RUBINSTEIN-TAYBI SYNDROME: FROM BEHAVIOUR TO COGNITION.

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A thesis submitted to the
University of Birmingham
for the degree of
DOCTOR OF PHILOSOPHY

School of Psychology
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May 2014

ABSTRACT

Examination of Autism Spectrum Disorder (ASD) phenomenology in genetic syndromes can aid our understanding of the aetiological pathways underpinning ASD. The current thesis directed attention to the specific study of Theory of Mind (ToM) development in syndrome groups with a high prevalence of ASD but fractionated social profiles. In an initial group comparison study, Rubinstein-Taybi syndrome (RTS) was highlighted as a syndrome group of interest. When compared to Down syndrome (DS), Fragile X syndrome (FXS) and idiopathic ASD, RTS showed a comparatively high prevalence of ASD but a fractionated 'sociable' social profile. As traditional ToM tasks load heavily on cognitive processes they are unsuitable for some individuals with intellectual disability. Consequently, a scaled battery of ToM 'precursor' tasks was developed and validated using a normative sample. This scale was then applied, alongside Wellman and Liu's (2004) ToM scale, to examine the development of ToM in RTS. An analysis of *overall* ability indicated that RTS may evidence relatively 'spared' *early* social cognitive skills. However, *later* ToM skills may be delayed due to memory difficulties. Developmental trajectory analysis indicated that RTS followed a different developmental sequence to the normative sample. Gaze understanding was found to be significantly harder than expected. These findings are discussed in relation to their theoretical implications for models of ToM and ASD, clinical implications for individuals with RTS, and potential areas for future study.

DEDICATION

For Mum and Bill

ACKNOWLEDGEMENTS

First and foremost I wish to thank my (very patient) supervisors, Professor Chris Oliver and Professor Ian Apperly. Thank you to Chris for his endless encouragement, guidance, and for sticking with me through my times of panic. Thank you to Ian for his invaluable advice and expertise on social cognition, and for his ability to explain difficult concepts so clearly.

I would like to express my gratitude to all the people who contributed to this thesis: to Mary and Asma for collecting the normative data; to Andy Surtees for his help with Guttman scaling; and to Lisa Nelson, Jo Moss, Kate Arron, Caroline Richards, Cheryl Burbidge and Katy Berg for collecting the cross syndrome comparison group data. Particular thanks go to the RTS support group and all the participants who gave up their time to be part of the project.

I would like to extend a big thank you to the original office 517: Jane, Caroline, Jess, Andy and Dan, for being great colleagues and even better friends. A special thank you needs to go to Jane Waite, who travelled the country with me to collect data. I feel extremely lucky to have been paired with such a wonderful person, the laughs we shared will stay with me forever.

These acknowledgements would not be complete without thanking those closest to me. Thanks to my family, the Hobsons and the Flints for their unwavering encouragement, and support. Thanks to Kat and Rachael for providing the alcohol that made me temporarily forget quite how much I had to do. Thank you to my amazing fiancé, for putting up with my SPSS induced meltdowns and for loving me regardless. Finally, a very special thank you needs to go to my Mum and Bill, not least for their financial support (!) but most importantly, for *always* believing that I could do it.

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CHAPTER ONE

FROM THE ASSOCIATION BETWEEN AUTISM SPECTRUM DISORDERS AND GENETIC SYNDROMES, TO THE ASSESSMENT OF THEORY OF MIND: A REVIEW.

1.1. Preface

This chapter details and synthesises the key research findings that have informed the focus, design and conduct of the empirical studies described in this thesis. The chapter begins by describing associations between autism spectrum disorders (ASDs) and several neurodevelopmental disorders of genetic origin. These associations are then examined by presenting evidence that highlights how subtle qualitative differences – such as fractionated social profiles – exist when 'finer grained' comparisons are made between genetic syndromes and idiopathic ASD. Evidence for a 'fractionation' of the triad of impairments in ASD is discussed at the behavioural, genetic, cognitive and neural levels, and it is argued that research examining the core impairments in ASD, and the pathways underpinning them, may be better understood if studied separately. The chapter then draws attention to the specific study of social behaviour and capacity for Theory of Mind (ToM) in genetic syndromes. Prevailing methodological constraints are discussed: the limitations of single task methodologies and the cognitive demands of typical ToM tasks (making them inappropriate for many individuals with genetic syndromes). In an attempt to overcome these constraints, research from the developmental literature is reviewed and a possible solution is presented, combining the use of a developmental trajectory approach with tasks that assess 'precursors' to ToM. Consequently, the empirical work in this thesis presents the development of a 'ToM precursor' social cognition scale suitable for individuals with intellectual disabilities (ID). The scale is validated using a normative sample of typically developing infants and then applied to a syndrome group of interest.

1.2. The Association between Autism Spectrum Disorder and Genetic Syndromes.

As classified by DSM-IV-TR (APA,2000[1]) and ICD-10 (WHO, 1992), Autism Spectrum Disorders (ASDs) are characterised by the presence of three core features: the presence of repetitive behaviour and restricted interests, and qualitative impairments in communication and social interaction. ASD is estimated to occur in around 1% of children in the general population (Baird et al., 2006) and around 40% of individuals with intellectual disability (ID; La Malfa et al., 2004). Over the last decade there has been increasing interest in the association between ASDs and neurodevelopmental disorders of genetic origin (genetic syndromes[2]), with a number of syndromes including a high proportion of children and adults reaching above the cut-off for ASD on autism spectrum assessments. For example, estimates for the proportions of individuals who score above the cut-off for ASD range between: 50-81% for Angelman syndrome, 50-67% for Cornelia de Lange syndrome; 21-50% for Fragile X syndrome, 25%- 97% for Rett syndrome and 24-60% for Tuberous Sclerosis Complex (see Moss & Howlin, 2009 for a review). Associations with 'autistic like' characteristics have also been described in Williams syndrome, Coffin-Lowry, Cohen Laurence-Moon-Biedel, Moebius syndrome, Phenylketonuria, Down syndrome (see Fombonne, 1999; Moss & Howlin, 2009 for reviews), and a number microdeletion syndromes including: 8p23 deletion, 3q29 deletion, and 9p partial duplication syndrome (Abu-Amero et al., 2010; Fisch, Grossfeld, Youngblom, Simensen & Battaglia, 2010; Quintero-Rivera, Sharifi-Hannauer & Martinez-Agosto, 2010).

It has previously been argued that such associations may simply be the result of the level of impaired intellectual ability (Skuse, 2007) but more recently it has been reported that the degree to which ID accounts for ASD in these groups is varied and it is not the

[1] Please note that this chapter was written prior to DSM-5 becoming available.
[2] Hereafter referred to as 'genetic syndromes'.

case that more severe ID is necessarily associated with autistic like characteristics (Moss & Howlin, 2009). These findings are of interest as it has been suggested that such syndrome associations can aid our understanding of the aetiological pathways underpinning ASD (Persico & Bourgeron, 2006). However, 'finer grained' analyses of ASD phenomenology in genetic syndromes are of particular interest as they suggest that although a high proportion of individuals with a given syndrome may meet diagnostic 'cut off' scores for ASD, these 'broad level' diagnostic descriptions may mask important qualitative differences across the triad of impairments when compared to a typical profile of idiopathic ASD.

1.3. The Phenomenology of ASD in Genetic Syndromes

Fragile X syndrome (FXS), Angelman syndrome (AS) and Cornelia de Lange syndrome (CdLS) are three genetic syndromes that illustrate how 'broad level' diagnostic descriptions can mask important qualitative differences in ASD phenomenology. All three syndrome groups have been reported to show strong associations with ASD (Moss & Howlin, 2009), but the finer grained analysis of ASD phenomenology in these groups highlights that subtle differences exist when compared to idiopathic autism.

