and socially and they had higher retention rates. There was evidence of increased socialisation through new friendships, and a reduction in reports of communication difficulties (e.g. with both peers and University staff). An individualised support network allows the opportunity to also capitalise on strengths at an individual level. For example, some autistic students in the current study reported being independent, a good listener, and confident to get on tasks when needed and these competencies can contribute to better daily functioning (Van Hees et al., 2015) and could be further incorporated into practice and student support programmes (Coseden et al., 2016). For example, initial screening of individual strengths and competencies in autistic students could give insight into the best possible support strategies for more personalised and tailored intervention. However, the downside of this approach is the need to invest in expertise to complete evaluations and expert support staff with sufficient knowledge of ASD and this requires additional University resources (e.g. staff, financial investment, time for student support).

Finally, autistic students reported the lack of awareness and a lack of acceptance of ASD. Many students highlighted that they felt their lecturers and other students did not have sufficient insight into their difficulties, or an acceptance of their differences. This may be a cause underlying, or leading to, social isolation or even bullying of students with autism (Pinder-Amaker, 2014). A recent study showed that neurotypical observers were found to build negative and less favourable opinions of both children and adults with autism engaged in a social interaction (Sasson et al., 2017). Additionally, the observers reported reduced desire to develop future social relationships with autistic individuals. A lack of social acceptance may also feed into mental health difficulties experienced by those with autism, as reported here (see also Cage, Di Monaco, & Newell, 2018; Griffith et al., 2011). Sasson and colleagues (2017) reported that autistic adults who reported high rates of depression and who considered there to be a lack of autism acceptance, were more likely to display 'camouflaging' behaviour, which has been reported in another recent study as well (Lai et al. 2017). The constant struggle to look "normal" can lead to increased levels of anxiety and social withdrawal and therefore it is important to consider all of these issues in tandem with the aim of increasing awareness and appreciation of neurodiversity in higher education students, in order to create a more inclusive and supportive environment.

5.4.1. Limitations and Future Directions

There are some limitations of the current study. The sample size of the non-autistic group was larger than the autism group, and indeed the sample size for the autistic students was relatively small. Nevertheless, the sample size of the autistic group was bigger than the average sample size of the previously published studies conducted with higher education students with autism outside the UK (*n* = 16; Anderson, Stephenson, & Carter, 2017b). Future research should aim to include more students with autism across a wide range of UK institutions which would allow further exploration of individual differences in addition to the core issues studied here. The other limitation is the uneven representation of sex in each group as the TD group has a bigger female:male (2:1) ratio than the autism group (1:3). This is important because the reported needs and challenges could be related to sex differences rather than the ASD diagnosis. Therefore, future research should further explore the impact of sex on the experience of studying at University. This was not an aim of the current study but a future project focusing on sex differences in the social and academic experiences would be particularly useful for further investigating females with autism.

A further issue to reflect upon for the current study was that the ASD diagnoses, and the reporting of mental health difficulties, were self-reported. Confirmation of diagnosis would be beneficial in future research though this is a challenge for working across a number of educational institutions and accessing students in sufficient numbers. On the other hand, self-report measures have been increasingly used in research with autistic participants (e.g. anxiety and depression research, Williams, 2010; personality research, Hesselmark et al., 2015) and these data are crucial for gaining insights into personal experiences and giving autistic adults a voice within society.

Given that the current study only looked at the self-reported experiences of students with and without autism, it is difficult to infer the underlying mechanisms behind the reported experiences (both challenges and proficiencies). There could be potential mechanisms, such as a role for executive function, emotion regulation, social motivation, and theory of mind (Gobbo & Schmulsky, 2014; White et al., 2016) that underpin a number of the issues raised by autistic students in this study. Future research should measure these constructs using more direct and objective methods and correlate these with the reported University experiences for students with autism. In a similar vein, the literature would also benefit from longitudinal studies with follow-up measures to examine how social and academic experiences in higher education can influence outcomes for students with autism (e.g. employment, quality of life). In more clinical terms, the current study provides insights into the support needs of autistic students and newly developed support systems should focus on increasing awareness of ASD among staff and other students, while considering individual differences between students with autism, and trying to capitalise on potential strengths. With this in mind the aim is to provide the best possible support for both academic and social participation to enhance the likelihood of autistic students reaching their full potential.

5.4.2. Conclusions

The current study was the first to compare the social and academic challenges and needs of age and study-matched students with and without autism in higher education in the UK providing both qualitative and quantitative data. The combination of demographic, quantitative and qualitative data provided further insight into the nature of self-reported social and academic experiences. The responses to open-ended questions indicated issues such as self-advocacy problems, vast heterogeneity in terms of proficiencies and challenges, and reported that autistic students felt there was a lack of awareness and acceptance of ASD. In order to promote a good transition to University, and in order help students with autism reach their full potential, all these factors should be considered in developing appropriate and effective interventions and support for autistic students.

Chapter Six: Profiles of social motivation in autistic and neurotypical adults

6.1. Introduction

Chapter 5 developed a new questionnaire focused on quantitative and qualitative insights into academic and social experiences for students with and without ASD at university. The results emphasized that some autistic students struggle at university, particularly in social domains including poor social skills, isolation/loneliness, together with high social anxiety and depression. However, in terms of social motivation, students with ASD reported similar motivation levels for friendships as their neurotypical (NT) peers. The results from Chapter 5 along with behavioural, psychophysiological, and self-report measures in previous chapters of this thesis, have provided evidence for a more complex and heterogeneous experience of social motivation in young adults with ASD, than that outlined in the Social Motivation Theory (Chevallier et al., 2012).

As discussed in Chapter 2, individual differences in social motivation of autistic individuals could be explained by other factors, such as social anxiety (Swain et al., 2015) and social skills (Neuhaus, Webb, & Bernier, 2019). Given the high variability that characterizes ASD, understanding social experiences requires investigation of individual differences that interact with social motivation and contribute to social functioning in adults with ASD. The current chapter, therefore, focused on individual differences in social motivation in a broader adult sample including both ASD and NT individuals. In addition to mean differences for the whole group, this chapter investigated social motivation at the more individual level and its associations with multiple factors including autistic traits, alexithymia, social anxiety, depression, and loneliness. Given the multi-method approach throughout this PhD thesis, primary measures of social motivation, autistic traits, social anxiety, alexithymia, depression, and loneliness were assessed by using self-report questionnaires in a complementary fashion to behavioural and psychophysiological measures applied in Chapter 3 and 4. This chapter contributes to the literature by characterizing potential factors that might interact with social motivation in a broader adult sample including both autistic and NT individuals. This line of research is important to understand the individual differences in social motivation and develop personalized interventions accordingly.

6.1.1. Self-report studies of social motivation

As discussed in Chapter 2, there is emerging evidence on self-report measures of social motivation in children and adults with ASD (see section 2.7). However, there is no consistency in terms of self-report measures used to assess social motivation in the literature. Moreover, social motivation as a construct consists of at least four components, including social orienting, social wanting, social liking, and social maintaining, which makes it even more challenging to measure using existing validated questionnaires. Social liking (e.g. pleasure gained from social interactions) is the most commonly studied component in research using self-report measures. For example, Chevallier et al. (2012) found that adolescents with ASD reported less pleasure in being and interacting with others, as measured by the Pleasure Scale (Kazdin, 1989). The reduced experiences of pleasure in autistic adolescents were specific to social pleasure whilst the physical and non-social pleasure were not different between the adolescents with and without ASD (Chevallier, Grèzes, et al., 2012). Similarly, autistic adults had significantly higher scores on the Social Anhedonia Scale (SAS; Chapman et al., 1976) compared to neurotypical adults, reflecting less pleasure derived from social situations in ASD (Carré et al., 2015). Foremost, higher social anhedonia in these studies was correlated with autism severity (Chevallier, Grèzes, et al., 2012) and autistic traits (Carré et al., 2015). The SAS scores in the latter study also predicted ASD diagnosis (Carré et al., 2015). These results overall emphasize that self-reported experience of pleasure (therefore social liking) in social interactions/situations is reduced in individuals with ASD.

In addition to social liking, the social wanting component has been investigated using a recently developed measure, namely the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS; Gooding & Pflum, 2014a). This 17-item measure assesses the capacity to experience pleasure in social and interpersonal situations. The ACIPS consists of two subscales; anticipatory subscale aims to measure the social wanting component, whereas consummatory subscale aims to measure the social liking component. Administering the ACIPS to a broader population of adults, Novacek et al. (2016) found that higher autistic traits were associated with less experience of pleasure in social and interpersonal interactions, as well as general pleasure measured by the Temporal Experience of Pleasure Scale (TEPS; Gard et al., 2006). However, the ACIPS scores in this study were a stronger predictor of autistic traits (21%) while the TEPS scores did not predict the autistic traits when added in the model. The researchers suggested that reduced social hedonic capacity should be included in conceptualizations of the broader ASD phenotype (Novacek et al., 2016). Recently, the ACIPS was administered to autistic adults in comparison to adults with clinical depression (NT-dep) and neurotypical adults who have never had depression (Han, Tomarken, & Gotham, 2019). The results demonstrated that the ASD and NT-dep groups were not significantly different in terms of their ACIPS and TEPS scores, which were both significantly lower than the NT group. In this study, higher autism severity (as measured by SRS-2) significantly predicted social hedonic capacity (39% of the variance) across participants, regardless of the diagnosis. This study will be discussed later in the section focusing on depression and loneliness in relation to social motivation.

Collectively, self-report studies of social motivation have shown that ASD individuals had on average reduced enjoyment/pleasure in social interactions than NT individuals, along with a link between increased social anhedonia and higher autistic traits in autistic and NT populations (Carré et al., 2015; Chevallier, Grèzes, et al., 2012; Novacek et al., 2016). The reduced capacity for enjoying social interactions in ASD could be due to mental health difficulties, especially social anxiety, which makes social interactions challenging and therefore less enjoyable. To understand the role of mental health on social motivation, the next section will discuss the contributions of social anxiety to individual differences in social motivation.

6.1.2. Self-report studies of social anxiety

As emphasized in Chapter 2 (see section 2.8.2), social anxiety is more prevalent among individuals with ASD. Moreover, social anxiety predicted feelings of exclusion and greater expectation for social rejection in Chapters 3 and 4 respectively. Therefore, social anxiety may contribute to heterogeneity in social motivation, which has been overlooked in the SMT. For instance, autistic individuals with high social anxiety might find it difficult to approach others leading to isolation and loneliness, and consequently less enjoyment in social interactions (White & Roberson-Nay, 2009). A recent study by Pallathra et al. (2018) investigated the relationships between social motivation, social anxiety, social skills, social cognition, and overall social functioning in adults with ASD (*n* = 29, mean age = 26 years). According to data from self-reports, lower social motivation scores (as measured by Motivation and Pleasure Scale; Llerena et al., 2013) were associated with higher social anxiety, poorer social skills and social functioning, and higher ASD symptoms (measured by SRS and Broad Autism Phenotype Questionnaire; BAPQ), but not with social cognition (Pallathra et al., 2018). Social motivation was the only variable that correlated with most of the other variables included in this study. These results emphasize the importance of social motivation as an intervention target, especially due to its relation to social functioning in ASD.

The relationships between social motivation, social anxiety, and emotion regulation were further investigated in 69 adults with ASD (mean age = 20.5) using self-report data from autistic participants and their caregivers (Swain et al., 2015). Lower social motivation (as measured by SRS) was significantly correlated with high social anxiety (as measured by Social Anxiety Score), and emotion dysregulation (as measured by Difficulties in Emotion Regulation Scale). Subsequent multiple linear regression analyses demonstrated that social anxiety, especially fear of negative evaluations, was a significant predictor of social motivation and emotion dysregulation in autistic adults (Swain et al., 2015). These results suggested that highly socially anxious individuals with ASD might display reduced social motivation due to avoidance behaviours in social situations. However, it is important to emphasize that social motivation in this study was measured by the SRS reported by caregivers, which is more indicative of behavioural manifestations of social motivation, but not less observable features such as social curiosity, interest in others, and desire for interaction. Therefore, highly socially motivated individuals might still score low on SRS and they might show avoidance behaviour due to fear of being negatively judged by others, rather than a disinterest in others. Moreover, linear analysis models may not allow for a complex relationship between the constructs such that both high and low social motivation might be associated with similar levels of social anxiety. Therefore, it is required to use other indicators of social motivation (e.g. pleasure in social interactions) and to apply more complex analysis methods in order to understand the link between social anxiety and social motivation.

6.1.3. Self-report studies of depression and loneliness

In addition to social anxiety, depression is highly prevalent in ASD (Sterling et al., 2008). According to a recent review of neurobiological and self-report studies, there is an association between having depression and reduced experience of pleasure and reward-related motivation (Cooper, Arulpragasam, & Treadway, 2018), which might also apply to some individuals with ASD. Alternatively, low social motivation in ASD could lead to loneliness and depression as a result of reduced social contact and isolation (Hedley et al., 2018; Whitehouse et al., 2009). On the other hand, reduced social motivation may not be associated with loneliness if the autistic individual is satisfied with their reduced social contact. Therefore, examining the relationship between loneliness and social motivation is relevant to understand varying social experience in ASD.

There has been only one study which examined the role of social motivation on loneliness and depressive symptoms in three different populations; ASD, NT with current clinical depression (NT-dep), and NT never depressed (Han, Tomarken, & Gotham, 2019). In this study, social motivation moderated the relationship between autism symptoms (as measured by the SRS) and loneliness (as measured by the Loneliness in Context Questionnaire; Asher & Weeks, 2014), such that low capacity for social and non-social pleasure (as measured by the ACIPS and TEPS, respectively) predicted loneliness regardless of the autistic symptoms across the samples. However, high hedonic capacity for social interactions together with high autistic symptoms predicted greater loneliness in the whole sample. These results suggested that reduced capacity for social and non-social pleasure might serve as risk factors for depression in adults with ASD and individual differences in social motivation modulate the trajectory between social impairments and loneliness. As such, individuals with a desire to interact but who don’t have the required social skills were more likely to feel lonely and depressed (Han, Tomarken, & Gotham, 2019). This can also explain why autistic individuals with typical social motivation might experience heightened loneliness and depression (Calder et al., 2013; Jobe & Williams, 2007). This study is important because it shows how varying levels of social motivation could have differential impacts on mental health in autistic and NT individuals depending on social skills. With this in mind, factors such as loneliness and depression might play a role in defining different profiles of social motivation in autistic and NT individuals. These results also emphasize the modulatory role of social skills in the relationship between social motivation and mental health in ASD.

6.1.4. Self-report studies of alexithymia

As discussed above, social skills are important in social motivation experiences in ASD. Difficulties in social skills and social communication can interfere with the capacity to enjoy social interactions. For example, reduced ability to identify and describe one's own feelings, known as alexithymia (Lane & Schwartz, 1987; Bird & Cook, 2013), may have an impact upon motivation for interacting with others. Alexithymia is commonly observed among autistic individuals (prevalence of 50%; Berthoz & Hill, 2005) and it is associated with difficulties in empathy, and therefore, an impaired ability to recognize the emotions of others (Valdespino et al., 2017; Bird & Cook, 2013). Due to these difficulties, autistic individuals might struggle with regulating their emotions and understanding others' emotions in social situations, and therefore find social situations confusing even if they are socially motivated (Vanheule et al., 2007). Concurrently, difficulties in expressing and sharing emotions with others might create a disconnection between the autistic and NT individual (Pastore et al., 2019). Previous research has shown that both self-reported social (SAS) and physical anhedonia (PAS) were significantly correlated with alexithymia (as measured by the Toronto Alexithymia Scale (TAS); Bagby, Parker, & Taylor, 1994) in a population including autistic adults, parents of children with ASD, and NT adults (Berthoz et al., 2013). These results suggest that individuals with poor ability to identify and describe emotions experience less pleasure mostly in social, but also in non-social situations. However, the SAS and PAS measures in this study had only "yes" or "no" to choose from, and therefore lacking the range of response options to assess different levels of pleasure obtained from social and non-social situations.

In a study investigating the relationship between alexithymia and social motivation in a large non-clinical population (*n* = 472, mean age = 35.4), autistic traits and alexithymia were found to have unique roles in social motivation (Foulkes et al., 2015). For example, a negative relationship between autistic traits and sociability suggested that individuals with social difficulties are less likely to engage in spontaneous socialising compared to their NT peers. On the other hand, both higher autistic traits and heightened alexithymia were associated with lesser enjoyment of prosocial interactions. These results indicated that ASD related symptoms such as the ability to identify one’s own emotions might play a role on experiences of pleasure in social situations. Given that this was a study with the neurotypical population, the interplay between autistic traits, alexithymia, and social motivation warrants further investigation in the autistic population.

6.1.5. Current study

Previous research has implied an interplay between social motivation, autistic traits, social anxiety, and loneliness, and alexithymia in autistic and neurotypical populations. However, most of these studies have only investigated the group level differences and none have examined these factors together in relation to social motivation in adults with and without ASD. Therefore, the main aim of the current study was to investigate the role of autistic traits, alexithymia, social anxiety, depression, and loneliness on individual differences in social motivation of autistic and NT adults. To this end, self-report measures were administered. To assess social motivation, the ACIPS was chosen as a reliable measure of hedonic capacity for social and interpersonal interactions in autistic and NT populations as it reflects less behavioural and more intuitive aspects of both social wanting and liking components of social motivation (Gooding & Pflum, 2014a, 2014b).

Before examining individual differences in social motivation, the first aim was to investigate group differences in primary measures of social motivation, autistic traits, alexithymia, social anxiety, depression, and loneliness between the ASD and NT groups. Based on the previous literature, it was hypothesized that group level comparisons would show significantly reduced social motivation together with higher autistic traits, higher social anxiety, higher alexithymia, and higher depression in adults with ASD compared to NT adults. The second aim was to investigate the factors that were associated with social motivation in the ASD and NT group separately. Even though analysing the data for each group separately would lead to smaller samples sizes (alongside multiple comparisons), it is important to examine whether the relationships were similar in ASD and NT groups. It was hypothesized that social motivation would be negatively correlated with autistic traits, social anxiety, and alexithymia in the ASD and NT groups, however, different factors were expected to predict individual differences in social motivation in ASD and NT adults. Based on the literature, both higher autistic traits, greater alexithymia, and higher social anxiety were expected to predict lower social motivation in the ASD group. However, the hypothesis regarding the predictors of social motivation in the NT group was more exploratory. Lastly, considering the heterogeneity of social behaviour in a diverse population, the profiles of social motivation within ASD and NT adults were identified using the cluster analysis. The purpose of this analysis was to examine the individual variability within each group and discover meaningful subgroups based on social motivation, social anxiety, autistic traits, and alexithymia that may exist within the ASD and NT group. The cluster analysis allows examining nonlinear relationships between the measures that correlations or regression analyses cannot identify. This analysis was exploratory, however, distinct subgroups were expected to emerge that were driven by social motivation, social skills, and social anxiety within the ASD group.

6.2. Methods

6.2.1. Participants

The participant characteristics are presented in Table 6.1. In this study, 73 adults with ASD (mean age = 29.77, SD = 9.61, range = 18-54, 33 females) and 69 NT individuals (mean age = 27.19, SD = 9.48, range = 18-52, 42 females) were recruited to complete an online questionnaire including all the primary measures noted below. In the ASD group, 13 individuals defined their gender as non-binary. In terms of chronological age, the groups did not significantly differ from each other, $t(139) = -1.646$, $p = .102$, $d = 0.27$. Both groups were recruited via advertisements around Durham University campus and via a number of social media outlets (e.g. Twitter and Facebook). The participants with ASD self-reported their diagnosis. All the participants self-reported that they spoke English fluently and 87.3% of the participants were native British speakers. The majority of the participants in both groups were university students

(ASD; 58.9%, NT; 63.2%). In the ASD group, 52% had mental health comorbidities (16.4% anxiety, 13.7% depression and 21.9% both anxiety and depression) while in the NT group, 16.2% had a mental health diagnosis (7.4% anxiety, 2.9% depression, and 5.9% both anxiety and depression). The participants above 55 years old (n = 3) were not included in the analysis as the interest of the study was not on the older adult population.

To detect the outliers, the mean raw scores from all the measures were transformed to z-scores and the z-scores between +3.29 and -3.29 were defined as an outlier (Tabachnick & Fidell, 2001; Ghosh & Vogt, 2012). As a result, one NT participant (37 years old, female) excluded from the analysis because her ACIPS z-score (raw score: 20, z-score: -3.52) was below the cut-off score. The final analysis included 73 adults with ASD (mean age = 29.77, SD = 9.61, range = 18-54, 33 females) and 68 NT individuals (mean age = 27.12, SD = 9.47, range = 18-52, 41 females).

Table 6.1. Participants demographics (ASD; *n* = 73, NT; *n* = 68)

Measure	ASD		NT	
	n	%	*n*	%
Sex				
Female	33	45.2	41	60.3
Male	27	37.0	27	39.7
Non-binary	13	17.8	0	0.0
Race				
White: not Hispanic or Latina	70	95.9	58	85.3
White: Hispanic or Latina	0	0.0	1	1.5
Black or African American	0	0.0	1	1.5
Asian	1	1.4	8	11.8
Mixed	2	2.7	0	0.0
Employment status				
Working	16	21.9	21	30.9
Not working	14	19.2	4	5.9
Student	43	58.9	43	63.2
High School	0	0	1	0.2
Bachelors	30	69.8	29	67.4
Masters	8	18.6	7	16.3
PhD	5	11.6	6	14.1
Mental health diagnosis	38	52	11	16.2
Anxiety	12	16.4	5	7.4
Depression	10	13.7	2	2.9
Both anxiety and depression	16	21.9	4	5.9
None	25	34.2	54	79.4

6.2.2. Measures

The Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS)

The ACIPS is a 17-item self-report questionnaire developed to measure the ability to experience pleasure in social and interpersonal interactions such as enjoying doing things together with others. Given the distinction between social reward wanting and liking (Berridge & Robinson, 2003), this questionnaire was designed to assess two aspects of pleasure; anticipation for social pleasure and enjoying having received the social pleasure. Therefore, 7 of the items include questions about the anticipation component (i.e. social wanting) such as “looking forward to seeing friends” and 10 of the items include questions about the consummatory component (i.e. social liking) such as “enjoy having a discussion with a friend”. The ACIPS is scored on a 1 (“very false for me”) to 6 scale (“very true for me). Lower scores in this questionnaire indicate social anhedonia – reduced interest in/pleasure from interpersonal interactions and social occasions. Previous studies reported 4-factor structure in the ACIP, overall explaining 51.32% of the variance (Gooding & Pflum, 2014a). These factors were general *social interactions* (34.08%), *close relationships* (6.4%), *bonding over shared interests and experiences* (5.77%), and *family-related interactions* (5.7%). However, a distinction between the anticipatory and consummatory items was not detected (Gooding & Pflum, 2014a). Previous studies showed that the ACIPS in neurotypical populations had good internal consistency ($\alpha = .91$), and high convergent validity with other measures of social pleasure ($\alpha = .72$ with Temporal Experience of Pleasure Scale – anticipatory subscale and $\alpha = -.60$ with Social Anhedonia Scale) (Gooding & Plum, 2014a, 2014b). In the current sample, the ACIPS demonstrated high internal consistency (coefficient $\alpha = .929$); ASD ($\alpha = .873$); NT ($\alpha = .902$).

Autism Quotient (AQ)

AQ is a 50-item self-report questionnaire to measure autistic traits in NT populations with IQ > 70. The measure, its subscales, and psychometric properties are described in section 3.2. In the present sample, the AQ demonstrated a high internal consistency (coefficient $\alpha = .930$); ASD ($\alpha = .854$); NT ($\alpha = .872$).

Toronto Alexithymia Scale – 20 (TAS)

The TAS is a 20-item self-report questionnaire designed to measure one’s ability to identify and describe one’s own and others’ feelings. The items are rated on a scale from 1 (“strongly disagree”) to 5 (“strongly agree”). Higher scores indicate higher levels of alexithymia. Previous research found a 3-factor structure explaining 31% of the variance in the data (Bagby et al., 1994). These factors were *difficulty identifying feelings*, *difficulty describing feelings,* and *externally oriented thinking.* The TAS-20 has demonstrated high internal consistency in previous studies (Bagby et al., 1994; α

= .81; Foulkes et al., 2015, α = .88). In the present sample, the TAS-20 scores demonstrated high internal consistency for total score (coefficient α = .861); ASD (α = .825); NT (α = .845), identify feelings subscale (coefficient α = .797); ASD (α = .774); NT (α = .711), describe feelings subscale (coefficient α = .900); ASD (α = .856); NT (α = .897), externally orienting thinking subscale (coefficient α = .429); ASD (α = .380); NT (α = .498).