A recent study using the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003) found that despite scoring above the cutoff for ASD, individuals with FXS showed a milder presentation of ASD symptomatology across all domains of the SCQ when compared to an idiopathic ASD group (Moss, Oliver, Nelson, Richards & Hall, 2013). It has also been found that there may be significant differences in the profile of social and communicative symptomatology in FXS compared to idiopathic ASD. Hall, Lightbody, Hirt, Rezvani & Reiss (2010) examined ASD phenomenology in 120 children, adolescents and young adults with FXS using the Autism Diagnostic Schedule (ADOS;

Lord, Rutter, DiLavore & Risi, 2002) and the SCQ (Rutter et al, 2003). Results indicated that although there were no differences in the repetitive behaviour domain, FXS were significantly less impaired across a large number of social and communicative behaviours including social smiling, range of social expressions, joint attention, gestures and imitation. Furthermore, other studies examining the social profile of FXS, have indicated that despite shyness, social anxiety and gaze avoidance, individuals with FXS may show preserved emotion sensitivity and willingness to interact (Cornish, Turk & Levitas, 2007; Hall, deBernardis & Reiss, 2006; Turk & Graham, 1997; Udwin & Dennis, 1995). These more 'specific' characteristics are certainly different to the 'prototypical' severe social withdrawal noted by Leo Kanner in his original descriptions of ASD (Kanner, 1943).

Although studies examining the prevalence of ASD in AS have implicated a strong association (Bonati et al., 2007; Trillingsgaard, & Østergaard, 2004) the social behaviour that is characteristic of the syndrome appears inconsistent with this conclusion. The behavioural phenotype of AS is characterised by excessive sociability, high levels of laughing and smiling behaviour and a strong desire to seek out and interact with adults (Horsler & Oliver, 2006; Oliver, Demetriades & Hall, 2002), a social profile very different to that described in idiopathic autism. This inconsistency was highlighted more recently in a study by Moss, Howlin, et al. (2013) who examined ASD characteristics and social behaviour in three genetic syndromes, including AS. Their findings for AS showed a social profile of increased positive affect and spontaneous social initiation alongside a high proportion of the group scoring above the 'cut off' for ASD on an autism specific assessment.

Moss, Howlin, Magiati and Oliver (2012) compared the presentation of ASD symptomatology in CdLS to a matched group of individuals with idiopathic ASD using the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2000).

Findings indicated that although a large proportion of the CdLS group reached the cut off for autism on the total ADOS score, domain and item level analysis indicated that individuals with CdLS displayed more eye contact, more gestures, less repetitive behaviour, and less stereotyped speech than the ASD group. The CdLS group also showed higher levels of anxiety. When taken together with previous reports of prolonged eye gaze and increased social anxiety (Collis, Oliver & Moss, 2006; Goodban, 1993; Nelson, 2010), the authors suggest that the social impairments in CdLS may be quite different to those observed in ASD. More specifically, they hypothesised that the frequent eye contact indicates a desire for social interaction but that this may be hampered by social and communication impairments and social anxiety. Furthermore, the differences noted regarding repetitive behaviour adds to previous findings that have suggested that this part of the triad contributes less to the ASD profile in the group than impairments in communication and social interaction (Oliver, Berg, Moss, Arron, & Burbidge, 2011).

Delineation of the profile of ASD in these groups clearly highlights how subtle differences in phenomenology can be masked if associations with ASD are based purely on clinical cut off scores. Comparisons between these syndrome groups have shown that even when these groups show similar proportions of individuals scoring above the cut off score on autism specific assessments, they may do so for different reasons. For instance, in Moss, Oliver, et al.'s (2013) study both FXS and CdLS were found to show similar proportions of individuals scoring above the ASD cut off. Both groups showed milder presentations of ASD symptomatology when compared to idiopathic ASD, but importantly the profile that contributed to this milder presentation differed between the groups. For FXS the milder presentation was accounted for by less severity across *all* domains of the ASD triad, while in CdLS; it was more specifically due to less severity in the repetitive behaviour domain. Similarly, in their study comparing social behaviour and ASD

characteristics across genetic syndromes including AS and CdLS, Moss and colleagues found that although both groups achieved similar scores on the SCQ, they demonstrated different social behaviour profiles (Moss, Howlin, et al. 2013). These findings are of interest as they suggest a possible *fractionation* within the triad of impairments.

1.4. Fractionation of the Triad of Impairments.

The findings relating to ASD phenomenology in genetic syndromes is just one line of research that contributes to an increasing body of evidence pointing towards a fractionation of the triad of impairments. Happé & Ronald (2008) argued that, for many years, research has been limited by the assumption that all ASD symptomatology proceeds from the same cause. In a review of the literature they demonstrate numerous examples that point towards the three diagnostic domains being fractionable and with independent causes.

Happé and Ronald (2008) outline that one of the previous barriers in establishing whether the ASD triad was unitary or fractionable was the emphasis on examining 'diagnosed' populations. These populations, by very nature of the diagnostic criteria, often show impairments in all three of areas of the triad. Instead, the authors drew attention to the study of the relationship between social, communicative, and restricted/repetitive traits within the general population. Ronald et al., (2006) asked parents of over 3000 eight year old twin pairs to complete the Childhood Asperger Syndrome Test (CAST; Scott, Baron-Cohen, Bolton, & Brayne, 2002), a screening measure used to assess ASD characteristics in mainstream populations. Findings indicated that although autistic-like traits were highly heritable, the subscales for the three core areas of the triad showed low covariation. It was also highlighted that a large proportion of children displayed isolated difficulties in *only one* area of the triad. For instance, 59% of children showing social impairments showed

only social impairments and not comorbid communication difficulties or restricted/repetitive behaviours. Approximately 10% of the sample showed *only* restricted/repetitive behaviours or *only* communication difficulties or *only* social impairment. Although findings showed that having one trait was a 'risk factor' for having a second or third trait, this 'risk' was relatively low and so the authors argued that their findings provided evidence for a fractionation in the ASD triad.

In their review, Happé and Ronald (2008) cite evidence to suggest that the fractionation in the triad of impairments is also evident at the genetic level. They report findings from large scale family studies that examine the 'broader autism phenotype' (subclinical manifestations of the triad) in relatives of individuals with ASD. These studies, using the Family History Schedule (FHS), indicate that not only do these relatives (siblings and first/second degree relatives) show higher rates of impairments across the triad than control comparison group, but that they often show *only* one or two of the three core features (Bolton et al. 1994; Pickles et al. 2000; Piven et al., 1997). The authors argue that this pattern of results suggests that that the genes that contribute towards ASD segregate among relatives and have separable influences on the different parts of ASD phenomenology. Additionally, they present findings from a multivariate, model-fitting analysis of cross-twin, cross-trait correlations in their twin studies (Ronald, Happé & Plomin, 2005; Ronald et al., 2006). These analyses indicated genetic heterogeneity across the three core ASD features. More specifically, both communicative impairments and restricted/ repetitive behaviours had genetic influences that were typically not shared with the other variables. They also showed that, for example, more than half of the genes that contributed to the variation in social impairment were independent from those that contributed to variation in restricted/repetitive behaviours or impaired communication.

1.5. Fractionation of Cognitive Impairments.

Evidence for the fractionation of impairments extends to cognitive explanations of ASD. Cognitive theories for ASD originated in the 1980s when Baron-Cohen, Leslie, and Frith (1985) published a paper that outlined how children with ASD failed simple tasks assessing 'Theory of Mind'. Theory of Mind (ToM) relates to the social cognitive ability to attribute mental states (i.e. beliefs, desires, intentions) to others, and the understanding that other's actions will be governed by these states. Baron-Cohen and colleagues argued that it was a deficit in this area of understanding that led to the social interaction and communicative impairments in ASD. Tasks commonly used to assess children's understanding of mental states involve making the inference that someone has a 'false belief' (Wimmer & Perner, 1983). For example, in a typical false belief task – the 'Smarties' task (Perner, Leekam, & Wimmer, 1987) – the child is shown a Smarties box and asked what they think is inside. Following the typical response of "smarties" or "sweets" the box is opened to reveal pencils inside. The box is then closed and a toy figure ('Peter') is produced. The child is informed that Peter has never seen inside the box before. Children are then asked what Peter will think is inside the box. Children demonstrate an understanding of false belief if they can reason that Peter will believe that there are Smarties inside. Although typically developing children pass such tasks at around 4 or 5 years (Gopnik & Astington, 1988), Baron-Cohen et al., (1985) demonstrated that 80% of lower functioning children with ASD (mean verbal age 5.5 years; mean chronological age 11.11 years) failed such a task.

Shortly after, Baron-Cohen (1989) proposed that this *same* impairment in ToM may also underpin other aspects of the ASD triad, including repetitive behaviours. It was suggested that repetitive behaviours develop as a coping strategy to reduce the anxiety caused from the inability to infer and understand others' mental states. However, this

position was not held for long. Such an account would predict that levels of repetitive behaviour would increase during social interactions or unpredictable social scenarios. Instead, a number of studies examining rates of these behaviours in different situations indicated lower levels of repetitive behaviour during social interactions and higher levels during periods of no interaction (Clark & Rutter, 1981; Donnellan, Anderson & Mesaros, 1984; Runco, Charlop, & Schreibman, 1986). Furthermore, as outlined by Happé and Ronald (2008), repetitive behaviours can be as frequent/severe in higher functioning individuals (who show greater levels of social insight) as lower functioning individuals. These findings, along with others, demonstrated that a deficit in ToM cannot fully account for both the social and non social aspects of the triad (Happé, 2001).

Later theorists proposed an 'executive function' hypothesis of ASD (Hughes, Russell, & Robbins, 1994; Ozonoff, Pennington, & Rogers, 1991; Russell, 1997). 'Executive Function' (EF) is an umbrella term used to describe a set of higher order cognitive processes used in the conscious control and regulation of lower-level thought and action, such as inhibition, planning, working memory, emotional regulation, generativity, and set-shifting (Alvarez & Emory, 2006). In the initial EF hypothesis, similarities drawn between the characteristics of ASD and neuropsychological patients with frontal lobe damage led to the suggestion that frontal deficits and their subsequent cascading effects may also account for the core impairments seen in ASD (Russell, 1997). Indeed, there is now a large body of evidence that links impairments in EF to the restricted/repetitive behaviours seen ASD (see Turner 1997 for a review). However, the ability for the EF hypothesis to fully account for *all* parts of the triad, including the social interaction and social communicative impairments, is limited. For instance, it has been reported that similar EF difficulties are found in individuals with ADHD yet these

individuals do not show the same level of social and communicative impairment that characterises ASD (Ozonoff & Jenson, 1999).

Alternative cognitive theories of ASD include the 'weak central coherence' theory (Frith, 1989; Frith & Happe 1994), and the 'extreme male brain' theory (Baron-Cohen, 2002). The weak central coherence theory posits a specific information processing style characterised by piecemeal or 'detailed focussed' processing rather than the ability to process information in its context. Such a theory can account for some of the deficits (i.e. the preoccupation with 'parts' and an inability to see the 'bigger picture') and assets (exceptional perceptual abilities) seen in ASD. The 'extreme male brain' theory (or empathising – systemising account) views ASD difficulties as an extreme of the 'normal' male profile, with limitations in empathising (the drive to identify another person's thoughts), and strengths in systemising (the drive to construct systems).

Although it is clear that all of the theories described above go some way toward describing the causal cognitive mechanisms involved in ASD phenomenology. No one account can fully explain all three aspects of the ASD triad together, leading to the conclusion drawn by Happé, Ronald, and Plomin (2006) that the cognitive underpinnings for social, communicative, and restricted/repetitive behaviours are likely to be independent of each other. Findings from neuroimaging studies would certainly support this assertion. Happé, Ronald and Plomin (2006) cite evidence that outlines how restricted/repetitive behaviours have been linked to caudate abnormality but social cognitive processes have been linked to other regions of the brain including the temporal poles, temporoparietal junction, superior temporal sulcus, and medial frontal cortex (Amodio & Frith, 2006; Sears et al. 1999).

1.6. Interim Summary

The previous sections of this review have outlined evidence for a fractionation in the ASD triad of impairments at the behavioural, genetic, cognitive and neural levels. When taken together, these findings challenge the assumption that all aspects of the ASD triad can be, or should be, explained together. Instead, the evidence suggests that research examining the three core impairments, and the pathways underpinning them, may be better understood if studied separately.

Evidence from ASD phenomenology in genetic syndromes demonstrated that although high proportions of individuals may meet the diagnostic 'cut off' for ASD, the profile of behavioural characteristics that contribute to these scores can vary between syndromes and provide further evidence for fractionation. As outlined before, it has been argued that the study of ASD phenomenology in genetic syndromes can aid understanding of the aetiological pathways underpinning ASD (Persico & Bourgeron, 2006). Consequently, syndrome groups that display fractionated ASD profiles can potentially provide a useful opportunity to study each aspect of the triad separately. With this in mind, the current thesis directs attention to the specific study of social behaviour and the development of ToM.

As described above in section 1.3, a number of syndrome groups reported to be associated with ASD, show social profiles that are very different to idiopathic ASD. To recap, despite seemingly high levels of ASD, individuals with AS show excessive sociability and a strong desire to seek out and interact with adults (Horsler & Oliver, 2006; Oliver, Demetriades & Hall, 2002); individuals with FXS are suggested to have a preserved emotion sensitivity and willingness to interact (Cornish, Turk & Levitas, 2007; Hall, deBernardis & Reiss, 2006; Turk & Graham, 1997; Udwin & Dennis, 1995); and individuals with CdLS show more eye contact and more gestures than idiopathic ASD but

alongside social anxiety (Collis et al., 2006; Goodban, 1993; Moss et al, 2012; Nelson, 2010). Given the link between ToM and the social interaction and communicative impairments in ASD, the question arises: *How does the development of ToM relate to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles?*

1.7. Theory of Mind in Genetic Syndromes.

Despite an obvious rationale, the question outlined above has received surprisingly little attention in the literature. In fact, the examination of ToM across genetic syndromes in general has been extremely limited and has predominately focussed on FXS and Williams syndrome (WS), with these studies often yielding inconsistent results. Some studies have included participants with Down syndrome (DS), however these individuals are often involved only as control group comparisons for studies focussing on ASD or FXS (e.g. Losh, Martin, Klusek, Hogan-Brown & Sideris, 2012; Wong & Leung, 2010; Yirmiya, Solomonica, Shulman, & Pilowsky, 1996).

Although 7% of children with WS meet diagnostic criteria for ASD (Leyfer, Woodruff-Borden, Klein-Tasman, Fricke, & Mervis, 2006), individuals with WS are typically described in the literature as 'hypersociable' (Jones et al, 2000). As characteristic social behaviours include being 'very empathic towards other people' (Gosch & Pankau, 1994), it has been suggested that the social phenotype of WS may represent the polar opposite of ASD and may be underpinned by a relative sparing of ToM (Karmiloff-Smith, Klima, Bellugi, Grant, & Baron- Cohen, 1995). Indeed, in an initial series of studies, Karmiloff-Smith et al. (1995) found that individuals with WS passed a number of standard ToM tasks that children with ASD typically fail, leading to the suggestion that ToM ability was spared in the group. However, this study did not include a control group and the

participants used were much older (9- 23 years) than the age in which children typically pass these tasks (4 or 5 years). In contrast, more recent studies, using control groups and younger participants with WS, have suggested that ToM ability in WS is delayed (Tager-Flusberg & Sullivan, 2000; Tager-Flusberg, Sullivan, & Boshart, 1997), leading authors to discount the originally proposed dissociation between impaired ToM in ASD and 'intact' functioning in WS (Brock, Einav & Riby, 2008).

In contrast to WS, and as described in section 1.3, individuals with FXS show a stronger association with ASD and a social profile including shyness and gaze avoidance (Moss & Howlin, 2009; Turk & Graham, 1997; Udwin & Dennis, 1995). Garner, Callias, and Turk (1999) assessed ToM in eight boys with FXS (without autism) using the 'Smarties' false belief task. They found that significantly more boys with FXS failed this task than a matched heterogeneous intellectual disability (HID) comparison group, initially suggesting that those with FXS may show ToM deficits similar to individuals with ASD. However, when the authors used another false belief task, the 'Sally-Anne task', no significant differences between the groups were found, thus leaving it unclear as to whether ToM deficits were a specific feature in FXS or simply related to overall level of ability. In a similar study, Cornish, Burack, Rahman, Munir, Russo, and Grant (2005) assessed ToM in a group of children with FXS (without autism) using the Sally-Anne false belief task. Findings indicated that these children performed similarly to a Down syndrome (DS) group, matched for age and verbal ability. Just under half of each group passed the task, leading the authors to conclude that individuals with FXS *did* evidence difficulties with ToM but that these difficulties were not as severe as in autism, as a poorer performance than DS would otherwise have been expected.