The Social Interaction Anxiety Scale (SIAS)

The SIAS is a 20-item self-report questionnaire developed to measure general fears of social interaction in adults, such as meeting new people or saying something embarrassing in social situations (Mattick & Clarke, 1998). The items are rated on a scale from 0 ("not at all") to 4 ("extremely"), to indicate the degree to which the person feel the statement is characteristic or true for him or her. Higher scores in the SIAS indicate great anxiety in social interactions. Previous research demonstrated high internal consistency in NT (α = .94) and autistic adults (α = .952; Maddox & White, 2015). In the present sample, the internal consistency of the SIAS was also high (coefficient α = .939); ASD (α = .825); NT (α = .845).

Depression Anxiety Stress Scale – 21 items (DASS-21)

The DASS-21 is an abbreviated version of the original 42-item DASS (Lovibond & Lovibond, 1995). The measure, its subscales, and psychometric properties are described in section 3.2. In the current sample, the DASS-21 demonstrated high internal consistency for total score (coefficient α = .942; ASD α = .938; NT α = .939), depression subscale (coefficient α = .898; ASD α = .906; NT α = .881), anxiety subscale (coefficient α = .875; ASD α = .884; NT α = .843), and stress subscale (coefficient α = .865; ASD α = .823; NT α = .885).

De Jong Gierveld Loneliness Scale – 6 items

De Jong Gierveld Loneliness Scale – 6 items is an abbreviated version of the original scale with 11 items (De Jong Gierveld &Van Tilburg, 1999). In this self-report questionnaire, the participants are asked to rate their agreement with each statement on a 3-scale response option; 1 ("yes"), 2 ("more or less") or 3 ("no"). Higher scores indicate greater experience of loneliness. Previous studies have shown that this brief version has 2-factor structure; social loneliness (3 items) and emotional loneliness (3 items), which were highly correlated with the 11 items from the longer version of the scale (De Jong Gierveld & Van Tilburg, 2006). The internal consistency for the 6-item varies between $\alpha = .70$ and $\alpha = .74$, while the reliability coefficients for emotional loneliness subscale were lower ($\alpha = .67$ and $\alpha = .74$) and for social loneliness subscale were between $\alpha = .70$ and .73 (De Jong Gierveld & Van Tilburg, 2006). In the present sample, the reliability coefficients were lower for the total score (coefficient $\alpha = .660$; ASD $\alpha = .656$; NT $\alpha = .627$), especially for emotional loneliness subscale (coefficient $\alpha = .470$; ASD $\alpha = .499$; NT $\alpha = .461$), compared to the social loneliness subscale (coefficient $\alpha = .699$; ASD $\alpha = .654$; NT $\alpha = .688$). Therefore, the results from this measure are interpreted with caution throughout this chapter.

6.2.3. Procedure

A battery of questionnaires including all the standardized self-report measures and demographics information was completed online, using the Online Surveys platform (onlinesurveys.ac.uk). The demographics section of the questionnaire included questions about age, gender, occupation, the level of study, the subject of study, highest qualification achieved, nationality, native language, ASD diagnosis, age of ASD diagnoses, and other current diagnoses (See Appendix F). Before the questionnaire, participants were first asked to enter a self-generated anonymous 4-digit number. All data collected were associated with this anonymous number and not with any identifiable information. The participants were also asked to enter their email addresses if they would like to enter a prize draw for a £50 Amazon voucher. At the end of the online questionnaire, participants were provided with the online link for the next study (to be discussed in Chapter 7) if they would like to participate. The study took between 20 and 40 minutes, depending on the pace of the participant to answer the questions. The study was approved by the Durham University Psychology Department Ethics Review Board.

6.2.4. Data analysis strategy

The data were described using boxplots and histograms to examine possible outliers and distributions in each group separately. In order to answer the first hypothesis, the group differences on primary measures were tested using independent samples *t*-tests (one-tailed). Bivariate correlations (one-tailed) were conducted to examine the relationships between the self-report measures in each group. The cut-off p-value for correlations was defined as 0.05 and multiple comparisons with Bonferroni corrections were also presented. The new p-value after adjusting for multiple comparisons was set at 0.004. In order to answer the second hypothesis regarding the predictors of individual differences in social motivation, correlations and series of hierarchical regression analyses were carried out to examine the predictor roles of autistic traits, alexithymia, social anxiety, depression, and loneliness on the ability to enjoy social and interpersonal interactions. Age was entered as a predictor in Step 1 of each model. In Step 2, AQ was entered as a predictor, followed by TAS-20 in Step 3. In Step 4, the SIAS was added as a predictor. In Step 5, the depression subscale of DASS-21 was entered. In Step 6, De Jong Gierveld Loneliness Scale was entered as the last predictor of the ACIPS scores. The regression analyses were run for each group separately in order to test the second hypothesis regarding different predictors of social motivation in the ASD and NT group. Data descriptions were performed using the R-Studio version 1.1.463 for Windows and data preparations and inferential analyses were performed using SPSS version 24 for Windows.

The last aim of the current study was to identify sub-profiles of social motivation within each group of ASD and NT participants. To this end, model-based cluster analyses with z-scores were run for each group separately (mclust: Zhong & Ghosh, 2003). Model-based cluster analysis uses the Bayesian Information Criterion (BIC) to compare multiple models with differing covariance matrix parameterizations and identify the best model with an optimum number of clusters (Raftery & Dean, 2006). A higher BIC indicates an optimal balance between the best fit of the model with the data and the complexity of the model. Model-based cluster analysis has been increasingly used in psychological research and it has been shown to be favoured when compared with other traditional cluster analyses (Mun et al., 2008). The cluster analysis was performed using the R (v 3.6.1, Vienna, Austria). One-way analysis of variance (ANOVA) with Tukey post hoc analyses were conducted to compare the clusters based on their autistic traits, social anxiety, and alexithymia.

6.3. Results

6.3.1. Descriptive statistics and group differences

Descriptive statistics and group differences in self-report measures are presented in Table 6.2. Consistent with the first hypothesis, the ASD group demonstrated significantly lower ACIPS scores than the NT group, indicating reduced capacity to experience pleasure in social and interpersonal interactions, $t(139) = 8.906$, $p < .001$, $d = 1.50$. When each subscale was examined, both anticipatory and consummatory subscales were significantly lower in the ASD group compared to NT group, $t(139) = 8.069$, $p < .001$, $d = 1.36$ for anticipatory and $t(139) = 8.883$, $p < .001$, $d = 1.50$ for consummatory subscales. As also expected, the AQ total scores were significantly higher in the ASD group than the NT group, $t(139) = -12.006$, $p < .001$, $d = 2.01$. As defined by Wheelwright et al. (2010), 14.7% of the NT participants met the criteria for either the broader (10.3%) or medium (4.4.%) autism spectrum phenotype category. However, none of the participants in the NT group met the criteria for the narrow autism phenotype.

Table 6.2. Descriptive information from primary measures and group differences

Variables		ASD		NT		*p*-values
		Mean	SD	Mean	SD	
ACIPS	Total score	55.08	13.88	76.22	14.30	< .001
	Anticipatory	22.10	6.18	30.78	6.60	< .001
	Consummatory	32.99	8.37	45.44	8.27	< .001
AQ	Total score	36.77	7.10	20.76	8.71	
TAS	Total score	62.40	11.46	50.54	12.50	< .001
	Identifying feelings	23.58	6.34	17.35	7.12	< .001
	Describing feelings	18.33	4.21	13.90	4.41	< .001
	Externally-oriented thinking	20.49	4.09	19.29	4.35	.047
SIAS	Total score	51.75	12.16	35.35	18.41	< .001
DASS-21	Total score	56.41	29.06	41.61	27.39	< .001
	Depression	18.16	11.61	13.88	10.60	.013
	Anxiety	14.99	11.49	10.21	9.22	.004
	Stress	23.26	9.77	17.52	11.30	< .001
De Jong Loneliness Scale	Total score	3.51	1.74	2.54	1.66	< .001
	Social	1.56	1.11	.84	(1.05)	< .001
	Emotional	1.95	1.01	1.71	(1.02)	.082

In terms of TAS-20 scores, the ASD group reported significantly higher alexithymia compared to the NT group, $t(139) = -5.875$, $p < .001$, $d = 0.99$ (see Table 6.2). In terms of the SIAS scores, the participants in the ASD group reported significantly higher social anxiety than the NT participants, and the effect size was large, $t(139) = -6.195$, $p < .001$, $d = 1.05$. As observed in the sample described in Chapter 3 and 4, the ASD group had significantly higher total DASS-21 scores than the NT group, $t(139) = -3.094$, $p < .001$, $d = 0.52$. The distributions of DASS cut-off scores are presented for each group in Figure 6.1. Lastly, the scores from De Jong Gierveld Loneliness Scale – 6 item demonstrated significantly higher loneliness in the ASD compared to the NT group with a medium effect size, $t(139) = -3.354$, $p < .001$, $d = 0.57$.

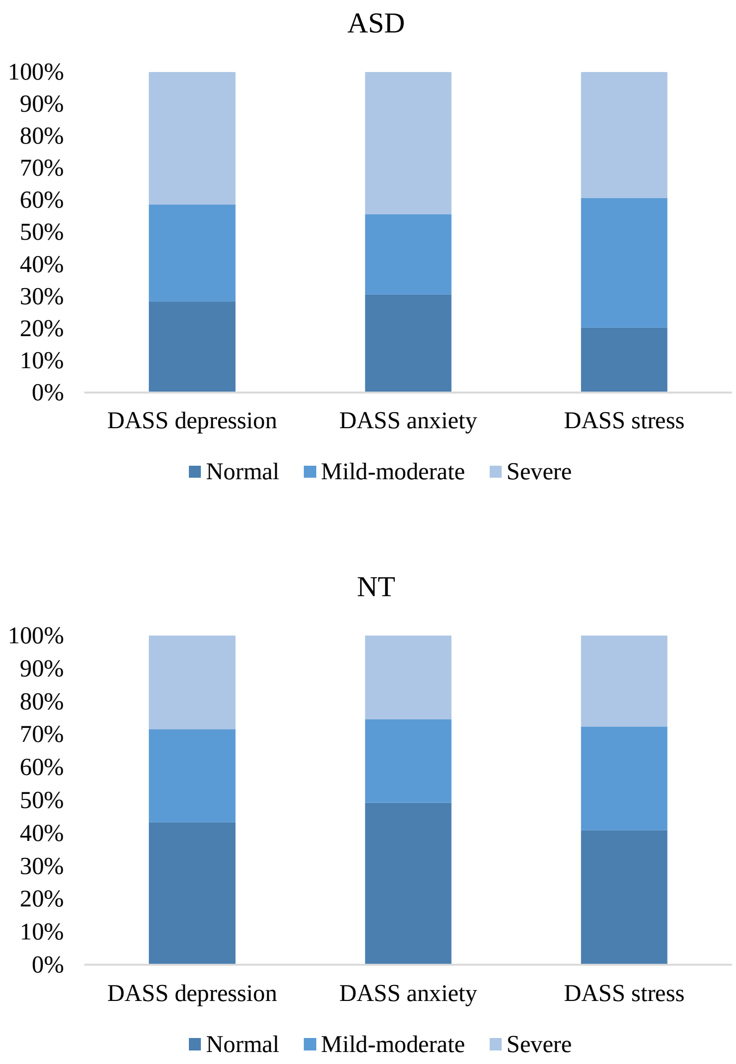

Figure 6.1. The distribution of DASS subscales based on the severity in the ASD (n = 73) and NT group (n = 67)

In order to examine the distribution of scores from the primary measures in each group, histograms were created (see Figure 6.2). As seen in these graphs, for every scale, there was substantial heterogeneity and variability within as well as between the groups. More importantly, there was a significant overlap between the ASD and NT group in all measures. These overlapping scores between the groups and the vast heterogeneity within each group emphasize the importance of examining individual variabilities and not only group means.

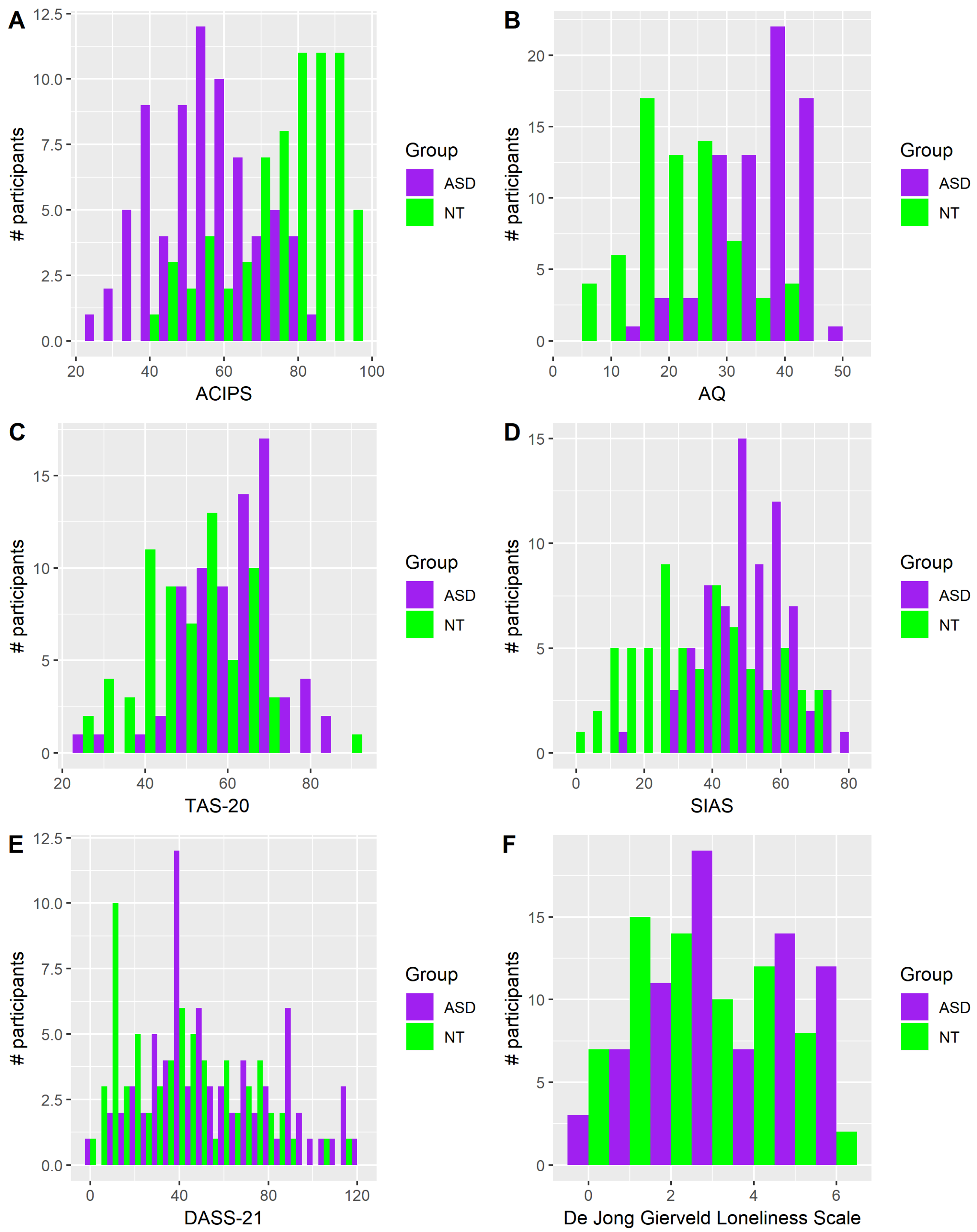

Figure 6.2. Histograms to demonstrate distribution on primary measures in each group

6.3.2. Correlation analyses

To test the second hypothesis in this chapter, one-tailed bivariate correlations between autistic traits (as measured by total AQ score), alexithymia (as measured by total TAS-20 score), social anxiety (as measured by SIAS score), depression (as measured by DASS-21 depression subscale score), loneliness (as measured by total De Jong Gierveld Loneliness Scale score) and the ability to experience social pleasure (as measured by ACIPS) were conducted in the ASD and NT group separately. Age was also entered in the correlations to examine its relationship with primary measures. In line with the hypothesis, social motivation was negatively correlated with autistic traits, alexithymia, social anxiety, and depression in the ASD group (see Table 6.3). However, the correlation between depression and social motivation was not significant after correcting for multiple comparisons. In addition, there was a significant negative relationship between age and social motivation in the ASD group, however, there was not a significant relationship between social motivation and loneliness. In terms of correlations in the NT group, there was a significant negative correlation between social motivation and autistic traits, alexithymia, social anxiety, depression, and loneliness, even after corrected for multiple comparisons (see Table 6.4). Therefore, the hypothesis for the NT group was accepted, as well. Moreover, these correlations were higher in the NT group than the ASD group. Similar to the ASD group, older age significantly predicted lower social motivation in the NT group.

Table 6.3. Bivariate correlations between all the primary measures in the ASD group (*n* = 73)

Variable	2	3	4	5	6	7
1. ACIPS Total	-.526**◊	-.403**◊	-.373**◊	-.242*	-.032	-.375**◊
2. AQ Total		.422**◊	.480**◊	.163	.057	.155
3. TAS-20 Total			.561**◊	.365**◊	.207*	.024
4. SIAS Total				.499**◊	.298**	.097
5. DASS-21 depression					.504**◊	.105
6. De Jong Gierveld Loneliness						.072
7. Age						

All correlations are one-tailed, *p <.05, **p <.01, ◊p < .004 significant effect after Bonferroni correction

Table 6.4. Bivariate correlations between all the primary measures in the NT group (*n* = 68)

Variable	2	3	4	5	6	7
1. ACIPS Total	-.738**◊	-.438**◊	-.570**◊	-.341**◊	-.432**◊	-.370**◊
2. AQ Total		.559**◊	.682**◊	.513**◊	.516**◊	.191
3. TAS-20 Total			.702**◊	.506**◊	.398**◊	-.112
4. SIAS Total				.521**◊	.488**◊	.054
5. DASS-21 depression					.666**◊	-.044
6. De Jong Gierveld Loneliness						.088
7. Age						

All correlations are one-tailed, *p <.05, **p <.01, ◊p < .004 significant effect after Bonferroni correction

In order to determine whether the correlations between the ACIPS and AQ scores were mostly derived from the items that measure similar constructs to social motivation in the AQ, the correlations were run without the items 17 ("I enjoy social chit-chat"), 44 ("I enjoy social occasions"), and 47 ("I enjoy meeting new people"). After removing these items, the correlations between ACIPS and AQ remained significant in the ASD (r = -.486, p < .001), and NT group (r = -.723, p < .001), suggesting that these items were not driving the association. Moreover, none of the relationships between the self-report measures in both groups indicated multicollinearity (r > .8), therefore not violating one of the assumptions of regression analyses.

6.3.3. Regression analyses

Having identified a relationship between constructs, as above, a series of hierarchical regression analyses were conducted to examine whether autistic traits, alexithymia, social anxiety, depression, or loneliness best predicted the ability to experience pleasure in social interactions in each group separately. Given the significant correlations between age and ACIPS scores (see Table 6.3 and 6.4), age was entered as the first predictor in each step. The results for the ASD group revealed that age was a significant predictor of ACIPS scores, β = -.541, t(71) = -3.407, p = .001, accounting for 12.8% of the variance (see Table 6.5). When AQ score was added to the model in Step 2, it was found to be a significant predictor of ACIPS, β = -.434, t(70) = -4.971, p < .001 and the model significantly improved, accounting for 34.7% of the variance. When TAS-20 total score was added in Step 3, it significantly predicted the ACIPS scores β = -.286, t(69) = -2.316, p < .001, accounting for 38.5% of the variance. When added in Step 4, SIAS total score was not a significant predictor of the ACIPS scores β = -.053, t(68) = -.394, p = .695. Depression, β = -.079, t(67) = -.601, p = .550 and loneliness, β = .986, t(66) = 1.141, p = .258 also did not predict ACIPS scores when added in Step 5 and Step 6, respectively. This suggests that social anxiety, depression, and loneliness did not explain any significant variance in the ability to experience social pleasure in autistic adults. Tests to check if the ASD data met the assumption of collinearity indicated that multicollinearity was not a concern (Age, *Tolerance* = .974, *VIF* = 1.207; AQ scores, *Tolerance* = .801, *VIF* = 1.248; TAS scores, *Tolerance* = .820, *VIF* = 1.219).

Table 6.5. Results from hierarchical regression predicting ACIPS scores in the ASD group

	Predictor	*B*	*SE B*	*t*	*p*	95% CI for *b*		adj. R^2
						Lower	Upper	
Model 1	(intercept)	71.192	4.966	14.336	.000	61.290	81.094	.128
	Age	-.541	.159	-3.407	.001	-.858	-.224	
Model 2	(intercept)	102.470	7.621	13.446	.000	87.271	117.669	.347
	Age	-.434	.139	-3.116	.003	-.711	-.156	
	AQ	-.938	.189	-4.971	.000	-1.314	-.561	
Model 3	(intercept)	113.478	8.789	12.911	.000	95.944	131.012	.385
	Age	-.448	.135	-3.314	.001	-.718	-.178	
	AQ	-.740	.202	-3.662	.000	-1.143	-.337	
	TAS	-.286	.124	-2.316	.024	-.533	-.040	

The hierarchical regression analysis was repeated using the data from NT participants (see Table 6.6). When age was entered as a predictor in Step 1, it was a significant predictor of ACIPS score, $\beta = -.565$, $t(65) = -3.285$, $p = .002$, accounting for 12.9% of the variance. When the AQ total score was added in Step 2, it significantly predicted the ACIPS scores, $\beta = -1.151$, $t(64) = -8.421$, $p < .001$, accounting for 58% of the variance together with age in the NT group. This suggested that higher autistic traits predicted reduced experience of pleasure in social and interpersonal situations in neurotypical participants. However, adding TAS-20 scores did not improve the model as it did not significantly predict the ACIPS scores, $\beta = -.137$, $t(63) = -1.212$, $p = .230$, accounting for very little extra variance (3%) after age and autistic traits. Similarly, social anxiety, $\beta = -.102$, $t(62) = -1.027$, $p = .308$, depression, $\beta = .068$, $t(61) = .510$, $p = .612$, and loneliness $\beta = -.933$, $t(60) = .951$, $p = .345$ did not predict the ACIPS scores in the NT group. Tests to check if the NT data met the assumption of collinearity indicated that multicollinearity was not a concern (Age, *Tolerance* = .958, *VIF* = 1.044; AQ scores, *Tolerance* = .958, *VIF* = 1.044).

These results suggested that for neurotypical individuals, age and autistic traits were the only significant predictors of ability to experience pleasure in social situations, whilst alexithymia, social anxiety, depression, and loneliness did not have predictive roles. Results from a stepwise regression further confirmed the results from the hierarchical regression in both groups. Collectively, age and autistic traits played a significant role in social motivation in ASD and NT groups. However, in the ASD group, alexithymia had an additional subtle role that was not observed in NT individuals. Thus, the pattern was same in ASD and NT, except for a small added role for alexithymia in ASD.

Table 6.6. Results from hierarchical regression predicting ACIPS scores in the NT group

	Predictor	*B*	*SE B*	*t*	*p*	95% CI for *b*		adj. R^2
						Lower	Upper	
Model 1	(intercept)	91.787	4.946	18.55555	.000	81.91	101.66	.129
	Age	-.565	.172	-3.285	.002	-.909	-.221	
Model 2	(intercept)	109.672	4.037	27.168	.000	101.608	117.73	.580
	Age	-.355	.121967	117.73	.005	-.559	-.112	
	AQ	-1.151	.137	-8.421	.000	-1.424	-.878	

6.3.4. Cluster Analysis

To test the last hypothesis regarding sub-profiles of social motivation within the ASD and NT group, model-based cluster analyses were conducted using z-scores. The cluster analysis allows testing individual variability and more complex relationships in the data that cannot be identified using correlations and regression analyses. For example, there could be autistic individuals with high social anxiety along with high social motivation, and vice versa, and these individuals cannot be identified based on linear assumptions made in regression analyses above. Therefore, based on previous literature and high rates of social anxiety in autistic individuals as shown in previous chapters, the SIAS scores were entered in the cluster analysis. As regression analyses demonstrated that age, autistic traits, and alexithymia were significant predictors of social motivation in the ASD group, these variables were also entered as input variables in the cluster analysis to define sub-profiles of social motivation. The three-cluster solution with the highest BIC score (BIC = -1011.241) was determined in the ASD group (see Figure 6.3). Post hoc pairwise comparisons showed that participants in the first cluster (Cluster 1; $n = 25$) were significantly younger than Cluster 2 ($n = 6$, $p < .001$) and Cluster 3 ($n = 42$, $p = .003$). Cluster 1 had also significantly higher ACIPS and lower AQ scores compared to Cluster 2 (ACIPS; $p <.001$. AQ; $p = .005$) and Cluster 3 (*ps* < .001) (see Figure 6.4). However, Cluster 1 had similar alexithymia and social anxiety scores with Cluster 2 (TAS; $p = .789$, SIAS; $p = .422$), which were significantly lower compared to Cluster 3 (*ps* < .001). Comparison of Cluster 2 and Cluster 3 showed that they both had similar ACIPS scores ($p = .795$), however, Cluster 3 had significantly higher alexithymia ($p < .001$) and social anxiety compared to Cluster 2 ($p = .008$) (see Figure 6.4). Overall, the Cluster 1 characterised younger autistic adults with high social motivation and low autistic traits, low social anxiety, and low alexithymia while the Cluster 3 consisted of autistic adults with the opposite profile; low social motivation, high autistic traits, high social anxiety, and high alexithymia. Interestingly, Cluster 2 characterized older autistic individuals with low social motivation, high autistic traits, but low social anxiety and alexithymia.

Model-based cluster analyses with the same input variables of age, ACIPS, AQ, and SIAS identified two subgroups in the NT group (BIC = -691.8427). Individuals in the first cluster (Cluster 1; n = 17) were significantly older compared to the second cluster (Cluster 2; n = 51), $F(1,66) = 248.79$, $p < .001$, and they reported significantly less pleasure in social interactions compared to Cluster 2, $F(1,66) = 9.141$, $p = .004$, $\eta_p^2 = .122$. However, the clusters did not differ in terms of autistic traits, $F(1,66) = 1.216$, $p = .274$, $\eta_p^2 = .018$, alexithymia, $F(1,66) = 2.461$, $p = .122$, $\eta_p^2 = .036$ and social anxiety, $F(1,66) = .575$, $p = .451$, $\eta_p^2 = .009$. Therefore, the sub-profiles within the NT group were based on having high or low social motivation and age, but not autistic traits, alexithymia, and social anxiety, which was in line with the regression results in the NT group reported above.

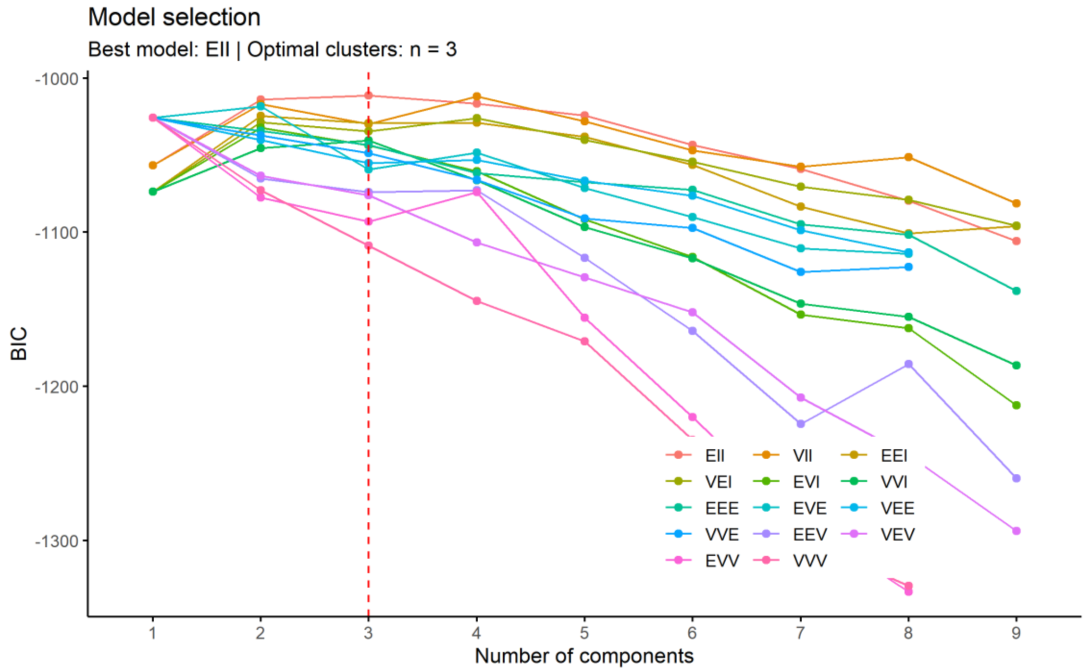

Figure 6.3. The BIC values for each Gaussian model in the model-based cluster analysis in the ASD group (n = 73). Based on this model, the optimal number of clusters with the higher BIC scores is 3. EII: spherical, equal volume, VII: spherical, unequal volume, EEI: diagonal, equal volume and shape, VEI: diagonal, varying volume, equal shape, EVI: diagonal, equal volume, varying shape, VVI: diagonal, varying volume and shape, EEE: ellipsoidal, equal volume, shape, and orientation, EEV: ellipsoidal, equal volume and equal shape, VEV: ellipsoidal, equal shape, VVV: ellipsoidal, varying volume, shape, and orientation

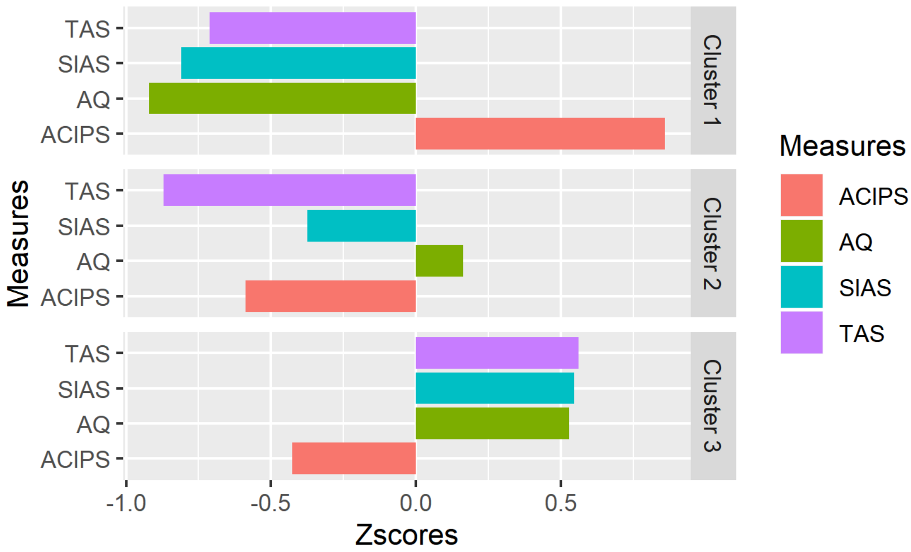

Figure 6.4. Mean scores of ACIPS, AQ, TAS, and LSAS for three clusters identified in the ASD group

6.4. Discussion

The current chapter aimed to investigate individual differences in social motivation by examining the role of autistic traits, alexithymia, social anxiety, depression, and loneliness in ASD and NT adults. Self-report measures were used as complementary to behavioural and physiological measures in previous studies (Chapters 3 and 4). In line with the first hypothesis, autistic individuals overall reported higher autistic traits, greater alexithymia, more social anxiety, more loneliness, and higher depression compared to NT adults. However, there was significant variability within each group along with a significant overlap between groups. As expected, lower social motivation was associated with higher autistic traits, heightened alexithymia, and higher social anxiety in both groups. Depression and loneliness were negatively correlated with social motivation only in the NT group. Regression analyses with higher predictive power revealed that both older age and higher autistic traits significantly predicted lower social motivation in both groups, however, only in the ASD group, alexithymia had an additional role to predict lower social motivation. Therefore, the hypothesis that different factors would predict social motivation in ASD and NT group was accepted. However, higher social anxiety did not predict lower social motivation in the ASD group, which contrasted with our hypothesis. The cluster analysis to identify subgroups in social motivation demonstrated a more complex contribution of other factors in self-reported social motivation within the ASD group compared to the NT group. These results were in line with the hypothesis by showing that distinctive profiles of social motivation exist within autistic adults compared to NT adults.

6.4.1. Between and within-group differences in social motivation

In line with the first hypothesis, group comparisons showed that participants with ASD reported significantly lower ability to experience pleasure in social and interpersonal interactions, together with higher autistic traits, higher alexithymia levels, more social anxiety, more depression, and greater loneliness. Therefore, the first hypothesis was accepted and overall (based on group mean), autistic individuals had reduced social motivation, difficulties with identifying self-emotions, and mental health difficulties, particularly high social anxiety and depression. Previous self-report studies with autistic adults demonstrated reduced pleasure in social contact in the ASD group compared to the NT group (Berthoz et al., 2013; Carré et al., 2015). The majority of autistic participants in these studies (74% and 80%, respectively) were found to display heightened social anhedonia. Overall, these results together with the current findings can be viewed as further support for the Social Motivation Theory (Chevallier et al., 2012), suggesting that ASD is associated with diminished pleasure/reward derived from social interactions.

Even though group mean differences suggested a significant reduction in ability to experience pleasure in social interactions among autistic individuals, the distribution of the ACIPS scores demonstrated a high heterogeneity within the ASD group and an important overlap between the two groups. For example, some of the autistic adults reported high ability to experience social pleasure while some of them reported lower ability to experience social pleasure. A similar distribution was also observed in neurotypical individuals. As discussed in Chapter 2 (see section 2.8.3), some individuals with ASD report desire and enjoyment in interacting with others, while some autistic individuals do not show much interest or experience pleasure in social interactions (Fletcher-Watson & Crompton, 2019). Therefore, the current study provides further evidence that social motivation is highly heterogeneous within ASD and not all autistic individuals should be assumed to have reduced interest for social contact.

6.4.2. Explaining individual differences in social motivation

The vast heterogeneity in social motivation as discussed above might be explained by other factors such as social anxiety, alexithymia, depression, and loneliness. The correlations among the primary measures in the current study revealed that lower ability to experience pleasure in social interactions was associated with higher autistic traits, heightened alexithymia, and more social anxiety, and depression in both the ASD and NT group. However, depression was not significantly correlated with social motivation in the ASD group when a more conservative approach was taken. More interestingly, age was also associated with social motivation in both groups such that older participants reported lower capacity to enjoy social interactions. Subsequent regression analyses with each group showed that age was also a significant predictor of the ACIPS scores in both groups. Older individuals reported reduced ability to experience pleasure in social and personal interactions, irrespective of ASD diagnosis. This could be related to change of life experiences regarding social interactions and interpersonal engagement over time. Research has shown that the number of close relationships peak around midlife, followed by a decrease towards older ages (Lang, 2004). This also implies that social motivation is linked to the availability of personal interactions, which might change over time. Alternatively, the items in the ACIPS might be asking about social experiences that are relatable to relatively younger individuals (Gooding & Pflum, 2014b). Even though the majority of participants in the current study were between 18 and 25 years old, older individuals might respond differently to ACIPS in the current study. However, given the restricted age group in the current sample, the effect of age on social motivation should be further investigated using a longitudinal design and a larger age range including middle and older ages.

In addition to age, autistic traits predicted the capacity to enjoy social interactions among both autistic and NT individuals. These results further confirmed the significant correlations between the ACIPS and AQ and provided support for the SMT by suggesting that reduced social hedonic capacity might be a characteristic of ASD. More importantly, autistic traits explained much of the variance in the NT group compared to the ASD group. These results suggested that autistic traits play a bigger role in predicting social motivation among neurotypical adults, while other factors might be at play in autistic individuals. Previous research has demonstrated that reduced social motivation predicted increased autism severity and higher autistic traits in the ASD and NT populations (Chevallier, et al., 2012b; Novacek et al., 2016). A recent study by Han et al. (2019) also found that greater autism symptoms predicted decreased capacity for social and non-social pleasure (39% and 18% of the variance, respectively) in autistic and NT adults. Another study investigating the predictive role of autistic traits on different aspects of social reward found that autistic traits predicted reduced enjoyment of admiration and sociability aspects of social reward in neurotypical adults (Foulkes et al., 2015). The results of the current study confirm these results.

The current study is the first to investigate the predictive role of alexithymia on social motivation in autistic and NT individuals. The results showed that alexithymia was a significant predictor of diminished ability to experience/understand pleasure in social interactions in autistic, but not in neurotypical individuals. Autistic individuals with greater alexithymia may not recognize their own feelings or interpret their own feelings including positive ones, and therefore they may not understand the experience of social pleasure or social inclusion (Berthoz et al., 2013; Gooding & Tallent, 2003; Aaron et al., 2015). The findings from the NT group in the current study cannot be explained by lack of variability in alexithymia scores as 35.2% of NT participants were above the cut-off score for potential alexithymia (>51; Bagby, Parker, & Taylor, 1994). These results overall supported our hypothesis for distinctive predictive factors of social motivation between autistic and NT individuals. Whilst both autistic traits and alexithymia were uniquely associated with the social hedonic capacity in autistic participants, alexithymia did not have an additional role to predict social motivation among neurotypical individuals. Instead, most of the variance was explained by autistic traits in the NT group.

6.4.3. Profiles of social motivation within ASD and NT

Cluster analysis was included as the final analysis in the current chapter to identify subgroups of social motivation by examining data-driven nonlinear relationships, which cannot be revealed by correlations or regression analyses. The results defined three distinct subgroups of autistic adults that were characterized by social motivation, age, autistic traits, alexithymia, and social anxiety. These results were especially relevant for understanding heterogeneous social experience in autistic individuals as they indicated that autistic individuals with similar social motivation might have distinguished social and mental health profiles. For example, low motivation might be underlined by high social anxiety and poor social skills in some autistic individuals (e.g. Cluster 3), but not in others (e.g. Cluster 2). These differences might lead to different outcomes in social functioning and mental health, and therefore, have implications for both theory and practice in terms of supporting autistic individuals with different needs. Previous research has shown that autistic individuals with high social motivation but poor social skills are more likely to experience isolation and loneliness (Han et al., 2019). Similarly, having typical social motivation and social skills can act as a protective factor for isolation and developing depression in autistic individuals (Mazurek, 2014). Thus, current results further have emphasized the importance of considering within-ASD heterogeneity in both theory and practice.

The cluster analysis with NT participants defined two subgroups that were characterised by individuals with high versus low social motivation. However, these subgroups were not different from each other in terms of autistic traits, alexithymia, or social anxiety. These results indicated that age and social motivation were the only determinants in NT sub-groups, compared to the ASD subgroups where an interplay between multiple factors was observed, reflecting the heterogeneity of social experience in ASD. These results emphasize that social behaviour in ASD might be a more complex phenomenon determined by multiple social factors including social motivation, social skills, and social anxiety.

6.4.4. Limitations

Even though the current study contributes to our understanding of the heterogeneity of social experience in relation to social motivation in ASD and NT individuals, it was not without limitations. First, the correlations between various measures could be influenced by the manner in which they were administered, the sample size, and the psychometric properties of those measures. Most of the measures used in this study have been reported to have high reliability in the literature. The internal consistency findings in the current sample were high, however, the loneliness scale had lower reliability in both groups. In addition, all the measures used relied upon self-reports which may affect sensitivity, especially in autistic participants given their challenges in self-reflecting capacities (Bird & Cook, 2013) as well as social desirability (Van de Mortel, 2008). It is also important to emphasize that even after including multiple measures of social behaviour in a relatively large sample, there was still a large variance left to be explained in the ASD group (around 60%), meaning that there are other factors that are related to individual differences in social motivation that have not been studied in the current chapter.

Related to methodological limitations, the ACIPS may not be a very sensitive measure to assess social motivation in autistic individuals as it was designed for the neurotypical population. As discussed in Chapter 2 (see section 2.8.3), social experiences and the expression of social motivation might be different in autistic individuals. Therefore, the items included in the ACIPS may not reveal these unique experiences of autistic individuals in social interactions. Future research should focus on developing reliable methods validated specifically in adults with ASD in order to capture the heterogeneous social experience in ASD. Including the perspectives of autistic individuals using qualitative measures is especially important to achieve this goal. The following chapter will consider these issues.

6.4.5. Conclusions

Overall, the current chapter examined individual differences in social motivation by investigating the role of autistic traits, alexithymia, social anxiety, depression, and loneliness to social motivation in autistic and neurotypical adults. Even though group differences showed significantly reduced social hedonic capacity in autistic adults, there was heterogeneity in social motivation within both groups and an important overlap between autistic and NT individuals. In addition, greater autistic traits and increased age predicted reduced capacity for pleasure in social interactions in both autistic and NT participants. More interestingly, alexithymia accounted for an additional variance on top of autistic traits in explaining the capacity for social pleasure in the ASD group, but not in the NT group. This suggested that autistic individuals might find social interactions confusing and therefore enjoy them less due to difficulties in identifying and describing their own emotions. Lastly, the exploratory cluster analysis showed that different profiles of social motivation existed, which was a finding that correlational or regression analyses alone cannot identify. The existence of subgroups of social motivation profiles within ASD, defined by varying social skills (e.g. alexithymia) and mental health (e.g. social anxiety), is very critical to demonstrate the complexity of social behaviour in ASD.

In relation to placing this chapter within the current thesis, the results were important to address the issues regarding individual differences in social motivation as introduced in Chapter 2 and supported the recent literature that has found different profiles of social motivation within the autistic population (Jaswal & Akhtar, 2019). The exploratory cluster analysis also demonstrated that the social experience might be more complex among autistic than NT individuals. Although this study utilized self-report measures in a complementary fashion to behavioural and psychophysiological measures in previous chapters, they may not be sensitive to reveal unique experiences of autistic individuals. Future work should include the perspectives of autistic individuals using qualitative methods to gain insights into social experiences and motivations in real-world. This will pave the way for the next chapter, which investigated the first-hand accounts of friendship experiences in autistic and neurotypical adults.

Chapter Seven: Friendship experiences in autistic and neurotypical adults: quantitative and qualitative insights

7.1. Introduction

Chapter 6 investigated individual differences in social motivation in autistic and NT adults using quantitative self-report questionnaires. The results showed quantitative differences in social motivation between individuals with ASD and NT, which fit with the theory (Chevallier et al., 2012). However, it is argued that social experiences of autistic individuals might be qualitatively different from those of NT individuals, which cannot be revealed with quantitative questionnaire measures developed for the NT population. As discussed in Chapter 2, understanding the varied experiences of autistic individuals, including the unconventional ways of showing motivation/interest, requires the perspective of autistic individuals themselves (Jaswal & Akhtar, 2019). To this end, the last study in this PhD thesis aimed to link quantitative measures of friendships to qualitative friendship *experiences* (e.g. perception, motivation, challenges, and strengths) in autistic adults in comparison to NT adults. Combining quantitative and qualitative methods (see Chapter 2 for justification for multi-method approach), studying friendship experiences, particularly motivation for friendships, would provide rich insights into social motivation of individuals with ASD in real-world social interactions.

Given that the Social Motivation Theory is core to this thesis, the qualitative part of this study aims to probe components of the theory in terms of social wanting and social maintaining by examining the motivation for initiating and maintaining friendships, respectively. Therefore, this part would only focus on individuals with ASD to gain in-depth insights into their friendship experiences. While doing so, the emphasis would be on challenges as well as strengths and positive experiences in making and sustaining friendships in ASD. Overall examining lived experiences of autistic individuals would provide qualitative and in-depth insights into heterogeneity observed in quantitative measures. This is especially relevant given the overlap in the ASD and NT groups in terms of social motivation as shown in previous chapters within this thesis. Considering the fact that frequent experiences of social exclusion/rejection might have an impact upon friendships experiences, this last study would also investigate the influence of early social rejection and negative experiences on current friendship experiences in ASD, and therefore would be complementary to behavioural and psychophysiological findings in Chapter 3 and 4.

7.1.1. Quantitative measures of friendships in autistic individuals

The majority of studies investigating friendships in ASD are based on quantitative measures and have mostly been conducted with children and adolescents. According to the review by Petrina et al. (2014), 18 out of 22 studies (> 80%) on friendships in children with ASD utilized quantitative measures (e.g. self-report questionnaires). Some studies reported fewer friends in autistic children and adolescents (Bauminger & Shulman, 2003; Rowley et al., 2012) and less enjoyment of close, empathic, supportive, caring friendships, less interest in making friends and less enjoyment in interacting with friends in adults with ASD (Baron-Cohen & Wheelwright, 2003). These differences in friendship experiences might be underlined by differences in how individuals with ASD define friendships and what they expect from their friends. In a recent study investigating preferences for friendship in young adults with ASD (age range = 18-24 years), significant differences in the broad perspectives and friendship practices of young adults with and without autism were found (Finke et al., 2019). For example, autistic individuals preferred to be friends with people who share similar interest over people with similar life views. Furthermore, young adults with ASD reported a preference for physical distance compared to NT adults who wanted physical closeness with their friends. This line of research is very important to show that incongruent expectations from friends and different perspectives on friendships might be the reason why autistic friendships are qualitatively different from NT friendships. Even though they are only tangentially relevant as the current chapter focuses on adults, the studies of children have shown different friendships experiences in terms of number of friends, friendship duration, frequency of meetings, and type of activities, and friendship expectations in autistic children compared to their NT peers (Bauminger et al., 2008; Daniel & Billingsley, 2010; Bauminger, & Kasari, 2000; Kuo et al., 2013; Bottema-Beutal et al., 2019).

A common quantitative measure of friendship experiences is the Cambridge Friendship Questionnaire (CFQ), developed by Baron-Cohen and colleagues (2003).

In the original study with 51 males and 17 females with ASD (mean age = 34.3), the ASD group overall had lower CFQ scores than the NT group (27 males and 49 females, mean age = 40.5), indicating less enjoyment and interest in friendships in autistic individuals (Baron-Cohen & Wheelwright, 2003). Moreover, the higher AQ traits in the ASD group were associated with lower CFQ scores and thus fewer friendships. In terms of gender differences, while there were not any differences in CFQ scores between females and males in the ASD group, NT females had higher quality of friendships than the NT males. The researchers concluded that ASD was not qualitatively different, but instead, an extreme end of the distribution in the general population. A recent study by Sedgewick et al. (2019) replicated the original study by administering the CFQ to 532 participants with ASD (72 males, 317 females, 143 non-binary) and 391 NT participants (34 males, 327 females, 18 non-binary) with an age range of 18-81 years. In addition to the original study, this study included non-binary (NB) autistic participants and added another self-report measure, namely Unidimensional Relationship Closeness Scale (URCS) to investigate the relationship between the two friendship measures. This questionnaire is to measure friendship features of the closest relationships (Dibble, Levine, & Park, 2012). The results showed that overall the ASD group had significantly lower CFQ scores than the NT group, therefore replicating the finding in the original study. However, there was also a significant effect of gender in the CFQ scores, such that NB autistic individuals scored significantly higher than autistic females and males, indicating that they had more friends and greater interest in friendships. However, there was not a significant difference between autistic females and autistic males in this study. The NB participants in the NT group scored significantly lower than NT males and females. These results should be interpreted with caution as the number of NB participants in the NT group was very small and the groups were not matched in terms of gender. Lastly, the URSC scores showed that autistic individuals reported their relationship with their closest friends/partners as more emotionally close than NT participants. Overall, these results suggested that even though the autistic individuals scored lower on the CFQ, there might be gender differences within the ASD group, which was revealed when NB individuals were added in the study (Sedgewick, Leppanen, et al., 2019). More importantly, autistic individuals might have fewer but closer friends, with whom they have a more intimate relationship compared to NT individuals whose social networks might be more diffuse.

Overall, the quantitative studies of friendships revealed that autistic individuals have different perceptions and quality of friendships along with reduced interest and enjoyment in their activities with friends compared to NT individuals. However, none of these measures is autism specific as they were developed for neurotypical populations, and therefore they might impose NT friendship expectations as the norm or desirable way of having friends. However, as previously discussed in this thesis (see Section 2.8), autistic individuals might relate to others in different ways, thus their friendships might be qualitatively different compared to neurotypical relationships. Therefore, research is needed using qualitative measures of friendships based on autistic testimony to capture their lived experiences.