In a more recent study, Grant, Apperly, and Oliver (2007) drew attention to the methodological limitations of the two previous studies. They highlighted how, although

the children with FXS did not have a diagnosis of ASD, no measure of ASD symptomatology was obtained. As many children with FXS show ASD symptomatology even when they do not meet diagnostic criteria (Dykens & Volkmar, 1997), Grant et al. (2007) assessed ASD symptomatology using the SCQ (Berument, Rutter, Lord, Pickles, & Bailey, 1999) and then compared ToM performance between a FXS group who showed many ASD features, a FXS group who showed few ASD features, and a HID control group. Findings showed that both groups of boys with FXS showed poorer ToM performance than the HID group thus suggesting that ToM difficulties are likely to form a part of the FXS profile. However, the nature of this ToM deficit was of particular interest. Grant et al. (2007) used new ToM methodology which enabled them to separate out the processing demands required for the task. A standard false belief task not only requires an individual to reason about another person's belief (i.e. ToM), it also requires an individual to remember a sequence of events (working memory), and resist interference from their own knowledge (inhibitory control). When Grant et al. (2007) conducted comparison trials that required working memory but *no* ToM, both FXS groups still performed worse, suggesting that ToM difficulties in the group may be underpinned by a more basic difficulty with working memory.

1.8. Constraints in Current Research: The Need for a Different Approach?

Until recently the methodology used to investigate the cognitive abilities/deficits in genetic syndromes, developmental disorders, and ID has typically been to compare the performance on a cognitive task to the performance of two matched comparison groups. In most studies one comparison group is matched for chronological age (CA) and the other is matched for mental age (MA). It is assumed that if the syndrome group of interest demonstrates a deficit relative to the CA matched group but not the MA matched group,

the group is considered developmentally delayed on this task. Alternatively, if the syndrome group demonstrate a deficit relative to both the MA and CA comparison groups, it is instead considered to be developmentally atypical (Hodapp, Burack & Zigler, 1990).

As section 1.7 demonstrates, the studies investigating ToM in genetic syndromes typically use a similar methodology. Studies generally compare the performance on a single standard false belief task to the performance of matched controls, finding the sample either comparatively delayed or atypical. However, it is now widely believed that the attainment of false belief understanding represents just *one of many* social cognitive[3] developments that emerge progressively during childhood (e.g. Flavell & Miller, 1998; Gopnik, Slaughter & Meltzoff, 1994; Gopnik & Wellman, 1992). Therefore, the methods currently being used to assess ToM in genetic syndromes actually provide very limited information with little insight into the developmental pathway or causal mechanisms that occur prior to, or following the understanding of false belief. More specifically, such single task methodologies cannot inform us whether false belief impairments in genetic syndromes are preceded by earlier impairments in less complex social cognitive abilities, and whether they are subsequently followed by further impairments in more complex social cognitive abilities.

1.9. A Developmental Trajectory Approach

One possible solution to this problem would be to adopt a developmental trajectory approach to the study of ToM. Such an approach has been undertaken recently by Wellman and Liu (2004) who established a scaled battery of five tasks that captured the developmental progression of ToM in preschoolers. Their analysis revealed that ToM tasks assessing *Diverse Desire*, *Diverse Belief*, *Knowledge Access*, *Contents False Belief*, and

[3] Throughout this thesis the term 'social cognition' is used as an umbrella term to encompass both Theory of Mind and any related 'earlier or later developing' skill.

Real-Apparent Emotion formed a highly scalable set i.e. typically developing preschool children tended to pass earlier tasks, reached a task that they failed, and then failed all subsequent tasks. The advantages of such a scale are twofold. Firstly, on a theoretical level, assessing individuals in this manner provides insight into the social cognitive development of 'typical' populations. More specifically, this method can go some way toward determining whether the development of later, more complex social cognitive skills, is dependent on the acquisition of earlier skills. For example, it may be the case that later skills can only be acquired if earlier skills are present. Secondly, by assessing atypical individuals in this way, using a scaled set of tasks, one can explore a number of different possibilities. One possibility is that atypical individuals progress along the same developmental trajectory as typically developing individuals, acquiring the same skills in the same order, but demonstrating developmental delay. Another possibility is that these individuals do not follow the typical developmental trajectory but instead display a unique profile of cognitive strengths and weaknesses.

The application of such an approach has been demonstrated by Peterson, Wellman, and Liu (2005) in their study comparing the performance of individuals with autism, late signing deaf children, and typically developing children on the five item ToM scale developed by Wellman and Liu (2004). Their findings showed that, albeit delayed in age of attainment, the ToM developmental sequence for late signing deaf children was matched exactly to the sequence shown in typically developing children. However, children with autism displayed a different sequence of development. Analysis indicated that for this group the last two tasks in the scale were reversed i.e. children with autism found the *Contents False Belief* task harder than the *Real Apparent Emotion* task. The authors have subsequently hypothesised explanations for the delayed and atypical developmental pathways shown by the two groups. They suggested that for the late signing

deaf children, departures from a normal experience with social interaction, language and conversation led to their delayed yet consistent progression of understanding. Conversely, for the autism group, high functioning individuals with autism may have developed a 'work around' solution to emotional situations that allows them to bypass false belief understanding. Importantly, the use of this method highlighted findings that may have been overlooked if social cognitive ability was assessed using just a single task.

As illustrated above, Wellman and Liu's (2004) ToM scale provides a platform to examine the interplay between social cognitive development and related factors in individual difference research. Such a methodology could provide valuable information about the ToM development of syndrome groups that show fractionated social profiles. However, although the five ToM tasks included in the Wellman and Liu (2004) scale require the assessed individual to reason about mental states, the tasks also load quite heavily on other cognitive processes as highlighted in the Grant et al. (2007) study discussed in section 1.7. To recap, tasks such as the Smarties task (contents false belief) not only require an individual to reason about false belief (that Peter will think there are smarties inside), but also place substantial demands on working memory and executive inhibitory control. Individuals must remember critical facts about the story and also resist interference from their own knowledge (the fact that there are pencils inside). Due to their cognitive requirements, these tasks are not suitable for individuals with ID who are too young or too cognitively impaired to complete them. This is of critical importance given that many genetic syndromes are associated with moderate to severe ID and deficits in expressive and receptive language. Such difficulties may explain why there is a dearth of research examining ToM in these populations.

1.10. Social-Cognitive 'Precursors' to Theory of Mind: A Possible Solution?

Fortunately, recent work in the developmental literature has begun to examine the early social cognitive abilities that develop prior to fully fledged ToM in typically developing individuals. Tomasello, Carpenter, Call, Behne & Moll (2005) propose that the foundational skill underlying the understanding of *beliefs* is, in fact, the understanding of *intentions* which begins emerge around 12 months of age. Tomasello and colleagues have developed a number of simple tasks that demonstrate a wide range of social cognitive competencies that occur in children at different developmental points prior to ToM acquisition. For example, from 9 months infants demonstrate an ability to perceive others as *intentional agents* (Behne, Carpenter, Call, & Tomasello, 2005), by 14 months show the understanding and motivation to assist others with their unachieved *goals* (Warneken & Tomasello, 2007), by 18 months make inferences about the communicative intention of gestures (Behne, Carpenter & Tomasello, 2005), and by 24 months show signs of *joint intentionality* by cooperating with another person in problem solving activities and social games (Warneken, Chen, & Tomasello, 2006). What is particularly pertinent about these tasks is that they require very little or no receptive/expressive language, meaning that they can potentially provide a valuable means of assessing the social cognitive abilities of individuals with genetic syndromes who are too young, or too cognitively impaired to comprehend and complete 'typical' ToM tasks.

1.11. Interim Summary

Given the constraints of single task methodologies discussed in section 1.8, and the potential benefits of a developmental trajectory approach discussed in section 1.9, if these 'precursor' tasks could be scaled in a similar manner to the ToM scale by Wellman and Liu (2004), then it may be possible to move closer to answering the previously posed

question: *How does the development of ToM relate to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles?*

1.12. Chapter Summary and Thesis Outline

The current chapter has detailed key research findings that provided the rationale for the empirical work in this thesis. Associations between ASDs and genetic syndromes were outlined and their nature questioned by presenting evidence that highlighted how subtle qualitative differences (including fractionated social profiles) exist when 'finer grained' comparisons are made between genetic syndromes and idiopathic ASD. Evidence for a fractionation of the ASD triad of impairments was discussed and it was argued that research examining the core impairments in ASD, and the pathways underpinning them, may be better understood if studied separately.

It was proposed that the study of ASD phenomenology in genetic syndromes can aid understanding of the aetiological pathways underpinning ASD (Persico & Bourgeron, 2006). Consequently, the chapter highlighted how syndrome groups that displayed fractionated ASD profiles could provide a useful vehicle to study each aspect of the ASD triad separately. More specifically, the chapter drew attention to the potential study of ToM development in syndrome groups that showed a high prevalence of ASD but fractionated social profiles.

Despite the potential benefits of studying ToM in genetic syndromes, the chapter outlined two main methodological constraints in the area: the use of single task methodologies and the cognitive demands of typical ToM tasks (making them inappropriate for many individuals with genetic syndromes). The goal of the work described in this thesis is to overcome these constraints by combining a developmental trajectory approach with tasks that assess 'precursors' to ToM.

Chapter 2 of this thesis begins by highlighting Rubinstein Taybi syndrome (RTS) as a syndrome of interest. Examination of the behavioural phenotype points towards a dissociation in ASD characteristics, with a fractionated social profile. It is proposed that RTS might therefore be used as model syndrome from which to study the development of ToM. In chapter 3 the development of a 'ToM precursor' social cognition scale, suitable for individuals with ID, is described. In chapter 4, this scale is then validated using a normative sample of typically developing infants and then in chapter 5 the performance of individuals with RTS on this scale is assessed and described. Finally, in chapter 6 the main findings of the thesis are discussed and the work is evaluated by considering the strengths and limitations of the methodologies used. Clinical and research implications are considered and the possibilities for future study are suggested.

CHAPTER TWO

EXTENDING THE BEHAVIOURAL PHENOTYPE OF RUBINSTEIN-TAYBI SYNDROME: CHARACTERISTICS OF AUTISM SPECTRUM DISORDER, AFFECT AND OVERACTIVITY.

2.1. Preface

In chapter 1 it was suggested that understanding the presentation of ASD characteristics in genetic syndromes that display a fractionation of the triad of impairments may be helpful in extending our understanding of the aetiology of ASD (Persico & Bourgeron, 2006). More specifically, the chapter drew attention to the specific study of ToM development in syndrome groups that showed a high prevalence of ASD but fractionated social profiles. The current chapter introduces Rubinstein-Taybi syndrome (RTS) as syndrome from which to do this.

The behavioural profile of RTS noted in the literature suggests a fractionation of the triad of impairments – with high levels of repetitive behaviour but good social interaction and social communication skills. However, to date, the majority of studies detailing behavioural characteristics in RTS are case studies or cohort descriptions. Such methodologies are limited as they cannot establish whether the behaviours reported are more likely to be found in RTS relative to other individuals with ID. Consequently, the current chapter aims to extend the behavioural phenotype of RTS by using a group comparison design to examine ASD symptomatology and other behavioural characteristics that have not yet been described in the literature: affect and overactivity.

2.2. Introduction

A behavioural phenotype is defined by Dykens, Hodapp, and Finucane (2000) as a heightened probability that individuals with a given genetic syndrome will show certain behavioural characteristics relative to those without that syndrome. Over the last decade, the association between genetic syndromes and particular behavioural profiles has been increasingly recognised (O'Brien & Yule, 1995; Flint, 1996) and as a result behavioural phenotypes have now been established for a number of different genetic syndromes (Horsler & Oliver, 2006; Oliver, Arron, Sloneem, & Hall, 2008; Turk, 1992; Udwin & Yule, 1991). Although studies are beginning to emerge, there is a dearth of research examining the behavioural characteristics of Rubinstein-Taybi syndrome (RTS). Extending the behavioural phenotype of RTS is of particular pertinence to this thesis because preliminary research suggests that the group may present with a fractionation of the triad of impairments – with high levels of repetitive behaviours but good social interaction and social communication skills. If this is the case then the group could potentially provide a useful vehicle to study the question posed in section 1.6.

RTS is a multiple congenital anomaly syndrome estimated to occur in approximately 1 in 125,000 live births (Hennekam, Stevens & Van de Kamp, 1990). The syndrome has been linked to mutations of the CREB binding protein (CREBPP) (Petrij et al., 2002), microdeletions within 16p13.3 (Lacombe, Saura, Taine & Battin, 1992) and mutations of the E1A binding protein (p300) located at 22q13.2 (Roelfsema et al., 2005). However, genetic markers are only found in around 55% of cases (Hennekam, 2006) and therefore individuals are typically diagnosed through the identification of clinical characteristics.

The physical characteristics associated with RTS have been well documented and include postnatal growth deficiency, dental abnormalities, broad thumbs and toes, and

microcephaly (Hennekam & Van Doorne, 1990; Hennekam, Van Den Boogaard, Dijkstra, & Van de Kamp, 1990; Partington, 1990; Rubinstein, 1990; Stevens, Carey & Blackburn, 1990a; Stevens, Hennekam & Blackburn, 1990b). Health and medical difficulties are also common in RTS. Feeding and related weight difficulties have been reported in the literature, with descriptions of poor appetite, vomiting and failure to thrive during infancy followed by enhanced appetite and weight gain in adolescence (Hennekam, Van Den Boogaard, Sibbles & Van Spijker, 1990; Hennekam, 2006; Stevens et al., 1990b). Other health problems include renal abnormalities, recurrent upper respiratory infections and keloids (Rubinstein, 1990).

Intellectual disability (ID) is an associated characteristic of RTS. Although estimates regarding the degree of ID have varied across studies (Padfield, Partington & Simpson, 1968; Stevens et al., 1990a) it is thought that most individuals lie within the mild to moderate range (Hennekam, 2006). Although research outlining the cognitive ability of RTS is limited, genetics studies have started to link the molecular abnormalities to cognitive dysfunction in RTS. The CREB binding protein implicated in RTS has been shown to underlie long term memory formation (Bourtchuladze et al., 1994; Yin et al., 1994; Bartsch et al., 1995) and consequently it has been suggested that ID may occur as a result of impaired long term memory (D'Arcangelo & Curran, 1995; Weeber & Sweatt, 2002).

Although still in its infancy, the literature outlining the behavioural phenotype of RTS is growing. Studies have described "stubbornness", sleeping difficulties and a tendency for individuals to be emotional and excitable (Gotts & Liemohn, 1997; Hennekam, 2006; Stevens, 2007; Stevens et al., 1990b). The presence of ADHD-type behaviours such as impulsivity and hyperactivity have also been described (Hennekam,

2006; Stevens et al., 1990b; Stevens, Pouncey & Knowles, 2011). However, the two most frequently noted characteristics relate to social behaviour and repetitive behaviour.

In a recent questionnaire study involving 45 adults with RTS, 43% were described as being "overly friendly" (Stevens, et al., 2011). Numerous other reports have described those with RTS as "happy", "loving", and "friendly" individuals who " love adult attention" and "know no strangers" (Baxter & Beer, 1992; Hennekam, 2006; Padfield, et al., 1968; Rubinstein & Taybi, 1963; Stevens, et al., 2011; Stevens et al., 1990a). Such descriptions have led to the suggestion that individuals with RTS may show superior social competency and social communication skills when compared to those with other causes of ID (Hennekam et al., 1992). Recent findings appear to support this suggestion. Galéra et al. (2009) compared 39 children with RTS to a matched heterogeneous intellectual disability (HID) group and found that those with RTS scored significantly lower than the HID group on a scale assessing 'reduced contact and social interest'. More specifically, findings showed that those with RTS showed superior performance on several items including acceptance of physical contact, initiating play with other children, and quality of eye contact. More recently, Nelson, Moss, Powis, Waite & Oliver, (in review) assessed levels of sociability in six genetic syndromes using a novel questionnaire measure suitable for individuals with ID. The study asked caregivers of individuals with RTS, Down syndrome (DS), Angelman syndrome (AS), Fragile X syndrome (FXS), Cornelia de Lange syndrome (CdLS) and ASD to rate levels of behaviour across a range of defined social situations with familiar and unfamiliar people. Findings indicated that the RTS, DS and AS groups were more sociable (scored significantly higher) than the CdLS, FXS and ASD groups with both familiar and unfamiliar people.