7.1.2. Qualitative measures of friendships in autistic individuals

In addition to quantitative measures of friendships in ASD, there is a growing literature on qualitative measures, which are more informative about the unique experiences of friendships based on the perspective of autistic individuals themselves. One of the first qualitative studies about the perception of friendships in ASD demonstrated that adolescents with ASD have less insight into what friendships entail and difficulties in using the language to convey their views on friendships (Carrington, Templeton, & Papinczak, 2003). In this study, autistic adolescents also reported to be aware of their social difficulties and try to mask them in order to fit in. In another qualitative study, even though adolescents with ASD defined trustworthiness, patience, helpfulness, and kindness as important qualities in a friend, they missed these qualities in description of themselves (they focused on abilities and talents instead; Locke et al., 2010). This might give insight into a lack of reciprocity in their friendships, resulting in 72% of autistic adolescents being either isolated or peripheral in their social network. These results indicate that comprehension of friendships may not always lead to successful friendships because autistic individuals might struggle to apply this knowledge in real-world.

Overall, the qualitative investigation of friendships in ASD, especially during adolescence, suggests that the nature of friendships might be different in autistic individuals from NT individuals, further emphasizing the need for autism-specific measures of friendships. However, the majority of these studies have focused on the difficulties and challenges that autistic individuals face in their friendships. Despite these challenges in making and maintaining friendships, it is crucial to investigate the positive social experiences and strategies/skills that autistic individuals have in their friendships.

7.1.3. Motivation for friendships in autistic individuals

Given the focus on social motivation throughout the thesis and the heterogeneity of social experiences shown in previous chapters, it is especially important to understand friendship motivations in ASD to probe social motivation in everyday life situations. In terms of motivation for friendships, recent research has suggested that many autistic children, young people, and adults desire, have, and maintain successful friendships and romantic relationships (Calder et al., 2013; Sedgewick et al., 2016, 2018). For example, qualitative studies have reported a desire to make friends in some individuals with ASD, despite lower scores on the FQQ (Calder et al., 2013; Sedgewick et al., 2016). These results suggest that group-level comparisons of averages in the quantitative questionnaires might overlook individual differences in motivation/interest to make friends among individuals with ASD (See Chapter 6; Figure 6.2). For instance, parents' reports of autistic children indicated differences in motivation to make friends such that some children would prefer to spend time alone whereas some children showed motivation to have and maintain friendships, indicating individual differences in motivation to make friends (Calder et al., 2013). Interestingly, some parents reported that the motivation of their children to make friends increased with age, suggesting that motivation for friendships evolves over time in autistic individuals. More importantly, experiences in relation to social motivation in adulthood might be different than fundamental differences in social motivation observed in younger individuals with ASD.

Motivations for friendships can show variability as some autistic individuals are motivated to have friends, however, the nature and experiences of their friendships are different, and they have social difficulties, which make it difficult to develop and maintain friendships (Cook, Ogden, & Winstone, 2018). A study combining qualitative and quantitative measures investigated gender differences in friendships and social motivation in 12-16-year-old autistic adolescent girls (n = 13) and boys (n

= 10) in comparison to NT peers (*n* = 23; 13 female; 10 male) (Sedgewick et al., 2016). The researchers found that autistic girls have higher social motivation (as measured by the SRS-2) and reported more willingness to make and maintain friends compared to autistic boys who reported less concern in making and maintaining friends to a degree that they avoided social interactions. There were also differences in definitions of friendships such that autistic girls emphasized people more than activities in friendships while autistic boys valued the actions more and were not concerned with intimacy in friendships as much as the girls. These results imply gender differences in friendship experiences such that autistic females have qualitatively and quantitatively different friendships compared to autistic boys and they are more similar to neurotypicals.

The role of mental health, especially anxiety and depression, on social motivation has been an important focus within the current thesis and it was expected to play a role in friendship experiences, as well. For example, Sumiya and his colleagues (2018) investigated the role of anxiety and depression on friendship motivations and experiences in ASD. Semi-structured interviews were conducted with 11 adolescent girls with an age range of 10 to 15 years. Thematic analysis revealed four themes; social motivation, loneliness, anxiety, and distress. In terms of social motivation, participants reported varying ranges of social motivation as some wanted to have friends but did not know how to be friendly or what they wanted in their friendships was different. Highly motivated individuals in this study might have higher social anxiety as they had the desire to make friends but were scared to fail. Overall, the majority reported to appreciate and desire friendships, however, they were not satisfied with their own social world. In terms of loneliness and anxiety, most of the participants were aware of being alone and isolated and they also reported heightened fear to lose their friends or being anxious to make friends due to social difficulties they have (Sumiya et al., 2018). Overall, these results suggest that negative friendship experiences of autistic individuals might result in social withdrawal and lessened motivation to pursue friendships in the future.

7.1.4. Current study

This study aimed to understand lived experiences of friendships in relation to social motivation in adults with ASD and gender-matched NT individuals by linking quantitative measures to qualitative measures of friendships. There was also a focus on both challenges as well as strengths in friendship experiences of autistic and NT individuals. To this end, an online questionnaire was administered to assess friendships using a self-report standardized measure (CFQ; Baron-Cohen & Wheelwright, 2003). In the second part of this study, open-ended questions asking about the friendships (e.g. perception, motivation, challenges, strengths, and negative experiences) were answered only by autistic adults in order to gain in-depth insights into their unique friendship experiences. A similar approach was adopted in Chapter 5 as well by combining quantitative differences in experiences between NT and ASD with more in-depth qualitative insights from autistic individuals. Gender differences in friendship experiences were not the main focus of this PhD thesis, however, given the increasing interest in female autism, the gender differences in friendship experiences were reported in this study.

Some of the participants included in this study also participated in the previous study described in Chapter 6. Using the group of participants who had data in both studies (Chapter 6 and 7), the associations between self-reported autistic traits (as measured by the AQ in Chapter 6), the capacity to enjoy social and personal interactions (as measured by ACIPS in Chapter 6), and the friendships (as measured by the CFQ in the current chapter) were investigated in the ASD and NT group. Instead of the neurodiverse approach adopted in previous studies, the groups were examined separately in this chapter, because the friendships experiences could be associated with different factors in autistic and NT individuals.

Based on the previous literature, the following hypotheses were made; first, i) on an overall group level, autistic participants would have reduced interest and enjoyment in friendships experiences compared to NT participants indicated by lower CFQ scores in the ASD group, ii) there would be significant negative correlations between quality of friendship experiences, autistic traits and social motivation in both groups, such that lower CFQ would be associated with higher AQ and lower ACIPS, and iii) qualitative experiences of friendships would provide further insights into unique friendship experiences and social motivation in ASD, which could not be captured by the quantitative measures.

7.2. Methods

7.2.1. Participants

In this study, 41 adults with ASD (19 females, 15 males, 7 non-binary, mean age = 29.39, SD = 10.77, range = 19-54) and 32 neurotypical individuals (17 females, 15 males, 0 non-binary, mean age = 24.44, SD = 7.21, range = 18-48) were recruited to complete an online survey. In terms of age, the ASD group was significantly older than the NT group, $t(71) = -2.346$, $p = .022$, $d = 0.540$. In terms of gender, there were more non-binary individuals in the ASD group, however, there were not any significant differences between the number of males and females in each group, $X^2(2, 73) = 6.094$, $p = .05$.

Given the online nature of both studies, the current study was advertised together with the previous study (Chapter 6) using the same recruitment procedure (see Section 6.2 for the recruitment details). All participants reported to speak English fluently and 88.2% of the participants were native British speakers. The majority of the participants in both groups were higher-education students (ASD; 61.4%, NT; 68.7%). In the ASD group, 50% had mental health comorbidities (18.2% anxiety, 9.1% depression and 22.7% both anxiety and depression) while in the NT group, 25% had mental health diagnosis (9.4% anxiety, 6.3% depression, and 9.4% both anxiety and depression). The participants above 55 years old ($n = 3$) were not included in the analysis as the interest of the study wasn't on the older adult population. The participants who completed both studies (Chapter 6 and 7) were identified based on their self-generated 4-digit codes and this created a subgroup of participants, with who the correlations between the AQ, ACIPS, and CFQ were computed. This group consisted of 20 participants with NT (13 females, 7 males, mean age = 24.60, SD = 7.85) and 38 participants with ASD (18 females, 14 males, 6 non-binary, mean age = 30.11, SD = 10.89). There was a trend towards the ASD group being slightly older than the NT group, $t(56) = -1.963$, $p = .06$, and the groups did not differ in terms of gender, X^2 (2, 58) = 3.932, $p = .140$.

7.2.2. Measures

The Cambridge Friendship Questionnaire (CFQ)

The Cambridge Friendship Questionnaire was designed to measure friendship experiences of adults in terms of how much they enjoy having close, supportive, and caring friendships, and their general interest in close social interactions (Baron-Cohen & Wheelwright, 2003). The CFQ is a self-administered questionnaire with a forced-choice format. It consists of 35 items, 27 of which can be scored. The highest score for each item is 5, adding up to 135 as the maximum score. Higher scores indicate more value given to friendships and greater interest in engaging in social interactions and friendships. Previous research has shown that the CFQ has high internal validity in autistic and NT populations ($\alpha = 0.75$; Baron-Cohen & Wheelwright, 2003). In the present sample, the reliability coefficient for the whole sample was $\alpha = .770$ (ASD; $\alpha = .686$, NT; $\alpha = .584$) indicating a high internal consistency, as well. However, when looking at the participant groups separately, the Cronbach's α for the NT group was within the poor range and Cronbach's α for the ASD group was within the questionable range. Therefore, the results should be interpreted with caution when drawing group comparisons.

The qualitative friendships questionnaire

Autistic participants were asked to fill in an online questionnaire about friendship experiences. There were 6-open ended questions asking about the *perception* of friendships, activities to do with friends, *motivation* for friendships, *challenges* and strengths/strategies in making/maintaining friends, and *negative friendship experiences* and their influence on future friendships (see Appendix G for the open-ended friendships questions). These questions were developed based on the literature on friendships and social interactions in ASD. Some of the questions were used in previous studies with autistic females (Sedgewick, Crane, et al., 2019) and were adapted for the aims and online nature of the current study. This questionnaire was also designed to explore both challenges and strengths in friendship experiences of individuals with ASD, which has not been investigated in the previous literature. The last question about the previous negative experiences was added to understand the results regarding the high expectation of rejection in autistic individuals in Chapter 4 (see Section 4.3.2) and how negative past experiences might influence future interactions (e.g. motivations to make friends) in autistic individuals (see Appendix G for the full questionnaire).

7.2.3. Procedure

An online questionnaire including demographics information, the CFQ, and open-ended friendship questions was completed using onlinesurveys.ac.uk. The same demographics information was collected as described in Chapter 6 (see section 6.2.3). Participants were also asked whether they participated in the previous study (as described in Chapter 6) or not. If participants completed the previous questionnaire, they were asked to enter the same self-generated anonymous 4-digit code. If they did not participate in the previous questionnaire, participants were asked to enter a new self-generated anonymous 4-digit number. Participants who only completed the present questionnaire had to fill in the demographics questionnaire (see Appendix F). The demographics data of the participants who participated in the previous study (Chapter 6) were matched with their data in the current study. The participants were also asked to enter their email addresses if they would like to enter a prize draw for £20 Amazon voucher. The email addresses were kept separately from the data. The study was approved by the Durham University Psychology Department Ethics Review Board.

7.2.4. Data analysis strategy

The quantitative data were described using histograms and boxplots to visualize the distribution of scores in each group and detect any outliers in the CFQ scores. The group differences in the CFQ total scores were calculated using independent samples *t*-test (one-tailed). The role of gender in friendship experiences was tested with 2 (gender; female, male) x 2 (group; ASD, NT) one-way ANOVA. The NB group within ASD was not included in this test due to the huge variability of scores and the small sample size (n = 7). Using the data from participants who participated in both studies (therefore have data on the AQ and ACIPS), bivariate (one-tailed) correlations were run between the CFQ, AQ, and ACIPS in each group separately in order to understand the relationship between the friendship quality, autistic traits, and the capacity for experiencing pleasure in social interactions. Caution is needed as the samples are relatively small for correlational analyses. The cut-off p-value for correlations was defined as .05 and multiple comparisons with Bonferroni corrections were also presented. The new p-value after adjusting for multiple comparisons was set at 0.0125.

The open-ended friendship questions were analysed using the data-driven thematic analysis to identify relevant themes in the qualitative data (following Braun & Clark, 2006). The thematic analysis phases were applied as described in Braun and Clark (2006); after reading each answer to familiarize with the data, initial codes were created for the ASD group. Then the main themes were identified by grouping the initial codes and they were reviewed before the final themes were decided. Twenty percent of the data was double-coded by two independent researchers and any discrepancies around the themes were discussed until 100% inter-rater agreement was observed.

Even though thematic analysis is a data-driven approach that provides rich insights into the perception of the individuals themselves, there is one important limitation to consider. The themes could be created based on the open-ended questions asked (e.g. the theme of "meaning of friendships"). In order to avoid this limitation, each question was analysed separately and the results are grouped under 6 sections; nature of friendships, activities with friends, motivation to have and maintain friends, challenges and strengths in making and maintaining friendships, and negative experiences of friendships.

7.3. Results

The results will be presented in two parts; quantitative (Part 1) and qualitative (Part 2) friendship questionnaire. Each part will be followed by a discussion of the presented results.

7.3.1. Part 1: Quantitative friendship questionnaire

Descriptive statistics and group differences

In line with the first hypothesis, the ASD group (mean = 55.41, SD = 16.47) had significantly lower CFQ scores than the NT group (mean = 78.22, SD = 15.49) with a large effect size, $t(71) = 6.023$, $p < .001$, $d = 1.426$. Autistic participants considered friendships significantly less valuable and had less interest in friendships than NT adults. However, the distribution of CFQ scores was highly variable within both the ASD and NT groups and there was an important overlap between the two groups. In fact, most of ASD participants fell within the range of NT participants, suggesting that self-reported friendship experiences of many autistic participants were similar to those of NT participants (see Figure 7.1).

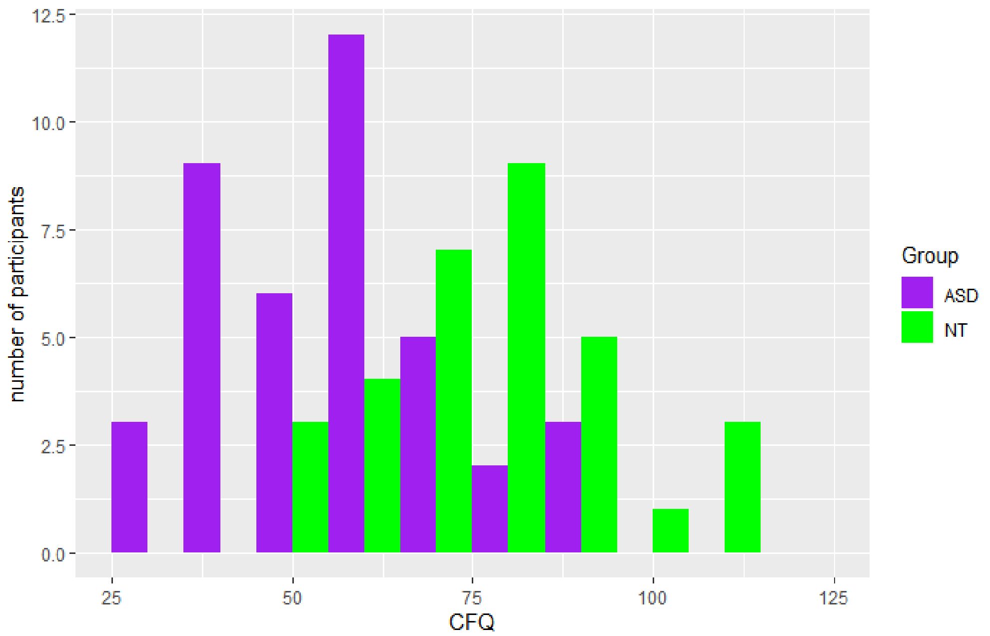

Figure 7.1. The distribution of the CFQ scores in the ASD (n = 41) and NT group (n = 32). The possible range of scores on the CFQ; 0-135.

The CFQ scores for each gender within each group was presented in Table 7.1. The effect of gender on the CFQ scores was tested by conducting 2x2 ANOVA with the factors of Gender and Group. The non-binary group within ASD was not included in this analysis due to small number of cases and huge variability within this group. As expected and also shown above, a significant main effect of Group was found $F(62) = 32.297$, $p < .001$, $\eta_p^2 = .343$. However, the results did not show a main effect of Gender $F(62) = .166$, $p = .685$, $\eta_p^2 = .003$. There was a significant interaction effect of Group and Gender, with a small effect size, $F(62) = 4.102$, $p = .047$, $\eta_p^2 = .062$. Posthoc tests demonstrated that autistic males reported significantly lower friendship quality than

NT males with a very large effect size, $t(28) = 5.307$, $p < .001$, $d = 1.937$. Similarly, autistic females had significantly lower friendship quality than NT females, however, the effect size was smaller, $t(34) = 2.676$, p = .011, $d = 0.892$. These results overall demonstrated that even though the difference between the scores of autistic and NT females was smaller compared to those between autistic and NT males, there was no effect of gender on friendship quality within the groups.

Table 7.1. CFQ scores by group and gender

Variables	ASD (*n* = 41)			NT (*n* = 32)	
	Female	Male	NB	Female	Male
CFQ scores					
Range	26-90	19-86	28-73	49-106	46-108
Mean	60.84	51.27	49.57	75.24	81.60
(SD)	(15.91)	(16.94)	(14.28)	(16.34)	(14.25)

Correlations between the autistic traits, social motivation and friendships

To investigate the relationship between self-reported autistic traits (AQ), capacity for pleasure in social and interpersonal relationships (ACIPS) and friendships (CFQ), the correlations between the AQ, ACIPS and the CFQ were investigated based on the data from participants who participated in both online studies (Chapter 6 and Chapter 7). These results should be interpreted with caution as the sample sizes were smaller in both groups, especially in the NT group (ASD; $n = 38$, NT; $n = 20$). Lower autistic traits and greater social motivation were associated with better friendship quality in the ASD group, however, only social motivation was significantly correlated to friendship quality after correcting for multiple comparisons (see Table 7.2). A similar pattern was observed in the NT group as friendship quality was negatively correlated with autistic traits and positively correlated with self-reported social motivation (see Table 7.3). However, the relationship between social motivation and friendship quality was not significant after correcting for multiple comparisons in the NT group.

Table 7.2. Correlation matrix for the ASD group (*n* = 38)

	1	2
1. CFQ		
2. AQ	-.334*	
3. ACIPS	.465**◊	-.526**◊

All correlations are one-tailed, *p <.05, **p <.01, ◊p < .0125 significant effect after Bonferroni correction

Table 7.3. Correlation matrix for the NT group (*n* = 20)

	1	2
1. CFQ		
2. AQ	-.512*◊	
3. ACIPS	.466*	-.738**◊

All correlations are one-tailed, *p <.05, **p <.01, ◊p < .0125 significant effect after Bonferroni correction

7.3.2. Part 1: Discussion

The first aim of the current study was to investigate group differences in friendship experiences between autistic and NT adults. Consistent with predictions, participants with ASD overall reported significantly lower interests and enjoyments in friendship experiences than NT participants. However, there was a large overlap between the groups and substantial individual differences within the ASD and NT groups. While looking at the group means suggested that the friendships of autistic adults were less close and less empathic compared to those of NT individuals, the substantial variability is crucial and should not be ignored. In fact, many autistic individuals were within a similar range of scores as the NT group. These findings indicated that, similar to heterogeneous social motivation as reported in Chapter 6, self-reported friendship experiences were highly heterogeneous in the ASD and NT groups. These results were in line with the previous literature showing overall lower friendship quality (as also measured by the CFQ) in children and adults with ASD compared to their NT peers (Head, McGillivray, & Stokes, 2014; Baron-Cohen & Wheelwright, 2003; Sedgewick et al., 2019).

In terms of gender differences in friendship quality, males in the ASD group had significantly lower scores than males in the NT group, and females in the ASD had significantly lower scores than females in the NT group. However, there was not any differences between females and males within each group, suggesting that friendship experiences were mainly determined by being autistic or not, rather than being female or male in the current study. Another study with autistic and NT adults using the CFQ revealed that autistic males reported significantly lower than NT males and so did autistic females compared to NT females (Sedgewick et al., 2019). The current results confirmed these findings by showing lower friendship quality in autistic compared to NT adults, irrespective of gender. Non-binary individuals with ASD could not be included in analyses in the quantitative part within this chapter, due to huge variability of scores and smaller sample size. However, considering the increasing numbers of non-binary gender identities in the autistic population (George & Stokes, 2018), future research should aim to increase the number of non-binary individuals. In fact, individuals with ASD and non-traditional gender identities might struggle further in their friendships due to issues such as stigma and isolation. This group will be represented in the qualitative part of this chapter as their number is sufficient for thematic analysis.

The second aim of the current study was to examine the relationships between friendship quality, autistic traits, and the capacity for experiencing pleasure in social interactions in each group. Consistent with expectations, higher autistic traits and lower hedonic capacity for social interactions were associated with lower friendship quality in both groups. However, when corrected for multiple comparisons, only higher social motivation significantly correlated with higher friendship quality in the ASD group, whilst only autistic traits were negatively correlated with friendship quality in the NT group. This is an important finding to show that social motivation in ASD might be linked to general friendship ratings. Moreover, the friendship and social motivation questionnaires in the current study might tap similar constructs in social interactions, and as pleasure in social interactions increased, so do the general friendship ratings. On the other hand, autistic traits could play a more important role on friendship experiences in the NT group, and this has also been shown in previous studies with neurotypical populations (Baron-Cohen & Wheelwright, 2003;

Sedgewick, Leppanen, et al., 2019). However, these results should be interpreted with caution as the sample sizes were different in each group, and therefore correlation coefficients could not be directly compared between the groups. Moreover, the friendship questionnaire in this study may not be a valid measure as indicated by lower reliability, especially in the NT group. Therefore, this measure requires to be revisited in terms of reliability and factor structuring.