'Repetitive behaviour' is an umbrella term used to describe a broad range of behaviours including insistence on sameness, stereotyped behaviour, adherence to routine,

and a preoccupation with circumscribed and narrow interests (Turner, 1997). Behaviours such as these have been said to form an important part of the behavioural phenotype of RTS. Stereotyped behaviours such as rocking, spinning, and hand flapping have frequently been described (Baxter & Beer, 1992; Hennekam et al., 1992; Stevens et al., 1990a), and Galéra et al. (2009) recently found that individuals with RTS displayed significantly higher scores than matched HID controls on questionnaire items assessing the stereotypies 'flaps arms/hands when excited', 'extremely pleased with certain movements/keeps doing them' and 'makes odd/fast movements with fingers/hands'. Other repetitive behaviours noted in around three quarters of individuals with RTS include an adherence to routine and an insistence on sameness (Hennekam et al., 1992; Stevens et al., 1990a; Stevens et al., 2011).

When taken together, the descriptions of repetitive behaviour and social behaviour in RTS are of particular interest. As outlined in section 1.2, ASDs are characterised by the presence of three core features: the presence of repetitive behaviour and restrictive interests, and qualitative impairments in communication and in social interaction (APA, 2000; WHO, 1992). The behavioural profile of RTS described in the literature suggests that individuals in this group may present with a dissociation of these core features. However, it is of note that the majority of studies detailing the behavioural characteristics of RTS are case studies or cohort descriptions. Such methodologies are limited as they cannot establish whether the behaviours reported are more likely to be found in RTS relative to other individuals with ID. If a behavioural phenotype is to be established, group comparison designs need to be employed. At present, only one study examining the behavioural phenotype of RTS has utilised such a design (i.e. Galéra et al., 2009).

The following chapter aims to extend the behavioural phenotype of RTS by using a group comparison design to examine ASD symptomatology and other behavioural characteristics that have yet to be fully described elsewhere; affect and overactivity.

Although not central to the overarching aims of this thesis, identifying information regarding affect and overactivity is important to further delineate the behavioural phenotype in RTS. Assessing affect provides valuable information regarding a person's quality of life and can subsequently highlight groups at particular risk of low mood, interest and pleasure. Assessing levels of overactivity is valuable as research has indicated that the presence of ADHD or ADHD-type behaviours such as overactivity and impulsivity can be a risk factor for challenging behaviours such as self injury and aggression (Arron et al., 2011). Furthermore, ADHD-type behaviours such as overactivity are known to adversely affect other areas of an individual's life including education and family wellbeing (Harpin, 2005). Identifying which syndrome groups are at particular 'risk' from these difficulties will enable the implementation of early intervention strategies.

In the behavioural phenotype literature, group comparison designs typically consist of a group of participants with HID matched for mental and chronological age. However, as the profile of ASD symptomatology is of particular interest in this group, an alternative strategy has been adopted. Establishing whether profiles of behaviour are 'ASD-like' would be difficult without comparisons to individuals with (and without) idiopathic ASD. Consequently, the study uses an idiopathic ASD comparison group alongside a FXS and a DS group. The use of these comparison groups allows the positioning of RTS relative to idiopathic ASD as well as two genetic syndromes of known aetiology with differing behavioural profiles and associations with ASD.

FXS and DS are the two most common causes of ID with known genetic aetiology. FXS results from an expansion of a trinucleotide repeat sequence, cytosine-guanine-guanine (CGG) on the FMR1 gene (Fragile X Mental Retardation 1 gene) of the long arm

of chromosome Xq27.3 (Dykens, Hodapp, & Finucane, 2000). DS results primarily from non-disjunction of chromosome 21 during meiosis (Connor & Ferguson-Smith, 1997).

A number of studies have suggested a strong association between FXS and the presence of ASD symptomatology (Clifford et al., 2007; Oliver, Berg, Burbidge, Arron & Moss, 2011). Although it has been questioned whether ASD characteristics in FXS are qualitatively different to those evident in idiopathic ASD (see Moss & Howlin, 2009), the heightened probability of repetitive behaviour in the group has been repeatedly described (Backes et al., 2000; Hagerman & Lampe, 1999; Mazzocco et al., 1998; Moss et al., 2009), alongside clear social communication deficits such as gaze avoidance, and social anxiety (Turk & Graham, 1997; Udwin & Dennis, 1995). In contrast, individuals with DS have been noted for their social competence (Rosner, Hodapp, Fidler, Sagun & Dykens, 2004) and have been described as charming, social, friendly, and engaging individuals (Dykens et al., 2000), with evidence to suggest lower levels of repetitive behaviour than those with a diagnosis of ASD (Hepburn & MacLean, 2009). If the repetitive behaviour and social profile of RTS described in the literature is correct, then when compared to ASD, FXS, and DS, one might expect RTS to be positioned more closely to ASD and FXS with regard to repetitive behaviour but closer to DS on measures of social behaviour.

The role of ID needs to be considered carefully when studying behavioural characteristics in genetic syndromes, particularly in relation in ASD symptomatology. As noted by Moss, Richards, Nelson and Oliver (2013) many of the core diagnostic features of ASD are developmentally weighted, meaning that a person might reach diagnostic criteria simply because they have not yet reached the developmental level required for a behaviour to be shown. However, controlling for ID when comparing across ASD, FXS, DS and RTS is difficult due to the differing degree of intellectual ability typically associated with each disorder. Although the process of matching participants is one

obvious strategy, this can significantly decrease sample size and thus limit how accurately each sample represents the population. Consequently, this study adopts two approaches. A total sample approach is initially used to position and describe RTS relative to representative group samples and then a matched contrast group approach is then used to control for ID.

The aims of the study were:

• To extend the behavioural phenotype of RTS by adopting both a total and matched sample approach to position RTS relative to three comparison groups on behavioural characteristics relating to affect and over activity.

• To examine the prevalence and profile of ASD symptomatology across groups using both total and matched sample approaches.

2.3. Method

2.3.1. Recruitment.

Parents and carers of individuals with RTS, ASD, FXS and DS were contacted for participation as part of an ongoing study investigating behavioural phenotypes in rare genetic syndromes and neurodevelopmental disorders (Arron, Oliver, Berg, Moss & Burbidge, 2011; Burbidge et al., 2010; Oliver, Berg, Burbidge, Arron & Moss, 2011). Participants were invited via their relevant support groups. 202 participants with RTS were contacted via the Rubinstein-Taybi syndrome support group. 1467 participants with ASD were contacted via the National Autistic Society. 432 participants with FXS were contacted via the Fragile X Society, and 500 participants with DS were contacted via the

Down Syndrome Association. Overall, 2601 participants were contacted and 748 responded (return rate of 28.8%)

2.3.2. Participants

Following exclusion, 643 participants were included in the study. 41 participants were excluded because they had no confirmed diagnosis from a Clinical Geneticist, Paediatrician, Neurologist or General Practitioner. One participant was excluded because they had an additional chromosomal abnormality. Eight participants were excluded because more than 25% of information was missing from at least one of their questionnaires. A further 19 participants were excluded because they had no confirmed age or were under the age of four. Participants under the age of four were excluded as one measure was not appropriate for young children. Finally, the presence of ASD in the ASD group was verified using the Social Communication Questionnaire (SCQ; Berument, Rutter, Lord, Pickles & Bailey, 1999). Thirty six participants with ASD were excluded because they either did not reach the cut off criteria for ASD (by attaining a score of 15 or above on the SCQ) or because they had not completed the SCQ.

2.3.3. Total Sample

For the initial analysis, a total sample approach was employed. Although this approach introduces confounds of group differences such as degree of disability, it maximises sample size and thus enables RTS to be positioned and described relative to representative group samples. The demographic characteristics of the total group sample are displayed in Table 1 (left hand side). Of the 643 participants included in the total

sample, 77.1% were male; 89.1% were able or partly able[4]; 85.2% were mobile; and 93.4% were verbal. 85.6% of the group had normal vision; and 89.2% had normal hearing[5]. The mean age of the group was 17.20 years (SD: 10.29; Range; 4.10-62.00).

2.3.4. Matched Sample

For the second analysis, a matched sample approach was employed. Such an approach allows for the control of varying degrees of intellectual and physical disability across groups. A subset of 168 participants (42 from each group) were selected and matched for chronological age, verbal ability, and self help score (+/- 2; derived from the Wessex Scale: Kuschlick et al., 1973). Self-help scores were employed as an indicator of degree of disability. The demographic characteristics of the matched group are displayed in Table 1 (right hand side). Of the 168 participants included in the matched sample, 69.6% were male; 89.9% were able or partly able; 83.2% were mobile; and 92.9% were verbal. 81.5% of the group had normal vision; and 83.9% had normal hearing. The mean age of the group was 15.70 years (SD: 7.40; Range; 4.95-45.84).

[4] Scoring six or above on the self help subscale of the Wessex Scale (Kuschlick et al. 1973). The self-help score is derived from summing three items regarding independent feeding, washing and dressing. Items are scored from one to three resulting in a total score ranging between three and nine.

[5]Information regarding mobility, verbal ability, vision, and hearing was derived from the Wessex Scale (Kuschlick et al. 1973)

Table 1: *Demographic characteristics of the total group and matched samples broken down by syndrome group*

		Total Sample Analysis								Matched Sample Analysis						
		Syndrome group								Syndrome group						
		A ASD	B FXS	C RTS	D DS	*Df*	χ^2/ Kruskal Wallis*	*p* value	Post hoc analyses (<.01)	A ASD	B FXS	C RTS	D DS	χ^2/ Kruskal Wallis*	*p* value	Post hoc analyses (<.01)
N[a]		228	196	87	132					42	42	42	42			
Age[b]	Mean	12.01	17.48	19.98	23.91	3	103.52*	<.001	B,C,D>A D>B	15.55	15.50	15.86	15.90	0.30*	.960	-
	SD	5.78	8.93	11.45	12.61					8.26	7.02	7.06	7.47			
	Range	4.10-45.84	6.30-47.49	4.24-59.41	4.37-62.00					6.61 – 45.84	6.31-34.06	6.60-32.80	4.95-34.63			
Gender	% male	86.0	100[f]	54.0	43.2	3	180.83	<.001	B>A>C,D	83.3	100[f]	57.1	38.1	44.91	< .001	B>A>C,D
Ability[c]	% able or partly able[d]	89.9	90.8	77.0	93.1	3	16.03	.001	A,B,D>C	90.5	90.5	83.3	95.2	3.34	.342	-
Mobility[c]	% mobile[e]	95.2	72.0	77.9	92.4	3	54.52	<.001	A,D>B,C	90.5	71.4	82.9	88.1	6.49	.090	-
Verbal ability[c]	%verbal	92.5	96.3	84.9	96.2	3	14.55	.002	B,D>C	90.5	95.2	88.1	97.6	3.59	.309	-
Hearing[c]	% normal hearing	96.9	97.4	85.1	65.9	3	101.68	<.001	A,B>C>D	97.6	97.6	78.6	61.9	27.67	< .001	A,B>C,D
Vision[c]	% normal vision	96.5	88.1	85.1	63.4	3	75.66	<.001	A>B,C>D	97.6	88.1	78.6	61.9	19.42	< .001	A> C, D B>D

Groups: *ASD* Autism Spectrum Disorder, *FXS* Fragile X Syndrome, *RTS* Rubinstein- Taybi Syndrome, *DS* Down Syndrome

[a] *N* may vary across analyses due to missing or incomplete data

[b] in years

[c] information obtained from the Wessex self help scale (Kushlick et al, 1973)

[d] Those scoring six or above on the self help subscale. Self help is derived from summing three items regarding independent feeding, washing and dressing. Items are scored between one and three resulting in a total score ranging between three and nine.

[e] defined as scoring six on the Wessex mobility subscale

[f] due to the X linked nature of the disorder 100% of FXS participants were male

Note. A letter missing from the post hoc analyses column indicates that the group did not differ from the other groups.

2.3.5. Measures.

Questionnaires included measures developed for use with individuals with ID. These included[6] a demographic questionnaire, the Wessex Scale (Kuschlick et al., 1973), the Social Communication Questionnaire[7] (SCQ; Rutter, Bailey, Lord, & Berument, 2003), the Mood Interest and Pleasure Questionnaire – Short form (MIPQ-S; Ross, Arron, & Oliver 2008), and The Activity Questionnaire (TAQ; Burbidge & Oliver, 2008; Burbidge et al., 2010).

2.3.5.1. Demographic questionnaire.

The demographic questionnaire obtains information regarding participants' age, gender, mobility, verbal ability and diagnosis. The questionnaire also collects data relating to when and by whom the participant was diagnosed.

2.3.5.2. Wessex Scale (Kuschlick et al., 1973.)

The Wessex Scale is an informant measure used to assess ability in children and adults with IDs. Five subscales measure literacy, mobility, continence, speech, and self help skills. This scale also includes items relating to vision and hearing. Informants are asked to rate the ability of the person they care for on a 3-point scale. Low scores on this measure indicate lower ability levels. In this study, the scale was used to establish the

[6] As this paper is part of a wider study examining behaviour in genetic syndromes, other questionnaire measures were also included but are described elsewhere (Arron, Oliver, Berg, Moss & Burbidge, 2011; Burbidge et al., 2010; Oliver, Berg, Burbidge, Arron & Moss, 2011)

[7] The FXS group completed an earlier version of the SCQ (Autism Screening Questionnaire; Berument, Rutter, Lord, Pickles & Bailey, 1999). However, one item (item 20: social chat) differs for non verbal individuals between the ASQ and the SCQ. Consequently, to ensure consistency, this item was treated as a missing item and prorated for all nonverbal participants. A mean item score was calculated based on the other completed items of the communication domain. This method has been used previously (Moss, Oliver, Nelson, Richards & Hall, 2013) and current analysis indicated that the use of this prorated item did not impact on the between group differences in SCQ scores.

degree of disability of participants. The scale has good inter-rater reliability at subscale level for both children and adults (Kushlick et al., 1973; Palmer & Jenkins, 1982).

2.3.5.3 The Activity Questionnaire (TAQ; Burbidge & Oliver, 2008; Burbidge et al., 2010).

The Activity Questionnaire (TAQ) assesses overactive and impulsive behaviours in individuals with ID. The measure includes 18 items that comprise three subscales: Overactivity, Impulsivity and Impulsive Speech. Items are scored on a 5 point Likert scale ranging from 0 (never/almost never) to 5 (always/almost all of the time). High scores on this measure indicate high levels of overactivity. To ensure comparability of scores across a wide range of ID, different scoring protocols are employed for immobile and non verbal individuals. Inter-rater reliability for verbal and non verbal participants is .74 and .78 respectively. Test-retest scores for verbal and non verbal participants are .88 and .94 respectively. Overall internal consistency is .94.

2.3.5.4. Mood, Interest and Pleasure Questionnaire Short-form (MIPQ-S; Ross, Oliver & Arron, 2008).

The MIPQ-S is used to assess affect in individuals with ID, including those with profound ID. Based on observations over a two week period, informants rate 12 items on a five point Likert scale. The MIPQ-S yields an overall score and two subscale scores – 'Mood' and 'Interest and Pleasure'. Low scores indicate low mood, interest and pleasure. The measure has good internal consistency (Cronbach's alpha coefficients: total = .88, Mood = .79, Interest and Pleasure = .87) and good test-retest and inter-rater reliability, with Kappa values of .97 and .85 respectively.

2.3.5.5. Social Communication Questionnaire (SCQ; Rutter, Bailey, Lord, & Berument, 2003).

Based on the Autism Diagnostic Interview, the SCQ was developed as a tool for screening for ASD in children and adults. The measure contains 40 items which are grouped into a total score and three subscales: Communication; Social Interaction; and Repetitive and Stereotyped patterns of behaviour. Informants are asked to respond 'Yes' or 'No' to items corresponding to the presence or absence of certain behaviours. Higher scores on this measure indicate a greater degree of ASD symptomatology. The authors employ a cut off score of 15 as the standard optimal cut off for distinguishing individuals with ASDs (including autism) from other diagnoses. The SCQ shows good concurrent validity with the Autism Diagnostic Observation Schedule and the Autism Diagnostic Interview (Howlin & Karpf, 2004). Internal consistency is good ($\alpha = .90$ for the total scale; Berument, Rutter, Lord, Pickles & Bailey, 1999).