7.3.3. Part 2: Open-ended friendships questionnaire

The first part investigated friendships experiences in autistic and NT individuals by using quantitative questionnaires from previous literature (Baron-Cohen & Wheelwright, 2003) and showed an overall lower friendship quality in ASD compared to NT adults. The second part of this chapter focused more in-depth at the experiences of friendship in autistic adults (n = 41). Therefore, participants with ASD (n = 41) completed the 7 open-ended questions about the perception of friendships, activities with friends, motivations for friendships, challenges and strategies in making and maintaining friendships, negative experiences of friendships in the past, and a final question to add any other comments about friendships. As outlined above, the data were analysed under 6 sections. The main themes for each results section are illustrated in Figure 7.2 and each main theme is presented in boxes, using direct quotes. Participants' quotes are identified by their group membership and gender (e.g. ASD-F: autistic female; ASD-M: autistic male; ASD-NB: autistic non-binary) (see Appendix H for more example quotes)

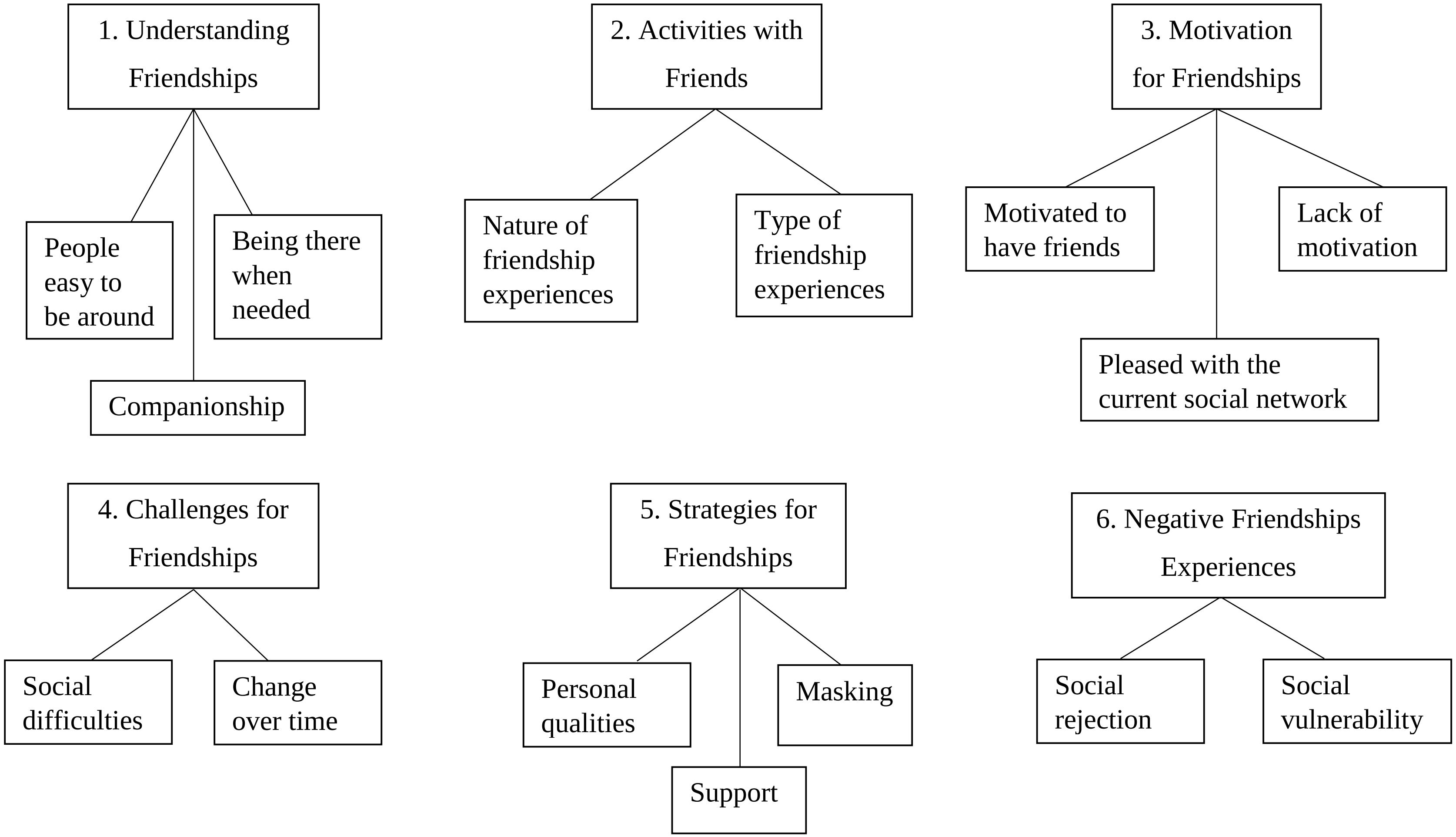

Figure 7.2. Themes that emerged from the thematic analysis in the ASD group

Theme: Understanding friendships

Responses from the first question about the perception of (e.g. "what do friendships mean to you?") and expectation from friendships (e.g. "what do you want from friendships?") resulted in three main themes; i) people that are easy to be around, ii) being there when needed, and iii) companionship (see Box 7.1).

People that are easy to be around. Twelve participants with ASD stated that they would prefer to be friends with people who will not judge them and accept them as they are. They emphasized the importance of being the 'real' you among friends, without the need to mask or look 'normal'. They commented that spending time with friends who understand them allows them to be comfortable in their relationships. All autistic females, males, and non-binary individuals described this feeling, however, it was more common among autistic females.

Being there when needed. One of the very common descriptions of friendships in autistic participants was trusting each other. Fifteen autistic participants reported trust as the most important quality of being a friend. Moreover, mutuality of this trust was also important (e.g. "you trust them and are trusted in turn"). Trust was so important in friendships that it could be valued more than other aspects (e.g. socializing). Support in friendships emerged as another very common quality of being a friend. The majority of autistic participants described friendships as someone who would support them in difficult situations. This theme was frequently reported in all autistic participants, irrespective of gender. Similar to trust, they also mentioned that the support should be reciprocal and they acknowledged the importance of "care" in their friendships.

Companionship. Doing things and spending time together (e.g. "someone who actually chose to spend time with you") was stated as one of the most common definitions of friendships in autistic adults (n = 18). The form of this companionship encompassed sharing a mutual interest or it could be sharing more personal issues with each other. Both autistic females and males reported sharing mutual interests and talking about personal issues as important aspects of friendships. What autistic individuals expected from friends was also what they reported to give to their friends. They also emphasized the importance of mutuality in their friendships by frequently using the words "each other" in their descriptions. Even though autistic adults reported the importance of companionship and enjoying their time together with friends, they also stated that they also need some space and quietness, especially after being with friends.

Box 7.1. Understanding friendships in autistic adults

People that are easy to be around (n = 12)

"Friendship is about people accepting you for who you are, you don't have to worry about being 'normal' or 'weird'." (ASD-F)

"People who get me, who don't require me to present as anything I'm not, and who are kind and clever and think about interesting things." (ASD-M)

Being there when needed (n = 15)

"Friendship is a unique bond between friends where trust and support/help is most important not just for going socialising, drinking, etc. I prefer trustworthy friends than one's who just want to go out. It's more like a bond than just companionship for socialising events." (ASD-M)

"Being a friend means being loyal and looking out for one another as well as sharing good times and being there for the bad times. It's about being each other's support." (ASD-NB)

Companionship (n = 18)

"Friendship is about having fun together, sharing mutual interests and being there to help each other out." (ASD-F)

"… sharing interests. Sharing experiences. An opportunity to have a brain-dump on something which has been on my mind, in order to clear some space to think." (ASD-M)

Theme: Activities with friends

As a response to the second question (e.g. "what you like to do with friends?"), the majority of autistic individuals (n = 25) reported many activities that they enjoy doing with friends. These responses resulted in 2 main themes; i) the nature of friendship activities and ii) the form of friendship activities (see Box 7.2).

The nature of friendship activities. In terms of the nature of friendships, 12 participants with ASD described talking about personal matters and interests and doing things together. Talking to friends about life/personal matters was a very common activity, especially for females. These talks could be about personal issues, but also about common interests (e.g. politics, anime). In contrast to autistic females, autistic males emphasized doing activities with friends more and they also focused on more practical elements of friendships.

The form of friendship activities. The next theme was about the form of friendship activities autistic individuals prefer to do with their friends (n = 13). While discussing what they like to do with their friends, autistic participants emphasized that they would prefer a closer (e.g. one-to-one), more intense relationship with friends instead of more causal or group friendships. Even though some autistic individuals preferred intense and closer relationships, a few of them commented that they would avoid friends who expect constant contact as it could be tiring and putting pressure on the individual. They also indicated a preference for quieter activities without too much pressure to socialize.

Box 7.2. Activities with friends in autistic adults

Nature of friendships (n =12)
“I like to share feelings and struggles with friends - connect with them about the deeper stuff, pains and fears and joys.” (ASD-F)
“I enjoy participating in activities which are shared interests e.g playing games, rock climbing, drinking, etc. It's good to have these kinds of friends for me because I get a lot of enjoyment from the activities.” (ASD-M)
Type of friendship activities (n =13)
“I enjoy spending time with a very select few friends. I enjoy the company of my closest friends and don’t mind if they interrupt my plans because I like them a lot. For casual friends, I often find them irritants who disrupt my flow of life.” (ASD-NB)
“… I like when there is mutual understanding of each other, but no obligation to be in constant contact -- when someone answers to a message or a call *shudder*, but isn't offended if we are out of touch for a couple of months.” (ASD-F)
“But I don't enjoy having to do small talk or do things they like doing but I don't like doing (like go to a noisy pub or bowling). I like going to quiet places with friends and seeing animals.” (ASD-M)

Theme: Motivation for friendships

The third friendship question, and highly relevant to the focus of this thesis, was about the motivation/desire to make friends. Participants were prompted to answer about their desire to make new friends and how satisfied they were with their current social network (e.g. “would you prefer to have more friends?”). Responses were grouped under 3 themes; i) motivated to have friends, ii) lack of motivation, and iii) pleased with the current social network (see Box 7.3).

Motivated to make friends. The majority of autistic participants (n = 28) reported to have a desire to make friends or willingness to have more friends (e.g. “I don't think anyone could ever have too many friends"). However, there was a huge variability in their motivation to have friends. Ten participants with ASD reported that they would like to have more friends because the friends are enjoyable and they value friendships. Many participants (*n* = 9) acknowledged that being with friends makes them feel happier/more positive and they have a lot of fun when they are with friends. Even though the majority of participants had the desire to have friends, their "social difficulties" could make it difficult to have friends, especially to initiate social interactions. Social difficulties were reported by 9 participants as a barrier to making friends. Seven participants with ASD reported being motivated to have friends in order "not to get lonely/isolated". Another motivation to have friends in autistic participants was "necessity". Four participants with ASD stated that they tried to make friends because they thought it was necessary to have friends to meet the societal demands or their family told them to do so. The least common motivation to make friends was "reputation". Three autistic participants reported that having friends and being liked are important for them. Lastly, three female and two male participants discussed that even though they wanted to have more friends, they found it hard to find friends, especially with similar interests.

Lack of motivation. Compared to autistic participants who reported to be motivated to make friends, fewer participants (*n* = 14) reported lack of motivation to make friends due to the facts that friends are emotionally draining, they have no pleasure/interest in socialization, and due to disappointment/early rejections. Many autistic participants (*n* = 8) emphasized that friends could take too much energy and it could be exhausting to keep up the contact. Six participants reported "no pleasure/interest in socialization" and therefore they are not motivated to make friends. Another reason for not being motivated to have friends was "disappointment/early experiences" in friendship experiences, which was reported by four participants, and will be further discussed in the last section of the results (e.g. negative experiences in friendships). Having early negative experiences might reduce motivation to seek friends.

Pleased with the current social network. The last theme in this section was "pleased with the current social network" as reported by 6 autistic participants. This theme was more common in males with ASD (*n* = 4) compared to female (*n* = 1) and non-binary individuals (*n* = 1). Many autistic individuals were satisfied with their current social network as they prefer to have few friends instead of many friends. One reason to prefer to have fewer friends could be that autistic individuals appreciate their space and alone time. The reason to prefer fewer friends could also be related to the issues discussed in the previous section (e.g. exhausting to have many friends, social difficulties). Even though some autistic participants (n = 4) reported to be satisfied with their current social network, they were open to new friendships. Lastly, two participants mentioned "getting closer to already existing ones", especially the close friends, instead of making new friends.

Box 7.3. Motivation for making and maintaining friendships in autistic adults

Motivated to have friends (n = 28)

"I would want to have friends but I am very bad at reading social cues and initiating friendships." (ASD-F)

"My motivation to make friends is to make sure I'm not a lonely, isolated person but also because experiences are nicer when shared.." (ASD-M)

"I'm open to making new friends but would be very anxious about it at the start". (ASD-M)

Lack of motivation (n =14)

I find them to take more emotional energy than I usually have available. So, I don't have much motivation to have friends for that reason.." (ASD-F)

"..again, I do not understand this apparent innate need for socialising and friendship. I have no motivation to make friends. I am friendly with everyone, and show respect and civility to all. However, people are mentally and emotionally draining, even the best of them." (ASD-F)

Pleased with the current social network (n = 6)

"I am satisfied with my current social network, I have few friends but it is the right amount for me. I am not very open to new friends and it takes me a long time to form a connection with people but I do try and stay in touch with old friends e.g. from school." (ASD-M)

Theme: Challenges in friendships

The fourth question asked participants about their challenges in making and maintaining friendships. These questions resulted in 2 main themes; i) social difficulties and ii) change over time (see Box 7.4).

Social difficulties. Social difficulties were the most common theme that emerged as a challenge in making and maintaining friendships in the ASD group (*n* = 32). In terms of challenges, meeting new people and making friends (*n* = 10) was a more common problem than maintaining friendships (n = 5). Communication problems were frequently reported challenges in autistic individuals (*n* = 9), regardless of gender. This included difficulties with interacting with people, especially in the first stages. Communication problems seemed to arise especially when autistic individuals found it harder to make small talks as they would prefer to have deeper conversations about common interests. The most common challenge for friendships in ASD (*n* = 15) was exhaustion and anxiety in making and sustaining friendships. Anxiety, in particular, might be a barrier in approaching to new people. Due to high anxiety, friendships can be very exhausting for individuals with ASD (e.g. keeping up contact with friends). Communication problems and exhaustion could be due to difficulties in social perception (e.g. understanding common assumptions/rules) as reported by 8 individuals with ASD. The social difficulties could make it harder to understand how deep the relationship is. These difficulties in social understanding might lead to misunderstandings between autistic individuals and their friends, as stated by 7 individuals with ASD. Several autistic participants identified their use of literal language as a barrier in maintaining and making friendships.

Change over time. A second key challenge that was identified related to ‘change over time’ (*n* = 5) which encompassed life events (e.g. marriage, moving), especially in others’ lives, and increasing age. Associated with life events, age was identified as an important factor that influenced friendship experiences. Over time, expectations of friendships might change, which was difficult for some autistic individuals to adapt.

Box 7.4. Challenges in making and maintaining friendships in autistic adults

Social difficulties (n = 32)

"I find that even with close friends I can struggle to start or continue a conversation which can make things awkward and seem very one-way." (ASD-M)

"Exhaustion also contributes to problems with maintaining friendships as does generally knowing how to manage communicating with so many people, especially if I have little pretext to do so." (ASD-F)

"I also find misunderstandings can be a big problem. I can take things very literally and personally and also get upset quite easily. This means that if someone says something which I misunderstand, it can ruin a friendship." (ASD-F)

Change over time (n = 5)

"Difficulty when friends' lives move on (e.g. getting married, children) when mine is staying still." (ASD-F)

"I'd like to have a number one best friend, someone whom I could rely on and someone who'd rely on me, but I guess the older we get, the less likely this becomes -- even the friends I used to have started to have families, and the relationship dynamic shifted." (ASD-F)

Theme: Strengths in friendships

The fifth question asked participants about their strategies in making and maintaining friendships. These questions resulted in 3 main themes; i) personal qualities, ii) masking, and iii) support (see Box 7.5).

Qualities in friendships. In addition to challenges, autistic individuals reported many strengths in making and maintaining friendships. 14 participants with ASD mentioned several personal qualities that could help them to have positive friendship experiences. These qualities were related to personal characteristics (e.g. good listeners, open-minded and non-judgemental, honest/loyal, and supportive) and mutual interests (e.g. video games). In addition to personal characteristics, having common interests/hobbies was reported by seven participants with ASD as a strategy to make friends. Related to being similar, two participants stated that it was easier to become a friend with someone who also has a similar condition.

Masking. In order to overcome their challenges for friendships, autistic individuals developed several strategies to have and sustain friendships. Masking emerged as a common strategy, especially among females (6 females, 2 males). The most common strategy was imitating neurotypical interactions as reported by 8 individuals with ASD. As part of masking and trying to fit in the social norms, 4 autistic participants stated hiding their mutual interests in order not to bore others or look different. In order to compensate for their social difficulties, two autistic individuals reported to use other strategies to make friends (e.g. using processing power).

Support. The last theme that emerged as a strategy to make and maintain friendships was support (*n* = 5). Three autistic males reported relying on others to make friends, such as their already existing friends or their partner/wife. In addition, using social media was recognized by 4 participants as a strategy to make expand social network and to keep contact with friends. It is important to emphasize that 10 autistic participants did not mention any strategy due to reasons such as not being interested, too shy, or not knowing how.

Box 7.5. Strengths and strategies in making and maintaining friendships in autistic adults

Personal qualities (n = 14)

"I try to be kind and funny, and to make my friends feel good about themselves." (ASD-M)

"I find shared interests and hobbies most helpful and I usually hang out with friends to play games or watch movies etc." (ASD-NB)

Masking (n = 8)

"I try to ask them lots of questions to show that I am interested, keep eye contact, smile etc."(ASD-F)

"I try to become friends with people who have children the same age. Keep everything superficial as my interests bore people. Smile and look at/through faces." (ASD-F)

"But when I get tired, or lose focus, I can slip up and my natural way of being can slip through. This is hard. I wish I didn't have to do that to get by, but the alternative is a very small world with few people in it." (ASD-M)

Support (n = 5)

"I'm married to a very extroverted NT, and I basically water-ski behind her socially: She does so much of the heavy lifting and maintenance for us, so there's a decent social life. Though I think the downside is our social life is dominated by her choices, which would be different from mine. So honestly outsourcing social things to my wife is a big part of my strategy." (ASD-M)

Theme: Negative experiences of friendships

The last question in the friendship questionnaire focused on the most common negative friendship experiences in the past. Based on the responses in the ASD group, two themes were defined; i) social rejection and ii) social vulnerability (see Box 7.6).

Social rejection. The majority of participants (n = 27) reported having experienced rejection by their friends in the past. Isolation and being left out emerged as the common experience in both autistic males and females. Some of the strategies discussed above (e.g. preferring small scale friendships or masking) might have developed in order to prevent frequent experiences of social rejection and isolation in autistic adults. The other issue that might lead to social rejection was lack of understanding or being misunderstood by others. Feelings of isolation and being misunderstood might lead to feeling different or wrong in autistic adults.

Social vulnerability. Another very common negative friendship experience among autistic individuals was social vulnerability, as reported by 14 participants. There were more autistic females (n = 9) who reported to experience social vulnerability compared to non-binary (n = 3) and males (n = 2) with ASD. One common experience related to being ignored, especially in females, was not being told the truth or not explaining what was happening in their friendships. Participants with ASD also discussed being manipulated and used by their friends. This negative experiences of being used and taken advantage of could lead to a more passive approach and less willingness to make friends in the future. Related to being used and manipulated, autistic individuals might experience asymmetry in relationships. In fact, individuals with ASD remarked that they invest more in their relationships, compared to what they get in return.

Box 7.6. Negative friendship experiences in autistic adults

Social rejection (n = 27)
"Being left out would be the most common experience.." (ASD-F)
"Sometimes people who I thought were my friends have excluded me from groups and not invited me out to activities. This made me feel sad and lonely." (ASD-M)
"People feeling I'm too weird to warrant the effort. I have a bad habit of being unable to regulate and thus people find me difficult to be around. I feel lonely and rejected when this happens because it confirms the fear that I'm abnormal and very alone." (ASD-NB)
Social vulnerability (n = 14)
"My negative friendship experiences have been being lied to and having things kept secret from me, and then being made to feel like this wasn't actually happening. I have had lots of friendships where I have been excluded from meeting up and feeling like I did something wrong that no one would tell me about." (ASD-F)
"I was manipulated by people I thought were friends as a teenager. I think this has likely made me more closed than I already was." (ASD-NB)

7.3.4. Part 2: Discussion

Taken together, the qualitative findings provided an in-depth and rich understanding of the varied friendship experiences in autistic adults. Autistic individuals experienced challenges in both making friends and maintaining friendships, however, they also developed many strategies to overcome these challenges and achieve belongingness through their friendships. More importantly, there were huge individual differences in friendship experiences within autistic individuals, particularly in motivation for friendships, which is a relevant point to consider throughout the thesis.

In terms of understanding friendships, autistic individuals demonstrated a rich understanding of and expectations from friendships. The majority of participants with ASD discussed companionship (e.g. doing things together, especially mutual interests) and being there when needed (e.g. support, trust) as important assets in friendships. The companionship (especially shared interests) and offering help and support as important requirements for friendships were also shown in previous research with autistic adolescents (for a review, see Cresswell, Hinch, & Cage, 2019). Regarding friendship activities, some gender discrepancies were observed. While both genders discussed companionship and spending time together with friends, autistic females focused more on the sharing "personal" issues while autistic males focused more on the activity-based and practical components of friendships. In terms of the form of friendship activities, autistic individuals preferred one-to-one and close friendships over group interactions and casual friendships. This could be owing to the feelings of exhaustion after being in social situations for too long. For example, previous research showed that autistic female adolescents use individual down-time as a strategy to be able to maintain their relationships, not because they do not enjoy them or want to be alone (Foggo & Webster, 2017). This could also be related to sensory issues or anxiety in autistic individuals (Jones, Hanley, & Riby, 2020). For example, some autistic individuals in the current study described that they prefer quieter and more structured activities with friends instead of loud social places or unpredictable activities. Therefore, social difficulties might play a critical role in shaping the preferences of autistic individuals for their friends and friendship activities.

Most importantly, current qualitative findings highlighted that the majority of autistic adults had a desire for friendships, along with vast individual differences in underlying reasons for similar levels of motivation for friendships. Autistic individuals reported to enjoy spending time with friends as it brings happiness and greater self-esteem. This stands in contrasts to the hypothesis stated in the Social Motivation Theory (Chevallier et al., 2012) as findings from the current study showed that some autistic individuals find social interactions rewarding and enjoyable. These results indicated that being with friends is good for the well-being of autistic individuals and it reduces feelings of loneliness and increases feelings of self-worth. However, a core theme that emerged was the social difficulties that make it difficult for motivated individuals to make friends. Therefore, even though many autistic adults reported to be motivated to have friends, they may lack the social skills to make and maintain friendships, which might result in an unsatisfied social life and/or cause distress. These results overall suggested that autistic individuals who appreciated and desired friendships might be more prone to stress and loneliness due to reduced social skills (Tierney, Burns, & Kilbey, 2016; O'Hagan & Hebron, 2016; White & Roberson-Nay, 2009), which might lead to reduced satisfaction in the social world (Sumiya, Igarashi, & Miyahara, 2018).

In the present study, more females with ASD reported motivation to have friends compared to autistic males. This could be explained by differences in societal gender-based expectations from girls who are expected to be friendlier, social, and nurturing (Goldman, 2013; Kreiser & White, 2014). This was also reflected in their descriptions of friendships such as talking about personal matters as opposed to doing things as reported by autistic males. Another qualitative study found higher social motivation in female adolescents with ASD compared to males with ASD (Sedgewick et al., 2016). The researchers discussed that greater social motivation but lack of social skills in autistic girls might make them more vulnerable for social neglect than active rejection as observed in autistic boys. This is a relevant point for the current study and will be further discussed in relation to social rejection and vulnerability in the following section.

Among autistic individuals who were not motivated to make friends, the most common reason was that the friends are emotionally draining. This theme was mentioned in many sections of the qualitative analysis (e.g. description of friendships, motivation, and challenges). Autistic individuals might not be motivated to have friends because friends are hard work and it is exhausting to maintain friendships. This was reported in previous studies in adolescents with ASD, as well (Foggo & Webster, 2017; Sedgewick, Hill, Pellicano, 2019). The current findings replicated those of existing studies and extend them to adults with ASD. Another reason for reduced friendship motivation in autistic adults was lack of interest in socializing as reported by fewer participants (n = 6). This group is the only one that support the Social Motivation Theory by suggesting that autistic adults have reduced motivation for social interactions (Chevallier et al., 2012). However, this was only about 12% of the ASD sample. Lastly, early experiences of failures in attempts to make friends, probably owing to social difficulties, might lead to reduced motivation in autistic individuals and subsequently loneliness and isolation (Mazurek, 2014).

Autistic adults faced multiple challenges, especially in making friendships. Social difficulties emerged as a core theme that was reported by almost 80% of autistic participants. The interplay between communication problems (e.g. interaction with people), anxiety in social situations (e.g. meeting new people), difficulties in social perception (e.g. not understanding social cues), and misunderstandings (e.g. due to literal use of language) make it harder to make new friends and maintain friendships in adults with ASD. These difficulties in social domains, together with high levels of stress and anxiety (Cook, Ogden, & Winstone, 2018), might cause exhaustion and feeling overwhelmed around friends. Foremost, developing awareness of their differences to NT individuals and lack of understanding by others over time could further lead to isolation in individuals with ASD.

Another challenge experienced by autistic adults in their friendships was the change over time. Autistic adults in the current study reported that they struggle to keep friends when situations change. Similarly, the expectations from friendship could change over time, which makes it harder for autistic individuals to adjust. Several studies have shown that making and maintain friendships became more challenging for autistic individuals as they get older (see Cresswell, Hinch, & Cage, 2019 for a review). These difficulties might be related to changes in expectations and social etiquette over time, which could be particularly difficult for autistic individuals transitioning to adulthood. These increasing challenges over time can cause social isolation and loneliness in autistic individuals (O'Hagan & Hebron, 2016). Overall, social motivation and friendship experiences seem to differ in older autistic adults which could be explained by lack of familial or formal support for social engagement in older compared to younger autistic adults. This is a topic that warrants further investigation.

Besides several challenges, autistic individuals in the current study highlighted many strategies and strengths. Personal characteristics such as being honest, supportive, open-minded, and a good listener were mentioned by autistic individuals, suggesting that individuals with ASD adapt similar qualities to what they value as key aspects of friendships. This is contradictory to what was found in a previous study showing that autistic adolescents did not report any of the personal qualities that they desired in a friend (e.g. trustworthiness, patience, helpfulness, and kindness) (Locke et al., 2010). It could be argued that older adults with ASD have a better understanding of reciprocity in their friendships and they adapt personal qualities that match with their expectations in a friend. Similarly, given the difficulties in social interactions (e.g. small talk), autistic individuals might find it easier to make and keep friends with similar interests as they would have something to talk about and do together. Moreover, socializing with someone who has no similar interests could be too exhausting and lead to a lot of stress and anxiety in autistic individuals (Causton-Theoharis et al., 2009).

Autistic adults in the current study engaged in masking as a strategy for making and keeping friends, especially among females. In order to “fit in” and look “normal”, autistic adults reported to imitate neurotypical interactions such as smiling and looking at the eyes. Masking as a strategy to overcome challenges has been found in previous studies with autistic adolescents and adults (Cook et al., 2018; Sumiya et al., 2018). The current results replicated those of existing studies and extended them to adults with ASD. However, masking for a long time could lead to critical problems such as misdiagnosis, undisclosed diagnosis in order not to be labelled, and internalizing problems (e.g. anxiety and depression) (Cook et al., 2018).

A less common strategy in making and keeping friends in the ASD group was support from others. Individuals with ASD might rely on their other friends or partners to facilitate social interactions. Even though it was not mentioned in the current study, previous studies showed that parents and school staff could also help autistic individuals to start new friendships (Howard, Cohn, & Orsmond, 2006; Tierney et al., 2016). For example, parents could provide opportunities for their autistic children to meet and engage with people (Howard et al., 2016) or other friends can give advice to help in friendships. Social media was also reported by one participant with ASD as a strategy for keeping contact with friends. Using emojis and memes might be easier for autistic individuals to express their intentions and emotions and therefore facilitate social engagement. It can also reduce anxiety during real-world social interactions and improve friendships quality (van Schalkwyk et al., 2017).

Social rejection and social vulnerability were commonly identified within the data regarding negative friendship experiences in autistic adults. Sixty-five percent of participants with ASD reported experiences of rejection in their friendships, including being left out, excluded, or isolated by others leading to feelings of sadness and loneliness. One reason for high rates of social rejection might be social difficulties associated with ASD as autistic individuals might be easily ignored and singled out when they act outside of the social norms. This could lead to negative attributions or bullying for the autistic individual, especially by others who lack understanding of ASD. Previous research has also demonstrated frequent experiences of peer rejection and victimization in autistic adolescents (Fisher & Taylor, 2016; O'Hagan & Hebron, 2016; Tierney et al., 2016), and consequently feelings of sadness or anxiety (Cage et al., 2016; Fisher & Taylor, 2016; Tierney et al., 2016; Sumiya et al., 2018). They also discussed that breaking social rules resulted in peer rejection in adolescents with ASD (Tierney et al., 2016). Linked to social rejection, autistic adults might be vulnerable to victimization and exploitation by others in their friendships. Similarly to social rejection, social vulnerability could be related to social difficulties associated with ASD. For example, NT adolescents with poor social skills and few friends were found to be marginalized in their social group and therefore more vulnerable to be exploited by their peers (Delfabbro et al., 2006). Similarly, others could exploit social naivety of autistic individuals in understanding and navigating the social world. This abuse of power in previous friendships might lead to a more passive approach and less willingness to make friends in the future or lack of trust in potential relationships.

7.4. General discussion

This chapter aimed to understand the friendship experiences of autistic adults by combining quantitative and qualitative self-report measures. The first part of this study demonstrated that, on average, autistic adults scored lower on a self-reported friendship questionnaire than NT adults, suggesting reduced friendship quality in autistic compared to NT adults. However, huge variability of scores within each group and a large overlap between the groups were also observed. In order to gain further insights into friendships in ASD and to link the quantitative data to qualitative data, perspectives of autistic individuals on their friendship experiences were explored in the second part. The qualitative insights highlighted that there was a huge heterogeneity in friendships experiences of autistic individuals, similar to what was observed in quantitative friendship questionnaire in the first part. Combining quantitative and qualitative measures has emphasized the importance of autistic testimony in understanding of lived experiences and has raised issues for existing theories, in addition to highlighting potential directions for implication and research.

The interplay between the main themes in the current study was important for understanding the complex social experience in autistic adults, as observed throughout the thesis. For example, ASD related social difficulties make it difficult to initiate and navigate social interaction, which in turn might lead to social rejection and decreased motivation for friendships. The impact of social difficulties upon social motivation was also present in Chapter 6, which found that older age, higher autistic traits, and heightened alexithymia predicted lower social motivation scores in autistic adults. Moreover, early negative experiences, especially prevalent incidences of rejection, might prevent autistic individuals from seeking friendships. Therefore, reduced social motivation might be a result of early negative experiences, rather than an initial cause for social impairments in ASD. These results were also in line with the findings in Chapter 4 which demonstrated large individual differences in expectations for rejection in the ASD group. Overall, the current qualitative insights have provided further evidence for the interplay between social skills, social rejection and social motivation, particularly in friendship experiences.

Linking back to the Social Motivation Theory (Chevallier et al., 2012) as it is the core to the thesis, the current and previous findings are in contrast with the Social Motivation Theory as they showed that many autistic individuals had a desire for friendships, enjoyed spending time with friends, and developed strategies to maintain their friendships, whilst there were many reasons for their lack of motivation besides reduced interest/pleasure in social situations (Calder et al., 2013; Causton-Theoharis et al., 2009; Cook et al., 2018; Sumiya et al., 2018; Whitehouse et al., 2009). In fact, only a small subgroup of autistic participants reported a lack of motivation due to reduced interest in socializing. Similarly, in Chapter 6, huge individual differences in capacity for pleasure in social and personal interactions in the ASD and NT group were observed. Therefore, recognising heterogeneity in experiences of autistic individuals, especially in social motivation, is a vital step to developing awareness of ASD and appropriate interventions.

A clear finding from this study was that autistic individuals experience high rates of social rejection and social vulnerability, which might be related to lack of understanding and awareness of ASD. This was also observed among university students with ASD, who reported that the struggles of autistic individuals were not recognized by other students and faculty members (see Chapter 5). Previous research has demonstrated that even though there is an increasing awareness of autism among the general population, individuals with ASD often experience stigmatization, especially by their peers (Cage, Di Monaco & Newell, 2018; 2019). Indeed, this lack of understanding could be related to the "double-empathy" problem described by Milton (2012). According to Milton, autistic and NT individuals have different social norms and expectations from each other, which might influence relationships between autistic and NT pairs (Brewer et al., 2016; Alkhaldi et al., 2019), forcing autistic adults to mask (Hull et al., 2017; Lai et al., 2017). Indeed, recent research has shown that autistic individuals prefer to be friends with other autistic people as they feel more comfortable around them (Crompton et al., 2020). Increasing understanding and acceptance of ASD can therefore eliminate the pressure to mask true selves of autistic individuals. Lastly, considering the fact that loneliness and having few friends significantly predicted greater depression and anxiety symptoms in autistic adults (Whitehouse et al., 2009), improving friendships experiences could be protective against poor mental health in ASD and NT.

7.4.1. Limitations

Although this study has provided a comprehensive understanding of unique friendship experiences in autistic adults by combining quantitative and qualitative insights, there were a few limitations. All measures in the current study were completed by autistic individuals themselves, and therefore, this study did not connect the perceptions of autistic adults to those of their friends. Indeed, autistic individuals might have misperceptions of their friendships and social involvement than their peers or parents. The discrepancies in friendship experiences between multiple informants have been identified in previous studies with autistic children (Chamberlain, Kasari, & Rotheram-Fuller, 2007; Kasari et al., 2011). For example, children with ASD perceived themselves more connected to their friends than their peers, or their nominated friendships were not reciprocal (Chamberlain et al., 2007; Locke et al., 2010). Therefore, future research should explore friendship experiences in ASD by including multiple informants, especially the nominated friends by the autistic individual. This would provide further insights into the friendship dynamics and the reciprocity of friendship experiences in autistic adults.

7.4.2. Conclusions

Overall, the current findings have added to the previous literature on friendships in adolescents with ASD by demonstrating some challenges persisting into adulthood (e.g. social difficulties and social rejection) while highlighting several strengths (e.g. personal qualities) in autistic adults. More importantly, a vast heterogeneity was observed within ASD as demonstrated by both quantitative and qualitative data. The qualitative insights of autistic individuals provided further understanding of the quantitative findings in previous chapters in this thesis, particularly in relation to social motivation, social difficulties, social rejection, and mental health difficulties. For example, the experimental methods in Chapter 3 and Chapter 4 also demonstrated individual differences in experiences of social rejection, which could not be revealed by group-level analysis. Moreover, high rates of social anxiety (Chapter 3, 4, and 6) and poor social skills in autistic adults (Chapter 5 and 6) could be related to some of the themes that emerged as challenges and negative experiences in friendships. Overall, the current chapter emphasized the importance of autistic voice in shaping our understanding of complex and unique social experiences in autistic adults. These findings are relevant for the theory, practice, and intervention, and highlight the need for further work, especially regarding heterogeneity and potential gender differences in friendship.

Chapter Eight: General Discussion

8.1. Introduction

This thesis aimed to explore social behaviour and social experiences within the framework of social motivation in adults with and without ASD, using a multi-method approach. Since the focus was on the social characteristics of ASD, the first Chapter outlined the theories that sought to explain social behaviour in ASD. Chapter 2 focused on the Social Motivation Theory (Chevallier et al., 2012) as it provided the framework for the thesis and the relevant literature on social motivation was reviewed. It was emphasized how the literature on social motivation has been dominated by neural studies in children and adolescents with ASD, while less is known about how predictions made by the SMT in ASD (based on early development) hold up for autistic adults and whether the SMT provides an accurate and valid explanation for social motivation in autistic adults (Clements et al., 2018; Jaswal & Akhtar, 2019; Kohls et al., 2012). Therefore, the primary aim of this thesis was to investigate whether there are social motivational differences between autistic and NT adults in line with the SMT, and subsequently, how social motivation in adulthood is linked to other aspects of the autistic phenotype. To this end, the first two studies administered behavioural paradigms and measured psychophysiological and behavioural responses to social exclusion (Chapter 3) and social rejection (Chapter 4) as an indicator of the social wanting component of social motivation in young adults with and without ASD. The first study using the Cyberball game showed that autistic adults experienced exclusion similarly to NT adults, and exclusion did not lead to higher arousal (indicated by the SCLs) in either group (Chapter 3). The second study using the Social Judgement Task demonstrated that autistic adults displayed cardiac slowing to general negative feedback whilst NT adults showed cardiac slowing specifically to unexpected social rejection (Chapter 4). Both experimental studies emphasized the role of social anxiety in experiences of exclusion (Chapter 3) and rejection (Chapter 4) across groups (see Table 8.1 for the summary of key messages in the thesis).

Given the multi-method approach adopted in this thesis, the second part aimed to investigate individual differences in social motivation and social experiences in autistic and NT adults by combining quantitative and qualitative self-report questionnaires. To this end, academic and social experiences of autistic and NT university students were examined using an online questionnaire including quantitative and qualitative data (Chapter 5). The findings demonstrated both social and academic challenges as well as strengths, especially in academic skills, among autistic university students (see Table 8.1). Previous chapters within this thesis reinforced the notion that there are individual differences in social experiences in relation to social motivation in autistic adults, which might be associated with social anxiety (Chapter 3 and 4) or social skills (Chapter 5). Therefore, the next study sought to investigate the interplay between social motivation, autistic traits, social anxiety, alexithymia, depression and loneliness in autistic and NT adults using self-reported quantitative questionnaires (Chapter 6). The results showed that even though, on group-level average, autistic adults scored lower on all measures, there was considerable within group variability and an important overlap between the groups. Foremost, older age and higher autistic traits predicted lower social motivation in autistic and NT adults (in a cross-sectional sample). Moreover, alexithymia had an additional role in social motivation among autistic adults, but not in NT individuals (see Table 8.1). The complex nature of the relationships between social motivation and other relevant factors was explored in a novel way by moving beyond linear methods of analyses. In this study, the existence of social motivation subgroups was explored in ASD and NT using the cluster analyses (Chapter 6). This analysis grouped autistic individuals with similar scores on age, social motivation, autistic traits, social anxiety, and alexithymia together, resulting in three distinct subgroups (see Table 8.1). The first subgroup displayed typical levels of social motivation alongside with lower autistic traits, lower social anxiety and reduced alexithymia. The other two subgroups had lower social motivation scores, however, they were different from each other in terms of social anxiety and alexithymia scores. The last study focused on friendship experiences in autistic and NT adults by combining standardized quantitative questionnaire with qualitative insights from autistic adults (Chapter 7). The results showed important variability in both quantitative and qualitative measures of friendship experiences among autistic adults (see Table 8.1). Most importantly, the majority of autistic individuals reported a desire to make friends despite their challenges, especially in social skills. These results from the second part of the thesis emphasized the importance of autistic testimony in understanding heterogeneous social behaviour in ASD and provided potential explanations for findings from previous experimental studies in this thesis. The theoretical implications of these results will be discussed next.

Table 8.1. Key messages drawn from each study within the thesis

Studies	Message 1	Message 2	Message 3
Study 1	Autistic and NT young adults experienced exclusion similarly, despite subtle differences in the broader experiences of autistic adults.	Exclusion did not lead to higher arousal in either group suggesting that SCLs may not be a very sensitive measure of adverse effects of exclusion.	Higher social anxiety predicted heightened feelings of exclusion across participants.
Study 2	Even though autistic adults reported higher expectations for rejection than NT adults, there was not a self-evaluation bias in either group.	Autistic adults showed cardiac slowing to general negative feedback, whilst NT adults had transient cardiac slowing specific to unexpected social rejection.	Higher social anxiety predicted a greater expectation for rejection across participants.
Study 3	Autistic university students reported several challenges, especially in social domains, along with high mental health comorbidity compared to NT university students.	Autistic university students reported many strengths especially in academic skills and their academic functioning was correlated with social functioning.	Autistic students reported motivation for friendship. However, there were also many autistic individuals who did not report any motivation.
Study 4	Autistic adults overall reported significantly lower social motivation than NT adults, however, there was an important within and between groups variability in social motivation.	Older age and higher autistic traits predicted lower social motivation in both groups, however, greater alexithymia had an additional role in lower social motivation in the ASD group only.	Cluster analysis identified three subgroups in the ASD group determined by social motivation, autistic traits, alexithymia, and social anxiety, and two subgroups in the NT group determined by social motivation only.
Study 5	Autistic adults scored lower on a friendship quality compared to NT adults. However, there was an important within and between groups variability in friendship experiences.	Lower friendship quality was associated with lower social motivation in the ASD group, but with higher autistic traits in the NT group.	Qualitative insights from autistic adults demonstrated both challenges and strengths in making and maintaining friendships. Most importantly, the motivations for friendships were highly heterogeneous within ASD, and the majority reported a desire to make friends.

8.2. Contributions to theoretical accounts of social motivation in ASD

Although it was beyond the scope of the current thesis to test each component of the SMT, the current findings have contributed to the understanding of different aspects of social motivation in autistic adults. The SMT is a theory which focuses on explaining autistic social difficulties by way of early social motivation atypicalities, rooted in early developmental responses to social information and reward processing (Chevallier et al., 2012). However, it lacks an explanation of how social motivation develops over the lifespan, and how social motivation deficits may present in autistic adults. If the fundamental assumptions of the theory hold true, then it would be expected that autistic adults would show clear differences in social motivation compared to NT adults. This section will discuss the thesis results in terms of their support for and contradiction with the SMT, followed by theoretical conclusions.

8.2.1. Theoretical contributions: support for the SMT

According to the SMT, reduced social motivation is the primary deficit which underlies social difficulties in ASD and early differences in social motivational factors would persist into adulthood (Chevallier et al., 2012). Therefore, atypical social behaviour observed in autistic adults would be the consequences of fundamental differences in the development of early social motivation. The current thesis utilized multiple methods including experimental, psychophysiological, descriptive, and qualitative, to probe social motivation behaviour in ASD and NT adults. Overall, if the assumptions of the SMT hold up through development, some of the findings were in line with the theory. For example, Chapter 4 studied behavioural and cardiac responses to unexpected social rejection to examine the social wanting component of the SMT. In line with previous literature, the results demonstrated that NT adults showed specific cardiac slowing to unexpected social rejection, which was more pronounced than cardiac responses to non-social negative feedback (Dekkers et al., 2015; Gunther Moor et al., 2014). On the other hand, autistic participants displayed cardiac slowing to both expected and unexpected social rejection, that was not distinguished from non-social negative feedback. Linking back to the SMT, adverse effects of social rejection are the strongest motives for individuals to seek social connection (Chevallier et al., 2012). Therefore, on the face of it, the results of this study provided support for the SMT by demonstrating a lack of social priority in the

ASD adults, which could be explained as a result of reduced social motivation in the early development of autistic individuals. However, it is important to emphasize that the broader experiences of autistic adults in these experimental paradigms might be different than those of neurotypical adults. For example, the same autistic adults did not feel the same level of exclusion to begin with (Chapter 3), they reported overall lower mood (Chapter 3), and their ratings for likeability did not change as a response to task manipulations (Chapter 4). These results suggest that the experimental paradigms might have different meanings for autistic adults compared to NT adults. Moreover, there were vast individual differences in behavioural responses to social exclusion and rejection within the ASD group in these studies. These issues are discussed in relation to heterogeneity in social motivation (see section 8.2.3) and the qualitative differences in interpretation of tasks in autistic individuals (see section 8.2.4).

In addition to experimental methods, self-report questionnaires on social motivation within this thesis demonstrated reduced social motivation in autistic adults compared to NT adults (Chapter 6). Using a quantitative questionnaire to probe social wanting and social liking components of social motivation, in the group-level analysis, autistic adults on average reported reduced social liking and social wanting behaviour compared to NT adults (Chapter 6). Moreover, lower self-reported social motivation was associated with higher autistic traits in both autistic and NT adults. The results of reduced self-reported social motivation in the ASD group were in line with the assumptions of the SMT suggesting that early differences in social motivation persist into reduced social motivation in adulthood (Chevallier et al., 2012; Chevallier, Grezes, et al., 2012). However, this questionnaire was not designed for autistic individuals, and therefore, it may not be appropriate to use with ASD samples in the first place (see section 8.4.1 for methodological limitations). As such, items on this measure may be interpreted differently by autistic adults. Moreover, there was a considerable within group variability and an important overlap between the groups in this chapter. The group differences may be driven by more extreme scores and the shared overlap may be just as interesting to explore. This heterogeneity was examined using individual level of analysis and nonlinear analysis methods in the current thesis, which will be discussed in section 8.2.3.

8.2.2. Theoretical contributions: in contrast with the SMT

The studies in the current thesis were informative about the experience of social motivation in autistic adults. As already highlighted, the SMT focuses its explanation on social motivation in early development based on biological disruptions in reward related mechanisms, without a clear explanation of how social motivation develops across the lifespan (Chevallier et al., 2012). Of course, the social motivation described in early development in the theory may be different to the social motivation behaviour probed in adults in the current studies. When the assumptions of the SMT were applied to adulthood (e.g. that autistic adults would show fundamental differences in social motivation behaviour), there were several findings from multiple sources of data (including psychophysiology, behaviour, and self-reports) which were not in line with the SMT. For example, both autistic and NT adults reported heightened feelings of exclusion after an online exclusion paradigm, suggesting that autistic participants could detect and feel being excluded in a manner similar to NT adults (Chapter 3). More importantly, feelings of exclusion in this paradigm and expectations for rejection in the Social Judgement Task (Chapter 4) were predicted by higher social anxiety across participants, not autistic traits. According to the SMT, higher autistic traits would be expected to associate strongly with lower social motivation (Chevallier et al., 2012). The association between social anxiety and social motivation in the current thesis emphasized the role of other factors in social experience in autistic adults, and therefore, challenge the assumption that reduced social motivation is the primary cause of social difficulties in ASD in adults.

According to the SMT, there is a strong intrinsic drive to seek acceptance and avoid rejection in typical development, which is claimed to be lacking or reduced in ASD starting from early development (Chevallier et al., 2012). Therefore, in a social exclusion paradigm, NT adults were expected to show higher arousal to being excluded as it interferes with the innate need for social belonging, while ASD adults would be less responsive to being rejected (Chapter 3). However, neither the autistic nor the NT group showed the expected results and there was not an increase in arousal level (e.g. SCLs) as a response to social exclusion in either group. The lack of higher arousal during exclusion, especially in the NT group, raised questions about the reliability of the SCLs to measure the negative effects of exclusion (see section 8.4.1 for measurement limitations).

Qualitative insights into friendship experiences also produced contradictory results with the SMT by suggesting that many autistic individuals enjoyed friendships (indicating social liking), wanted more friends (indicating social wanting), and developed strategies to maintain friendships besides their social challenges including anxiety and exhaustion (Chapter 7). However, both quantitative (Chapter 6) and qualitative measures of social motivation (Chapter 7) demonstrated that there were also many autistic individuals who did not report motivation for friendships. Overall, the current findings did not provide evidence for a reduced social wanting, liking, or maintaining component in all autistic adults, which contrasted with previous behavioural and neural studies (Kohls et al., 2012). Instead, the current results emphasized that social motivation might not be reduced in all adults with ASD and there might be subgroups with different levels of social motivation. Indeed, based on descriptive and qualitative data in Chapter 5, 6 and 7, and the findings from nonlinear analysis methods in Chapter 6, vast heterogeneity in social motivation levels of autistic adults was observed. The next section will further discuss this heterogeneity in social motivation within ASD.

8.2.3. Theoretical conclusions: heterogeneity in ASD

One of the important questions raised in the SMT is whether the social motivation account applies to all individuals with ASD, especially given the high heterogeneity that characterizes ASD (Chevallier et al., 2012). Indeed, a closer look at the individual data, rather than group-level means, revealed that social motivation was highly heterogeneous among autistic adults and many factors were indeed at play. For example, psychophysiological responses to social exclusion (Chapter 3) and social rejection (Chapter 4) were highly heterogeneous among autistic individuals. Further investigation of this heterogeneity using linear regression models demonstrated that reduced responses to rejection (indicating reduced social motivation) were predicted by higher social anxiety across participants, but not by autistic traits (Chapter 4). This is a very interesting finding as it emphasized that experiences of social rejection and exclusion are linked to broader social anxiety issues, rather than ASD specific issues.

Moreover, the investigation of individual differences in self-reported social motivation demonstrated that, in addition to autistic traits, alexithymia might play a role in social motivation in autistic adults (Chapter 6).

Linking to the heterogeneity of social motivation in ASD, the SMT raises the issue of potential subgroups that do or do not have reduced social motivation (Chevallier et al., 2012). Wing and Gould (1979) were the first to classify ASD subtypes based on social interaction styles in autistic children, which were "aloof", "passive", and "active-but-odd" subtypes (Wing & Gould, 1979). According to this classification, individuals in the "aloof" subtype resist any social interaction and they represent the most severe end of the spectrum. Individuals in the "passive" subtype do not initiate social contact, but they accept them when initiated by others. Individuals in the "active-but-odd" subtype are the least severe group as they approach others and desire social interactions. However, individuals in this subtype display inappropriate behaviour due to idiosyncratic preoccupation and egocentric social exchanges, and therefore, they are the most vulnerable to rejection by their peers. Leading from this idea of subgroups, in this thesis, investigation of individual variability in the data using nonlinear analysis models (e.g. the cluster analysis) identified subgroups based on social motivation, which were determined by age, autistic traits, alexithymia and social anxiety among autistic individuals (Chapter 6). Comparing to the classifications by Wing and Gould (1979), the First Cluster was could be similar to "active-but-odd" subtype, in that it was characterised by higher social motivation and arguably was more 'typical'. Even though this subgroup was more typical in terms of lower autistic traits, less alexithymia, and lower social anxiety than other subgroups within ASD, their scores on these measures were still higher than the NT group, indicating more impairment. Therefore, individuals with ASD in this subgroup might display typical social motivation, but this may be alongside characteristic autistic social challenges. The Third Cluster displayed a very different profile with low social motivation, higher autistic traits, heightened alexithymia, and greater social anxiety. This subgroup could be compared to Wing and Gould's "aloof" subtype as they may not have much interest in social aspects of interaction, have social difficulties, and may be more avoidant of social interaction due to finding it more anxiety provoking. The Second Cluster was the most interesting one as it was the older subgroup with lower social motivation and less autistic traits than the First Cluster, yet lower levels of alexithymia and social anxiety. The autistic individuals in this cluster might resemble the "passive" group, with less motivation to initiate social contact with others, but not particularly avoidant. These descriptions are speculative, and clearly warrant further investigation. However, they do emphasize the complexity and heterogeneity of social behaviour in ASD and support the idea that social behaviour in ASD may be better understood in terms of clusters/subtypes rather than through a linear lens (Grzadzinski, Huerta, & Lord, 2013).

This thesis advocates the use of a multi-method approach and emphasizes the usefulness of autistic testimony alongside the empirical measures when investigating social motivation (Kapp et al., 2019). Therefore, motivations to make friends (social wanting) and maintain (social maintaining) friendships were investigated by combining standardized quantitative measures with qualitative insights in autistic and NT adults (Chapter 7). The observed heterogeneity of the data from experimental tasks and self-report questionnaires were also reflected in the lived experiences of autistic individuals. For example, qualitative insights revealed that motivations for friendships were highly varied among autistic adults and there might be many reasons why someone is not willing to make friends (e.g. social skills, anxiety, exhaustion); it was not only lack of interest. Indeed, many autistic individuals reported a desire to have and maintain friendships, however, they found it difficult due to social and mental health difficulties. Applying the same approach as Wing and Gould (1979), autistic individuals who reported a desire for friendships may be similar to the "active-but-odd" subtype. On the other hand, there was a subgroup of autistic individuals who reported lack of motivation to make or sustain friendships due to lack of interest in socializing. This subgroup within ASD (12%) might be similar to the 'aloof' subgroup. Collectively, these findings not only emphasized that reduced social motivation is not an inherent characteristic of adults with ASD and there are subgroups of social motivation which might be determined by other factors, such as social anxiety and social skills.

The observed heterogeneity within autistic adults in the current thesis also suggested that not all aspects of social motivation are impaired in autistic adults, as proposed by the SMT (Chevallier et al., 2012; Kohls et al., 2012). In fact, the majority of autistic adults reported enjoying social interactions (*social liking* - e.g. Chapter 7) and having a desire to make more friends (*social wanting* - Chapter 7). In terms of social maintaining, autistic individuals engaged in strategies, such as masking, to be accepted by their friends (Chapter 7). However, social difficulties (e.g. alexithymia, poor social perception) might act as a barrier to transfer this motivation to social interactions in real life (Chapter 6 and 7). It is very important to emphasize that this complexity of social motivation behaviour could only be revealed using multiple methodologies and analyses methods. For example, psychophysiological studies of social rejection (Chapter 4) and group-level analysis (Chapter 6) indicated reduced social motivation in ASD, however, non-linear analysis methods (Chapter 6) and qualitative insights (Chapter 7) demonstrated interest/desire for social interactions in many autistic adults. Therefore, the use of a multi-methods approach including the testimony of autistic individuals is important to chart the heterogeneity of social motivation in ASD (Tottenham et al., 2013; Pellicano & Stears, 2019). Moreover, the possibility of sub-groupings within ASD, and general heterogeneity among people with ASD should be recognized and addressed in autism research (Georgiades, Szatmari, & Boyle, 2013; Happé & Frith, 2020).

8.2.4. Theoretical conclusions: developmental accounts

Another issue that is raised in the SMT is whether there are developmental changes in social motivation in ASD and how early deficits in social motivation have a long-lasting effect on social skills in adulthood (Chevallier et al., 2012). According to the SMT, early atypicalities in social reward processing persist into adulthood and restrict the opportunities to learn from social interactions, resulting in impaired social skills in autistic adults (Chevallier et al., 2012). Therefore, the SMT would claim that the social impairments observed in autistic adults are consequences of early atypical social motivation. However, the vast body of research on social motivation has been conducted with younger children and adolescents with ASD (Bottini, 2018; Clements et al., 2018) and the developmental trajectory of social motivation into adulthood is not specified in the theory. The current thesis did not aim to test the fundamentals of SMT, however, the results in this thesis have provided considerable insights into social experiences in relation to social motivation in adults with ASD, particularly in young autistic adults without intellectual disabilities. Specifically, this thesis focused on social motivation in young adults because, in addition to challenges associated with ASD, transitioning to adulthood is a critical period in terms of increasing demands of social relationships, academics, employment, and independent living (Barnhill, 2007; Thompson et al., 2018; Kapp, Gantman, & Laugeson, 2011; Volkmar et al., 2017).

Indeed, in all chapters within the current thesis, autistic adults displayed social challenges together with high rates of mental health difficulties. However, the underlying reasons for these impairments in adulthood may not be explained by reduced early social motivation per se and there could be other factors that have an impact upon these experiences in adulthood. For example, early negative experiences (e.g. social rejection; Chapter 4 and 7) might *lead* to reduced social motivation as an adaptive response in autistic adults (Brown & Foxley-Webb, 2019), rather than reduced social motivation being the precursor for the subsequent social impairments. These results overall suggested that social motivation in autistic adults is highly complex, and there certainly are not clear social motivation deficits which could be linked directly back to early social motivation atypicalities. Previous neurological studies of social motivation also demonstrated that hypo-activation in reward related regions as a response to social stimuli disappeared with age in autistic individuals (Clements et al., 2018). On the other hand, older age was associated with hyperactivity in hippocampus and amygdala for both social and non-social domains, which might be related to social anxiety (Kleinhans et al., 2010; Swain et al., 2015). These results overall indicated that social experiences related to social motivation might be different in adults compared to younger children with ASD and the SMT does not hold up in all autistic adults.

8.2.5. Theoretical conclusions: qualitative differences in interpretation of tasks and measures

This thesis utilized multiple methodologies (e.g. psychophysiology, behaviour, and self-report) and several analysis methods (e.g. linear regression, cluster analysis) to have a comprehensive understanding of social experiences and social motivation in autistic adults. However, only a small proportion of variance in the outcome measures could be explained throughout the thesis, especially in the ASD group (Chapter 3, 4, 5 and 6). One explanation for this pattern in the ASD group is that the nature and the degree of social experiences might be qualitatively different in autistic individuals. For example, in the experimental paradigms, the ASD group overall had lower feelings of inclusion and lower positive mood (Chapter 3) and lower review ratings to be liked (Chapter 4), suggesting that autistic participants started the task at a different level and they did not have the same experiences/feelings to begin with. Moreover, task manipulations might have different meanings for autistic individuals. For example, in Chapter 4, autistic adults were found to show cardiac slowing to both social and non-social negative feedback. This could be due to the fact that autistic individuals were more afraid to make a mistake in front of others (e.g. guessing the age wrongly), and therefore, it is possible that *both* the Social and Age Judgement Tasks were effectively *social* tasks for autistic adults and thus all negative feedback was social. On the other hand, NT individuals responded to the social and non-social aspects of the tasks differently and so there were important group differences in that respect. Therefore, it is important to discuss what constitutes sociality in ASD and how it is enacted across different social situations and social groups (Ochs & Solomon, 2010). There is an increasing interest in research about autism sociality and its indicators (Akhtar & Jaswal, 2020) and the current results emphasized the importance of qualitative differences in broader social experiences in autistic adults. This issue will be further discussed in relation to the autistic-neurotypical interactions in section 8.3.

Another issue regarding the low variance explained in the ASD group is the appropriateness of the social motivation measures to use with ASD samples. For example, using multiple self-report questionnaires, less than 40% of the variance in social motivation scores could be explained in the ASD group (Chapter 6). If the experiences of autistic individuals are qualitatively different, the existing measures designed for NT populations will not be able to pick up those differences in autistic individuals. This raised issues about the reliability and sensitivity of the social motivation measure in autistic individuals. Alternatively, key measures that underlie social motivation behaviour in the ASD group were not included in the current thesis. These issues will be further discussed in relation to the limitations of the measures in section 8.4.1.

8.3. Contribution to practice and implications

Heterogeneous social experiences in ASD as discussed above are very important to consider in designing and evaluating interventions for autistic individuals. One of the aims of the current thesis was to explore the predictors of social motivation, which has important implications for clinical and therapeutic practices for adults with ASD. Based on the findings from Chapter 6, alexithymia predicted lower social motivation in autistic adults. These results implied that interventions targeted at alexithymia might help autistic adults to find social interactions less confusing, therefore more enjoyable. For example, creating understanding and awareness of one's own and others emotions or mental states might contribute to reciprocal social interactions in ASD (Gaigg, 2012). This could also lead to reduced isolation and withdrawal from social situations in autistic individuals, which is especially relevant for improving mental health as suggested in Chapter 5 and 7. However, the development of these interventions requires more objective measures of alexithymia and systematic understanding of the developmental trajectory of alexithymia in autistic and NT individuals.

Another important factor in social experiences as discussed above is social anxiety. Based on the previous and current studies in this thesis (Chapter 3, 4, 5, and 6), the high rates of social anxiety in autistic adults, and its role on social motivation are important to consider in clinical practices. The interplay between social anxiety and social motivation suggests that targeting social anxiety in ASD might improve social experiences by providing strategies to navigate unpredictable social situations including friendships. For example, previous research has shown that peer interventions in adolescents (11-16 years old) and young adults with ASD (17-28 years old) improved friendships skills and decreased social anxiety levels and autistic traits (Schohl et al., 2014; McVey et al., 2016). Therefore, targeting social skills and social anxiety might contribute to improvements in social experiences including friendships in ASD. This suggestion was supported by the findings in several chapters as heightened experiences of exclusion and rejection were associated with higher rates of social anxiety (Chapter 3 and 4) and social anxiety and social communication difficulties influence motivation of autistic individuals by creating challenges for making and sustaining friendship (Chapter 7).

Another very important implication of the current thesis is the importance of the neurodiversity approach in understanding and improving the social experience in ASD. There is a growing shift in the autism literature in terms of conceptualisation of ASD from ‘atypicalities’ towards acceptance as initiated by the neurodiversity approach (Kapp et al., 2013), whilst still acknowledging the difficulties and challenges characterized within ASD. This approach has implications for both research and practice. In terms of research, expectations for similar understanding of and experiences during experimental paradigms between autistic and NT individuals might lead to restricted interpretations of observed group differences as a response to the task (Chapter 3 and 4). In terms of practice, the expectance of “neurotypical” ways of interacting socially and in friendships may lead to stigmatization and isolation among autistic adults at university (Chapter 5) and in their friendship experiences (Chapter 7). On the other hand, autistic individuals might choose to engage in activities or friendships that complement their capabilities (Kapp et al., 2019). Therefore, social experience and engagement including friendships can be determined by not only the autistic individuals themselves, but also the external factors such as attitudes of others and situational factors (e.g. type of activities). Acknowledging and accepting these differences can only be achieved by including the qualitative insights and perspectives of autistic individuals in research (Cage, 2020; Cage et al., 2018). Moreover, improving autism acceptance could prevent poor mental health in autistic individuals. This suggestion was supported in Chapter 3 and 4 by showing a relationship between social anxiety and experiences of exclusion and rejection, and also in Chapter 5 and 7 by providing qualitative insights of lack of awareness and stigmatisation together with anxiety and stress in social situations in autistic adults. Therefore, educating others about the ASD and creating neurodiverse environments that allow expression of diverse interests/behaviours are vital to improving quality of life and social community engagement in ASD.

It is also important to discuss neurodiversity within the framework of the SMT. To this end, two chapters in this thesis adopted a neurodiverse approach to examine whether social motivation lines in a continuum in everyone, regardless of diagnosis (Chapter 3 and 4). The results supported this view as social motivation was associated with social anxiety *across* participants. More importantly, the huge variability in self-reported social motivation within autistic adults was *also* observed in NT adults, along with a significant overlap between groups (Chapter 6). These results emphasized that social motivation might be on a continuum in the general population rather than an area of deficit associated only with ASD. However, the varying levels of social motivation might be underlined by different factors as demonstrated in Chapter 6. Therefore, even if the social motivation levels are highly variable in the general population, the underlying broader mechanisms of these differences might be different between ASD and NT individuals.

Linked to the neurodiversity approach, the current thesis demonstrated many strengths in autistic individuals in terms of their academic and social experiences (Chapter 5 and 7). These strengths should be acknowledged and incorporated into interventions with ASD. Indeed, developing strategies that capitalize on autistic individuals' interests, motivations, and strengths could help them to succeed in academic and social domains (Lanou, Hough, & Powell, 2012). For example, as reported in Chapter 7, creating opportunities for diverse social activities in line with the interests of the autistic individual (e.g. more structured and quiet activities) might be motivating and engaging for the autistic individual. Given the importance of leisure and social participation in greater quality of life, mental and physical health, and life satisfaction in ASD (Dovgan & Mazurek, 2019; Stacey et al., 2019), the interventions based on individualised interests and strengths are crucial and hugely needed in the autism literature.

8.4. Strengths and Limitations

8.4.1. Methodology and measures

The methodological challenges of measuring social motivation were discussed in Chapter 2 (see Section 2.8; Uljarević, Vivanti, Leekam, & Hardan, 2019). The current thesis sought to accommodate these challenges by adopting a multi-methods approach that allows a comprehensive and rich understanding of the social experience and social motivation in autistic adults compared to NT adults. To this end, the studies within the current thesis included multiple variables that might contribute to social behaviour (e.g. social anxiety, alexithymia) and applied multiple methods of data collection (e.g.

surveys, behaviours, and psychophysiology) and analysis methods (e.g. cluster analysis) in order to capture individual and subgroup differences within ASD. Inclusion of a comparison group throughout the thesis has provided insight into autistic adults' social experience in the context of the general population. Using a multi-method approach across the thesis is also important to balance the advantages and disadvantages of each individual method used. For example, the psychophysiology was utilized in early chapters as a more objective method of social motivation and it provided insights into biological mechanisms of social experience in ASD. To this end, Skin Conductance Levels (SCLs) were measured to examine responses to social exclusion in ASD and NT adults (Chapter 3). Contrary to expectations, the NT group did not show an increased reactivity to social rejection, which raised questions regarding the reliability of skin conductance responses as a measure of negative feelings following social exclusion (Iffland et al., 2014b). Instead, SCLs might be a measure of general arousal as a result of task engagement, and therefore, cannot distinguish between the positive and negative emotional experiences (Bradley et al., 2001). To accommodate this limitation, heart rate measures were administered as an indicator of social rejection sensitivity using the same set of autistic and NT participants (Chapter 4). The cardiac measures were proven to be a more reliable measure to detect negative feelings of rejection, and therefore, can be suggested as a more effective measure of social motivation than SCLs. It is also important to emphasize that the psychophysiological and behavioural responses to the same task might produce different results (Chapter 3 and 4), and therefore, combining the different types of insights on the same task can be informative as well as challenging.

To complement the psychophysiology methods, self-report research method was also used as a valuable source of information in the current thesis (Baldwin, 2000). Using quantitative questionnaires of social motivation allowed a large amount of control to be exercised, as these measures have established validity and reliability (Chapter 6 and 7). However, some of these standardized questionnaires demonstrated low reliability (e.g. low Cronbach's alpha levels) in the ASD group (Chapter 6 and 7). This issue could be related to the lack of established validity or reliability of these measures in autistic samples. As discussed in Chapter 2, the questionnaires that are developed for

NT populations may be lacking the insights into the unique experiences of individuals with ASD. This was clearly shown in Chapter 6 using the ACIPS as a measure of social motivation. When asked at the end of the questionnaire “Are there any other things missing from these questions regarding your social motivation?”, many autistic individuals reported the importance of context in answering the items in ACIPS. For example, their motivation was mostly dependent on the number of people involved and the closeness/familiarity of the people. They reported being more motivated to do things in one-to-one settings rather than with a group and with people they are close to (e.g. family, friends) rather than unfamiliar people (e.g. co-workers, strangers). Previous research has also shown that autistic participants reported fewer autistic traits when the context was defined as the participants’ in-group (e.g. “I like being around autistic people”) compared to out-group (e.g. “I like being around non-autistic people”) (Gernsbacher, Stevenson, & Dern, 2019). The current findings based on quantitative questionnaires of social motivation (Chapter 6) and friendship experiences (Chapter 7) emphasized that these measures may not be sensitive to assess social experience in autistic individuals. Combining both quantitative and qualitative questionnaires in Chapter 5 and 7 supported this view by showing qualitative differences in social experiences of autistic individuals along with a vast heterogeneity within ASD, which could not be revealed by standardized questionnaires. To conclude, qualitative measures might be very informative to measure social motivation in ASD, however, relying solely on self-report measures may be problematic, especially in autistic individuals due to issues of self-reflection (Bird & Cook, 2013), therefore, they should be complementary to more objective methods of social behaviour.

8.4.2. Sample sizes and generalizability of the findings

The existence of vast heterogeneity in ASD created some challenges in terms of sample sizes and generalizability of the current findings. As such, smaller samples of autistic individuals may not be sufficient to capture the variability within the data as it makes it difficult to have a secondary analysis to explore within group differences. For example, the ASD sample in Chapter 3 and 4 was too small to explore within group heterogeneity in psychophysiology responses. Therefore, a neurodiverse approach was adopted and ASD and NT samples were analysed together to investigate variability in the data. Moreover, due to smaller sample size in the ASD group compared to the NT group in these studies, which is quite a common experience in ASD research, I did not have enough power to conduct more advanced statistical analysis. The challenge regarding smaller sample sizes in the early chapters was addressed by including larger ASD sample in Chapter 6, which allowed me to investigate the heterogeneity within the ASD and NT groups separately as there were enough participants in each group.

Another issue regarding the sample characteristics is the generalizability of the current findings to other samples within the ASD. The majority of the participants across the studies of this thesis were young adults with relatively high verbal ability and intellectual functioning, and therefore, represent a small proportion of those with ASD and only some of the characteristics of those functioning on the autism spectrum. Especially given that over 50% of autistic individuals have an additional learning disability (Emerson & Baines, 2010), the current results should be interpreted with caution when generalized more broadly to the ASD population. High co-occurrence of mental health conditions or developmental disorders in autistic individuals could also be problematic in terms of generalizability of the current results. For example, 69% of autistic adults met the lifetime criteria for a psychiatric disorder (Buck et al., 2014). In all studies in the current thesis, autistic individuals were asked to report their comorbid mental health or developmental conditions, and the ones with these comorbidities were included in the results. Even though this would enable a representative sample to be studied, future studies should separately investigate autistic individuals with and without comorbid mental health condition, especially social anxiety, as they might have distinct social experiences (Han et al., 2019). Moreover, clinical measures of mental health conditions should be used as opposed to self-reports as they are more objective to assess comorbidities in ASD.

Finally, all autistic participants in this thesis self-reported their ASD diagnosis. Given the online nature of the studies in Chapter 5, 6, and 7 and working across several higher-education institutions to recruit students for Chapter 3 and 4, it was not possible to confirm their ASD diagnosis. However, autistic students that participated in Chapter 3 and 4 all had to obtain a clinical diagnosis of ASD to register University Disability Services. Regarding the online studies in this thesis, no financial compensation was advertised to assure that individuals were participating because of genuine interest in the study and not financial reasons. Moreover, individuals who reported to be waiting for an ASD diagnosis were not included in the analysis. However, clinical confirmation of diagnosis would be beneficial in future research.

8.5. Future research

The current thesis highlights several interesting avenues for future research. First, there is an urgent need to develop measures of social motivation that are validated in autistic samples. These measures should include contextual factors that have an impact upon sociality such as how social motivation for autistic people varies when in autistic and non-autistic interactions (Fletcher-Watson & Crompton, 2019). As shown in this thesis, autistic individuals have valuable insights into their unique lived experiences, therefore they should also be included in the development and the design of these measures (Fletcher-Watson et al., 2019; Gillespie-Lynch et al., 2017). There is increasing recognition of the importance of integrating autistic testimony in autism research (e.g. participatory research; Pellicano & Stears, 2019). That said, these methods should be combined with behavioural and brain imaging methods, creating a "methodological triangulation" in autism research (Kapp et al., 2019; Moseley & Sui, 2019).

As social motivation behaviour is a very complex and heterogeneous construct with contributions from multiple factors, especially social skills and social anxiety, future studies should investigate the role of these factors using more direct and experimental paradigms. More objective measures of social behaviour and social experience might also contribute to the understanding of the remaining unexplained variance in social motivation of autistic individuals. Another factor that might have an impact upon varying social motivation in ASD is the previous experiences of social rejection as shown in Chapter 4 and 7. For example, reduced social motivation in autistic adults might be an adaptive response to early negative lived experiences, rather than a defining characteristic of ASD (Brown & Foxley-Webb, 2019). The role of previous experiences that shape social behaviour in autistic individuals should be further investigated using longitudinal studies with the aim of predicting social functioning outcomes such as employment and quality of life in ASD.

Another potential inquiry for future research in ASD should be upon understanding the role of gender on social experiences and social motivation, especially in females with ASD. There is a growing interest in research with autistic females who have been mostly overlooked in the autism literature, probably owing to later or misdiagnosis (Loomes, Hull, & Mandy, 2017). Recent research has shown that social experiences in autistic girls are quantitatively and qualitatively different compared to autistic boys, with some similarities to neurotypical individuals (Sedgewick et al., 2016; Sedgewick, Hill, et al., 2019; Sedgewick, Leppanen, et al., 2019). This line of research has mostly focused on sex differences in friendship experiences, as also implied in Chapter 7, however, more systematic research is required to investigate broader mechanisms (e.g. executive function, social skills) that might underpin these differences between female and male autistics (Moseley et al., 2018). Lastly, the inclusion of autistic individuals with lower intellectual functioning in future research is necessary to understand whether social motivation and social behaviour are expressed similarly throughout the spectrum.

Another important demographic characteristic that warrants further investigation in ASD is age, especially older populations with ASD. Older autistic and NT individuals reported lower social motivation in the current thesis (Chapter 6). Similarly, qualitative insights into friendships demonstrated that friendship motivations and challenges might change over time (Chapter 7). These results are important to show that social experiences might be influenced by age. However, the only conclusions drawn from the current thesis regarding age were based on cross-sectional studies including a very few older adults (as the emphasis was on the younger sample), therefore, this change over time in social motivation has not been systematically tested in the current thesis. Only longitudinal studies can reveal the developmental changes in social motivation over time, however, they are time-consuming and financially costly. Given the findings in neurotypical populations indicating a change in motivation to interact with other people over the course of life (Carstensen, 1993; Fung, Carstensen, & Lutz, 1999) and the scarcity of studies in autistic individuals over the age of 40 years (Michael, 2016), there is a timely need for studying social experience in ageing autistic samples. Understanding how these mechanisms change over time, and how this affects social functioning at different ages would provide further evidence to support the advancement of theoretical models.

8.6. Conclusions

In conclusion, this thesis has contributed to the existing literature and the SMT by improving our understanding of social experiences in relation to social motivation in autistic adults compared to NT adults. The systematic explorations of the social experiences in autistic adults using a multi-methods approach provided a rich and comprehensive understanding of heterogeneous social behaviour in autistic individuals. In line with previous research, autistic adults self-reported significant social challenges including high rates of social anxiety and depression as well as reduced social motivation compared to neurotypical adults. In terms of experimental paradigms, adults with ASD demonstrated understanding and awareness of social exclusion and rejection, however, the psychophysiological responses showed different patterns compared to NT adults, which might be owing to qualitative differences in social experiences of autistic individuals. Using multiple research methodologies and analysis methods, the current thesis demonstrated considerable heterogeneity in social motivation and several subgroups within ASD. It also emphasized that social motivation in autistic adults is associated with social skills (e.g. alexithymia; Chapter 6) and social anxiety (Chapter 3 and 4), which are vital to consider in clinical practice. Moreover, qualitative insights from autistic individuals provided further evidence for heterogeneity in social experience within ASD while emphasising the importance of context and diversity in understanding the unique experiences of social motivation in autistic adults. Overall, this thesis addressed several issues raised by the SMT and highlighted that social experiences of autistic adults are highly heterogeneous, and rather than reframing all autistic individuals as socially unmotivated, future research should seek to systematically understand this within group heterogeneity in order to improve social and professional outcomes for adults with ASD.

Appendices

Appendix A: Chapter 3 Need for Threat Scale

Needs were assessed on 7-point scales ranging from 1 (do not agree) to 7 (agree). Questions ending with an "R" were recoded.

Belongingness

1. I felt as one with the other players.

2. I had the feeling that I belonged to the group during the game.

3. I did not feel accepted by the other players. (R)

4. During the game I felt connected with one of more other players.

5. I felt like an outsider during the game. (R)

Control

1. I had the feeling that I could throw as often as I wanted to the other players.

2. I felt in control over the game.

3. I had the idea that I affected the course of the game.

4. I had the feeling that I could influence the direction of the game.

5. I had the feeling that the other players decided everything. (R)

Self-Esteem

1. Playing the game made me feel insecure. (R)

2. I had the feeling that I failed during the game. (R)

3. I had the idea that I had the same value as the other players.

4. I was concerned about what the other players thought about me during the game. (R)

5. I had the feeling that the other players did not like me. (R)

Meaningful Existence

1. During the game it felt as if my presence was not meaningful. (R)

2. I think it was useless that I participated in the game. (R)

3. I had the feeling that my presence during the game was important.

4. I think that my participation in the game was useful.

5. I believed that my contribution to the game did not matter. (R)

Appendix B: Chapter 3 and 4 Debriefing form

Project title: **Physiological and Behavioural Indicators of Social Motivation**

Thank you for taking part in the study. This research focuses on the mechanisms underlying social motivational factors by specifically looking at physiological and behavioral indices of unexpected social rejection. Different groups of people can respond differently to being rejected or excluded by others. The role of other factors in social motivation behavior such as anxiety is also investigated in the current study.

We would like to inform you about the manipulations in both tasks. In Social Judgement Task, we provided you with a cover story that the people would see your profile picture before the experiment. In reality, nobody saw your profile picture before the experiment and the feedback was created randomly by the computer, so there were not any human agents involved in the task. In the Cyberball Task, you played against the pre-programmed computer players, not real people and the number of tosses you received was manipulated by the programme. You are paid a fixed standard amount for your participation regardless of ball tosses you received during the game, in this way all participants receive the same reward for their participation.

If you would like further information about the study or would like to know about the findings when data collection and analysis are complete then please contact us at emine.gurbuz@durham.ac.uk. Please remember that you have the right to withdraw your data at any point, up until the data are submitted for publication. Individually identifying information would not be included in any part of the collection and publication of the data.

If participating in this study has raised any issues or concerns for you, please inform the lead researcher (Emine Gurbuz emine.gurbuz@durham.ac.uk) or the supervisors (Dr Debbie Riby deborah.riby@durham.ac.uk and Dr Mary Hanley mary.hanley@durham.ac.uk) who will be able to signpost you to relevant support within your higher education institution.

Thank you very much for your participation.

Appendix C: Chapter 3 the mean of NTS subscale scores by group

Condition	Need Threat Scale	ASD		NT	
		Mean	SD	Mean	SD
Inclusion	Belongingness	5.01	1.12	5.50	0.92
	Control	4.54	0.99	4.79	0.83
	Self-esteem	5.28	1.14	5.68	0.62
	Meaningful existence	5.09	1.14	5.32	0.87
Exclusion	Belongingness	3.05	1.04	3.47	1.22
	Control	2.74	1.45	2.76	1.38
	Self-esteem	4.76	1.05	5.33	1.02
	Meaningful existence	3.49	1.27	3.88	1.09

Appendix D: Chapter 4 Cover story

<u>Before the Social Judgement Task:</u>

In this project, we are investigating the characteristics of social motivation and social interaction behaviour; such as what determines our behaviour to engage in social interactions. As you could imagine, some people find social interactions easy and some other people find them quite difficult, like people with Autism. Therefore, our lab is looking at different factors involved in social interaction behaviour.

Today, you will be doing two different tasks. Both tasks are related to social behaviour and they are about first impressions.

In this project, we are looking at what characteristics people rely on to make first impressions about others. This is very important because first impressions say a lot about whether you would want to interact with them in the future. Other people have first impressions of us too, just from looking at us or a picture of us, they might decide whether they like us or not. In order to test first impressions, we have spent the last couple of months approaching many students from Universities in the North East including Northumbria, Sunderland, and Teeside. We asked them to look at your picture for a few seconds and decide whether they liked you or not based on your ID picture.

Now, in the first task, you will be presented with the ID pictures of students from other universities who have already made a judgement about you. So what we want you to do is to indicate whether the person in the picture said that they liked you or not. You can do this by pressing a button. Button '1' stands for YES or LIKE and the button '2' stands for NO or DISLIKE.

In the next session, it will be your turn to make a judgement about them. But for now, focus on whether you THINK they liked you or not.

<u>Before the Age Judgement Task:</u>

The current study is part of a big project about first impressions such as age, ethnicity, gender, and other characteristics people rely on to make first impressions about others. Now, it is your turn to make an impression about the same people you have seen in the first experiment, but this time we want you to judge them based on their AGE. Now, you will look at the pictures of the students and tell us whether you think they are 21 years old or older. You can do this by pressing a button. Button ‘1’ stands for YES this person is 21 years old or older and the button ‘2’ stands for NO this person is NOT 21 years old or older.

Appendix E: Chapter 5 Likert-scale questionnaire about university experiences

The agreement with each statement was rated on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree).

1. My motivation to develop friendships is the pleasure I get by talking with friends.

2. My motivation to develop friendships is the fun of doing interesting things with friends.

3. My motivation to develop friendships is the fun moments that I have with friends.

4. My motivation to develop friendships is that I think having friends is good for me.

5. My motivation to develop friendships is that friends make me feel better when I am sad

6. My motivation to develop friendships is I am better able to express my opinions

7. My motivation to develop friendships is that my teachers find that it is important to have friends.

8. My motivation to develop friendships is to be invited to parties

9. My motivation to develop friendships is to be the centre of attention

10. My motivation to develop friendships I think that having friends does not bring much to my life.

11. I often feel I prefer to be alone.

12. I think that having friends does not bring much to my life.

13. I often get excited when I see an opportunity for meeting a new person I like.

14. I often feel willing to maintain my current friendships.

15. I often feel willing to maintain my current romantic relationships.

16. I often find it difficult to introduce myself to others.

17. I often find it difficult to express my opinions to others.

18. I often feel I am involved in socializing with others.

19. I often find it difficult to socialize with others.

20. I often feel outgoing and friendly.

21. I often care about what people think about me.

22. I always wonder why people act the way they do.

23. I often feel like I get enough fun and enjoyment out of life.

24. Compared to others, I often feel like I am better off.

25. I think university is harder than high/secondary school.

26. I have the academic skills to succeed in my institution.

27. I have good study habits in terms of the time and activity I allocate to studying.

28. I get good grades.

29. I find it easy to focus when I am studying.

30. I have thoughts of withdrawing from my institution/course.

31. I am satisfied with the level at which I am performing academically.

32. My academic goals and purposes are well defined.

33. Getting a university degree is very important for me.

34. I really haven't had much motivation for studying lately.

35. I am enjoying my academic work.

36. I find myself giving considerable thought to taking time off from my current institution and finishing later.

37. I am quite satisfied with my academic situation at my institution.

38. I have the social skills to succeed at my institution.

39. I have some good friends or acquaintances on my course with whom I can talk about any problems I may have.

40. I prefer to spend time in quiet places on campus.

41. I can cope effectively with stress and anxiety.

42. I feel like people ignore me.

43. I am involved in social activities at my institution.

44. Being on my own and taking responsibility for myself has not been easy.

45. I am having difficulty feeling at ease with other people on my course.

46. I feel I am very different from other students in ways that I don’t like.

47. I feel confident that I will be able to deal in a satisfactory manner with future challenges here at my institution.

48. I am adjusting well to my institution.

49. I am pleased about my decision to go to higher education.

50. Lately I have been having doubts regarding the value of university education to me.

51. The disability service coordinator is knowledgeable about individuals with an ASD.

52. I feel comfortable with disclosing my diagnosis with people on campus.

Appendix F: Chapter 6 Demographics questionnaire

1) What is your age (in years)?
2) Please provide the gender with which you identify:
3) What is your current occupation?
    a. if you are a student, what level of study are you currently enrolled in? (Response options: Bachelor's Degree level, Taught postgraduate level (e.g. Masters degree, postgraduate diploma), Doctoral level (e.g. PhD), OR other level (please name type of qualification)
4) What is the highest academic or skills qualification you have received to date (e.g. A Level, Bachelor degree etc)?
5) What is your nationality?
6) Is English your first language? (Response options: Yes, No)
7) Do you have any current diagnoses (e.g. developmental disorders, mental health issues, ADHD)? (Response options: Yes, No)
    a. If yes, what are these?
8) Have you previously been diagnosed as functioning on the autism spectrum (including Asperger Syndrome)? (Response options: Yes, No)
9) Age of diagnosis for functioning on the autism spectrum (in years):
10) Is anyone else in your family considered as functioning on the autism spectrum? (Response options: Yes, No)
    a. If yes, what is their relationship to you? (You can pick more than one option if needed) (Response options: Mother, Father, Sister, Brother, Other family members)

Appendix G: Chapter 7 Open-ended friendship questionnaire

These questions were only answered by participants with ASD.

1) We would like to know what friendship means to you. For example, you might include information on what you want from friendships and/or what being a friend means to you and/or what qualities you think are important at a friend?

2) On this question, we would like to know how much you *enjoy* friendships. For example, you might include information on what you like to do with friends and/or what is good about having friends and/or how it makes you feel to be with friends.

3) On this question, we would like to know about your motivation to have friends. For example, you might include information on how open you think you are to making new friends and/or how satisfied you are with your current social network (e.g. would you prefer to have more friends)?

4) On this question, we would like to know about any friendship challenges you may have to deal with. For example, you might include information on what things are difficult about making friends (e.g. meeting new people) and/or maintaining your friendships (e.g. having arguments or misunderstandings)?

5) On this question, we would like to know the strategies you use to build and maintain friendships. For example, you might include information on your strategies to make friends and maintain your friendships and/or what qualities help you to have good relationships with others.

6) On this question, we would like to know about your most common negative friendship experiences in the past. For example, you might include

information on how it made you feel and/or whether it affected your subsequent friendships and how?

7) Is there anything you think we should know about your friendships or how you get on with people?

Appendix H: Chapter 7 Example quotes from qualitative friendship questionnaire

Understanding friendships

People easy to be around

“A friend is someone who has taken time to get to know the real 'you' as opposed to the mask you show the world.” (ASD-F)

“Someone you can talk to about anything and not feel judged. Someone who accepts you for who you are..” (ASD-M)

“Friends are people who are like me in some way, who it isn't hard work to be around or chat to.” (ASD-F)

Being there when needed

“…to have someone to call in the middle of the night, when needed -- and to be that someone to call, when they need it..” (ASD-F)

“A friend - ..someone who cares for you like they were a member of your family and vice versa” (ASD-M)

“A friend is a person who cares for you and wants the best for you while you have the chance to have fun together” (ASD-M)

Companionship

“…Ability to talk at some depth about life, feelings and purpose.” (ASD-F)

“..someone who you can freely and confidently confide any problems you are personally experiencing and they will listen to you and attempt to provide advice/solution.” (ASD-M)

“I tend to want a friend who is not going to be too needy, someone who is going to give me the space I want, and not to violate that space. They have to now to keep their distance, unless I suggest otherwise. No loud or aggressive people, and no one controlling or dominant. They must be sensible, intelligent, and thoughtful. They also must not make too many demands of my time.” (ASD-M)

“Friendship is a mutual bond between two people based on understanding and affection. This is most true for best friends. Important qualities in a friend are enjoying time with them, being authentic and respecting each other.” (ASD-F)

“Friends tell everything to each other, give support always and love each other unconditionally.” (ASD-F)

“Being a friend means being loyal and looking out for one another as well as sharing good times and being there for the bad times. It's about being each other's support.” (ASD-NB)

Activities with friends

Nature of friendships

“Often we just end up sitting in a room and talking even if we put a film/ tv show on it just springboards more discussion” (ASD-F)

“…we rarely *do* anything, but we get on well and can talk about anything.” (ASD-NB)

“I enjoy having friends to share common interests with and spend time with. I enjoy having new experiences with my friends. I tend to enjoy my friends most when I haven't seen them in a long time and we have plenty to do and talk about.” (ASD-F)

“I find friendships to be functional rather than enjoyable. I find it confusing to do all the friendship stuff, it's nice to work with people on projects who have a similar outlook.” (ASD-M)

Type of friendships

“I find it especially hard when I am ignored. Because I rarely speak in a group situation I find that when I do speak up, what I have to say is swept aside and not worthy of consideration. This is why I now find it much easier to be friends with individuals rather than in a group as it takes away this problem.” (ASD-F)

“I tend to have very intense friendships with a few people, and then some other casual friendships. I enjoy the intense ones a lot, but they usually burn out and get sick.” (ASD-M)

“I prefer to have a minimal amount of friends, and to see them relatively infrequently (face to face).” (ASD-M)

Motivation for friendships

Motivated to have friends

“I would like to have more friends, particularly those who are interested in the same things as me. I would also like to have a best friend. I have a couple of people who I consider to be close friends but I would prefer to have a single person who I can talk to about everything. I find that there are different areas that I talk about with each friend.” (ASD-F)

“I wish I'd have one or two really close friends, i. e. the might call them up in the middle of the night kind. But as people usually are interested in romantic relationships (unlike me) they tend to end up with their partner/spouse as their "number one" person. I'd like to have a number one best friend, someone whom I could rely on and someone who'd rely on me..” (ASD-F)

“An important in quality I would also seek in a friend is initiative - initiative to contact me, rather than me being the one to do so all the time.” (ASD-M)

“I would like to have more friends. I feel very lonely.” (ASD-F)

“When I first went to university after living an essentially friendless life, I did not think that making friends was overly necessary. However, when I realized, emotionally, that I had made friends, I realized that I had been terribly lonely and that having friends made me feel much more positive and connected, and as such I have endeavoured to be friends with several people.” (ASD-M)

“I really like the friends I have and I feel generally supported and my friends are more important to me than my family. I wish I had a significant other however friends are comforting, I still feel very alone but they help me feel less isolated.” (ASD-NB)

“When I was young society told me I was supposed to have friends. That was my motivation. The older I got the more the lack and my failure created practical difficulties, and that became my motivation.” (ASD-F)

“Being wanted and needed is important to me, makes me feel worthwhile. I struggle to keep up and give enough to my friends but feel I must work hard so they'll continue to like me”. (ASD-F)

“I like to have friends so someone is there to rely on if I need help or someone to talk to. I might like to have more friends but I find it hard to make them. I would want to make friends that like to do the same stuff and don't mind going to quiet non busy places. People like that are hard to find at my age.” (ASD-F)

“I've just started a new job and there aren't people around my age around me so it's not easy to find like-minded friends, not even for casual chit-chatting. I am open to making new friends but would be very anxious about it at the start”. (ASD-M)

“I would like to have more friends here at university and to deepen and strengthen friendships I already have. I think I am open to making new friends but am often not in the right place or mindset.” (ASD-F)

Lack of motivation

“I don't have many friends but I am happy with this and wouldn't want more because it takes a lot of effort to maintain friendships.” (ASD-F)

“I am not really motivated to have friends. I like to keep in touch with acquaintances and to keep up to date with what they are doing through social media, but I am not interested in engaging with them directly.” (ASD-N)

“I am not good at making or maintaining friends. My social circle has decreased lately and I am happier for it. I had some toxic friends last year who exploited my autistic naivety, which has made me less inclined to seek any friendships.” (ASD-NB)

I don't feel very motivated because I always get disappointed very easy. I have been trying to have casual friends just to talk in college about homework, but even that is not working at all. (ASD-F)

“I am not at all open to making new friends because I know I will not be able to commit much time to them. My friendships tend to happen accidentally, I would not seek friendships. I am happy with my social circle at the moment because it is small, and they give me space.” (ASD-M)

Pleased with the current social network

“I am not very open to making new friends, because I am rather shy and quiet and don't know how to communicate with other people very well. I often end up being awkward or having a lot of dead air moments. Nevertheless, I am quite satisfied with my current social network. I treasure the few friends I have because they are close friends and I think a few close friends is enough for me. I would prefer to know more people, but not necessarily have more friends (or close friends) because I don't think I would be able to handle more relationships.” (ASD-F)

“I'm pretty satisfied with my current network, I'm always open to new friendships if it happens naturally but I've no desire to seek out new people..” (ASD-M)

“I would prefer to be closer to the close friends I do have but not necessarily more of them. I am open to making new friends still. I think friends can improve your life satisfaction and I don’t want to be all alone when my mum dies because I would be very upset as she is my closest friend in the world” (ASD-NB)

Challenges in friendships

Social difficulties

“Meeting people is easy. You just go places. I can walk in on my own and feel no fear. The problem is the moment you attempt to interact with people. It just doesn’t work. I’m like a bird flying in to window. I can’t connect with people no matter how hard I try.” (ASD-F)

“I struggle to make new friends due to not being particularly good at small talk and general conversation.” (ASD-M)

“I find it difficult to continue with conversations that are on topics that I either am disinterested in or genuinely have no opinions on. I am usually a very honest person and am afraid that this new person would be offended by my lack of effort in pretending that I'm interested in whatever that they're saying. Even if I don't want to be long-time friends with this person, I'm terrified of coming across as rude but I normally won't realise it until I'm being told." (ASD-M)

"I am extremely shy and very hesitant to approach new people, and when I begin talking with new people I feel very anxious. So, making new friends is quite difficult for me. When it comes to maintaining friendships, my main problems are my hesitancy to actively engage with friends due to subsided but still present feelings of shyness, and the fact that I do not particularly like or can feel uncomfortable when going to a lot of social events, e.g. a trip to the pub." (ASD-M)

"I find it hard to keep up contact with my more social friends because it takes a lot of energy especially when juggling work too. They struggle to understand why I don't frequently message them just to chat. I really struggle with being in a friendship group and only tend to see one friend at a time. Sometimes I feel like I have to listen to their problems when I don't want to, or don't know how to help them or what to do." (ASD-F)

"..it just takes so much time and energy to socialize, to keep up contact, to ask what's up: you can't really schedule in advance that on Tuesday I have to check up on X and on Wednesday on Y, and then on Thursday send an email to Z." (ASD-M)

"I have alienated friends in the past by not following their cues, being blunt, and defending my boundaries when I don't allow myself to be used." (ASD-F)

"I struggle to make new friendships and often find it difficult to navigate the intricacies of friendships and social connections, I'm bad at maintaining contact with people." (ASD-M)

"…I enjoy friendships although I can find it difficult to maintain them or gauge the other person's perception on how close they feel we are.." (ASD-F)

"Misunderstandings arise if people are not objective in their use of language, however much I warn them. If there is a structure/rules I find it difficult when they are comprehensively ignored (most of the time)." (ASD-M)

“I often misunderstand my friends' thought processes and do not comprehend why anyone would deliberately make 'grossly illogical' choices.” (ASD-F)

“I'm very transparent, I think, and this runs counter to NT culture and it makes people afraid. "Why is he so eager to move to greater depth so fast? We haven't spent the requisite time on superficial levels first, and I'm not comfortable yet." I just don't have time for this.” (ASD-M)

“When people stop talking to me I don't know why. I am very honest about my autism in the hope they will know any offense is not meant.” (ASD-F)

“Misunderstandings are ok, my friends already know that I might not always think like most people, and so misunderstandings are to be expected sometimes.” (ASD-M)

“I dread the thought of going among people and being touched (I scream and wail, then feel like killing myself for that behaviour out of shame)”. (ASD-M)

Change over time

“I find that I struggle to keep friends when situations change - people I was friends with in school I drifted away from in sixth form, and the same thing happened when I moved from sixth form to uni.” (ASD-F)

“While we are in the same school, same workplace, same community, it works out, but once life gets in the way, we just… stop, I guess.” (ASD-B)

“Friendship challenges throughout all my life have been centred around the fact that I things that are different or considered age inappropriate. In childhood- I was always behind preferring to play with younger child’s as pretend games well into my teens- witch made bullying easy. As a teenager I sort of got along with sum peers but was always having to pretend to be interested in things I wasn’t like boys/gossip or make-up . Now as a sort of adult- I just talk to acquaintances and don’t try to hide my interests which are still considered age inappropriate like comics/drawing/go karts and Marvel etc.” (ASD-M)

Strategies in friendships

Personal qualities

"I am trustworthy, loyal, will do anything to help, am funny and smart." (ASD-F)

"Making myself available for help or company, have good humility and try and always be there which can be difficult if you have moved but keep in touch." (ASD-F)

"I think the fact that I will listen to anything people say even if it's outrageous and not laugh at them or judge means I am quite a good listener even if I don't always understand where they are coming from or get their point of view I try and listen and help. And I'm good with finding practical solutions and looking things up for friends." (ASD-NB)

"I don't have any strategies. I simply make friends with people with similar interests, and maintain them through the interests. There's nothing else too it, really." (ASD-M)

"I tend to gravitate towards groups who also identify as being a bit different. The events and gatherings that I attend are generally to do with disability and/or autism as I find it easier to start up a conversation with people there. In particular I find I am much closer to the people I know who also have mental health difficulties. I think because I am much better at supporting and looking after others than general chitchat that I feel I have a purpose in the friendship and it becomes more two-way." (ASD-F)

Masking

"If someone shows an interest in me, I will reciprocate. I will ask them about themselves, listen and remember their replies, and ask them about things they mentioned previously." (ASD-N)

".. as it is hard to read people, I tend to rely on self-deprecating humour to avoid offending anyone." (ASD-F)

"I know that I'm probably an Aspie, but I also understand social expectations and just use my processing power to compensate a lot." (ASD-M)

Support

"I try to make friends by being open and friendly to everyone when I first meet them as well as trying to present myself well. Maintaining friends can be difficult but I mostly use Facebook messenger. For one of my best friends I send her gifs to say hello or pictures/ messages of funny or cool things that happened or either of us is interested in and she does the same. I suppose I also try and organise meeting up to do something when I go home." (ASD-F)

Negative experiences of friendships

Social rejection

"I find it especially hard when I am ignored. Because I rarely speak in a group situation I find that when I do speak up, what I have to say is swept aside and not worthy of consideration. This is why I now find it much easier to be friends with individuals rather than in a group as it takes away this problem." (ASD-F)

"When I was younger, people my age found me strange. I tried to form friendships with them but ended up being excluded or bullied. It severely affected my ability to interact with others for a while but I am improving. It forced me to mask my differences which led to mental health difficulties." (ASD-M)

"Being part of large circles in my first year of University wasn't particularly pleasant because there were people in the group that just didn't really understand me as a person. This lead to awkward encounters, and them just generally saying negative things about me when I wasn't there." (ASD-M)

"I think people around me notice that I'm a bit different, and just don't want to be around me or can't see past that to who I am underneath it all." (ASD-NB)

Social vulnerability

"My negative friendship experiences have been being lied to and having things kept secret from me, and then being made to feel like this wasn't actually happening. I have had lots of friendships where I have been excluded from meeting up and feeling like I did something wrong that no one would tell me about." (ASD-F)

"..communication barrier, like you're not supposed to talk about the friendship itself? I'm not quite sure, but when someone gets annoyed, they won't tell, just expect that I'll figure it out without the actually mentioning what's bothering them -- and when I don't, they get offended, and sometime later all that pent-up frustration will explode, and I'll be surprised. and then I'll try my hardest to figure out what happened, what did I do wrong, what did I say what I shouldn't have, I apologize over and over (and I don't even know what for) and no-one ever explains. And that's the end of it, it is never fixed, and I get more and more careful every single time, when I'm meeting a new person, because I came to expect this same outcome." (ASD-F)

"I used to have a friend when I was 15 years old. She forced me to do bad things with her in order to keep our friendship, she also used to tell me bad things to make me feel worthless and she even hit me sometimes. I was so obsessed to keep her as a friend that I let her to all that to me until I was able to stop her and stay away from her. She also moved to a different neighborhood, so that helped too." (ASD-F)

"People who are not autistic but for some reason are temporarily finding it hard to make friends latch on to me like a limpet just because I am 'available' then drop me when their dry spell passes." (ASD-F)

"I am often taken advantage of and this makes me reluctant to have future friendships because of this. I am very trusting and willing to help and people will take this, but then leave when they get what they wanted." (ASD-M)

"…betrayal. I don't really trust people anymore." (ASD-F)

"The critical point was a betrayal in a social situation (annual club gathering) of fellow cavers. I failed to see the humour in the practical joke and have found any trust hard to come by since, and usually leading to trouble anyway." (ASD-M)

"My most common experience is probably feeling like the relationship isn't balanced, that I'm putting in more than I'm getting out of the relationship / made to feel like I'm not interesting or worth the time." (ASD-F)

"..and also: my "friendships" tend to be unsymmetrical: either someone who wants something from me, uses me for a while, as long as I let them, but I don't really like them -- or someone I adore or admire, or someone I can learn from, a mentor or something like that. and they, this latter group are supporters and cheerleaders for me for quite a while, then after a few years something changes, and they get angry (for no apparent reason, at least not a reason I can figure out or one they'd be willing to tell) and we fall out.” (ASD-F)

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