As the number of non-verbal participants varied across groups, a proportional communication subscale score was used. Items 2 to 7 of the SCQ are only scored for verbal participants, yet items 2 to 40 are used in the SCQ scoring algorithms. As a result, nonverbal individuals can only score on 8 of the 13 communication domain items and this introduces a scoring bias between groups of different abilities. The proportional communication subscale uses a mean item domain score (score on communication subscale / 8 x 13) to control for this bias.

2.3.6. Procedure

Participants were sent a pack consisting of a covering letter, consent form, information sheet, and questionnaire booklet (see Appendix A-D). To avoid priming, the study was entitled 'Understanding behaviour in people with neurodevelopmental

disorders'. Participants were asked to return completed questionnaires and consent forms to the University in prepaid envelopes.

2.3.7. Data Analysis

Data were inspected for normality using Kolmogorov-Smirnov tests (for n >50) and Shapiro-Wilk tests (for n <50). Where data were not normally distributed ($p<.05$), non parametric tests were used. To examine differences in demographic characteristics between groups, Kruskal-Wallis tests were employed for ordinal data and Chi-square statistics for categorical data. To compare RTS to the comparison groups across the areas of affect, overactivity, impulsivity, and autism spectrum behaviour, Kruskal Wallis tests were employed for subscales of the MIPQ, TAQ and SCQ. Significant differences were examined using post-hoc Mann- Whitney U tests. Chi square statistics were employed to examine differences in the proportions of each group reaching criteria for ASD. All analyses were conducted for both the total group and matched samples. Due to the large number of statistical analyses being conducted, a conservative alpha value of <.001 was utilised throughout.

2.4. Results

2.4.1. Total Sample Analysis

2.4.1.1. *Demographic characteristics*

Between group analyses indicated that significant differences were found between groups on all demographic measures. These results are presented in Table 1 (left hand side). For ability, post hoc comparisons revealed that individuals with RTS were significantly less able than all other groups. Individuals with RTS also showed significantly lower verbal ability than the FXS and DS groups. For age, the ASD group was significantly younger than all other groups, and the FXS group was significantly younger than the DS group. Due to the X linked nature of the disorder (Garber, Visootsak

& Warren, 2008); the FXS group contained a significantly higher proportion of male participants than all other groups. Also, as expected (Fombonne, 2003), the ASD group contained a higher proportion of male participants than the RTS and DS groups. Individuals with FXS and DS were less mobile than individuals with ASD and DS. Individuals with DS and RTS evidenced poorer hearing than the ASD and FXS groups, and the DS group also showed poorer hearing than the RTS group. For vision, the ASD group had a significantly higher proportion of individuals showing 'normal vision' than all other groups. It was also found that individuals with DS had poorer vision than the FXS and RTS groups.

2.4.1.2. *Overview*

The aim of the total sample analysis was to position and describe RTS relative to representative samples of ASD, FXS, and DS on measures of affect, overactivity/impulsivity and ASD symptomatology. To achieve this, between group analyses were conducted on subscales of The Activity Questionnaire, The Mood, Interest and Pleasure Questionnaire and The Social Communication Questionnaire. The results of these analyses are shown in Table 2.

2.4.1.3. *Impulsivity, overactivity and impulsive speech*

Between group analyses revealed significant group differences on all three subscales of the TAQ. Post hoc comparisons revealed that both the ASD and FXS groups scored significantly higher impulsivity and overactivity scores than both the RTS and DS groups. Individuals with RTS were also found to score significantly higher on these subscales than individuals with DS. For the impulsive speech subscale the ASD group scored significantly higher scores than the RTS and DS groups. Individuals with FXS also scored significantly higher on this domain than the DS group.

Table 2: *Total sample mean scores and standard deviations for all measures and results of statistical analyses comparing syndrome groups*

		Syndrome Group							
		A ASD	B FXS	C RTS	D DS				
		Mean (*SD*)				*df*	χ^2	*p* value	Post hoc Mann Whitney tests (<.001)
Activity Questionnaire	Impulsive	15.79 (6.21)	15.70 (7.15)	12.42 (7.25)	6.67 (6.20)	3	139.13	< .001	ASD,FXS>RTS>DS
	Overactive	17.67 (9.88)	18.13 (10.52)	11.47 (9.17)	5.99 (7.58)	3	148.47	< .001	ASD,FXS>RTS>DS
	Impulsive speech[a]	6.03 (3.51)	5.40 (3.78)	3.60 (2.44)	2.46 (2.56)	3	89.92	< .001	ASD>RTS,DS FXS>DS
Mood Interest and Pleasure	Mood	18.72 (3.22)	20.83 (2.77)	20.61 (3.23)	21.49 (2.29)	3	102.14	< .001	FXS,RTS,DS>ASD
	Interest/Pleasure	14.06 (4.46)	16.79 (4.05)	16.77 (4.78)	18.67 (3.85)	3	94.22	< .001	FXS,RTS,DS>ASD DS>FXS
	Total	32.77 (6.92)	37.62 (6.02)	37.38 (7.37)	40.16 (5.23)	3	117.23	< .001	FXS,RTS,DS>ASD DS>FXS
Social Communication Questionnaire	Communication[b]	9.19 (2.37)	7.19 (2.52)	6.08 (3.26)	4.02 (3.11)	3	188.84	< .001	ASD>FXS>RTS>DS
	Repetitive behaviour	5.96 (1.64)	4.65 (2.24)	4.10 (2.12)	2.06 (1.83)	3	210.69	< .001	ASD>FXS,RTS>DS
	Social interaction[b]	10.07 (3.16)	8.14 (3.26)	6.80 (3.18)	3.59 (3.40)	3	187.36	< .001	ASD>FXS,RTS>DS
	Total	26.36 (5.48)	21.00 (6.79)	17.15 (5.51)	9.84 (7.07)	3	255.28	< .001	ASD>FXS>RTS>DS
	% ASD[c]	100	83.5	64.9	19.2	3	266.90	< .001	ASD>FXS>RTS>DS
	% Autism[d]	78.1	48.3	23.4	9.6	3	161.73	<.001	ASD>FXS>RTS,DS

ASD Autism Spectrum Disorder, *FXS* Fragile X Syndrome, *RTS* Rubinstein- Taybi Syndrome, *DS* Down Syndrome

[a] calculated only for verbal participants

[b] a higher score on the social communication questionnaire indicates greater impairment

[c] percentage of participants scoring a total of 15 or over on the social communication questionnaire (Berument et al, 1999)

[d] percentage of participants scoring a total of 22 or over on the social communication questionnaire (Berument et al, 1999)

Note. A letter missing from the post hoc analyses column indicates that the group did not differ from the other groups.

2.4.1.4. *Mood, interest and pleasure*

Between group analyses revealed significant group differences on both subscales of the MIPQ. For both the mood, and interest and pleasure subscales, post hoc comparisons revealed that individuals with ASD displayed significantly lower mood, interest, and pleasure than all other groups. Comparisons also revealed that the FXS group displayed significantly lower interest and pleasure than the DS group.

2.4.1.5. *Communication, social interaction and repetitive behaviour*

Between group analyses revealed significant differences on each of the three domains of the SCQ. For the communication subscale, post hoc comparisons indicated that the ASD group scored significantly higher (greater impairment) than all other groups. The FXS group scored significantly higher than the RTS and DS groups, and the RTS group scored significantly higher than the DS group. For the repetitive behaviour and social interaction subscales, post hoc comparisons indicated that the ASD group scored significantly higher on both these subscales (more impaired social interaction, more repetitive behaviour) than all other groups. For these subscales, it was also found that both the FXS and RTS groups scored significantly higher than the DS group.

The proportions of each group scoring at or above the cut off for ASD (scoring 15 or above on the SCQ) and Autism (scoring 22 or above on the SCQ) are also displayed in Table 2. Between group analysis revealed significant differences in the proportion of participants scoring above the ASD and Autism cut offs. For the ASD cutoff, post hoc comparisons indicated that the ASD group contained a significantly higher proportion of participants meeting the cut off than all the other groups. The FXS group contained a significantly higher proportion than the RTS and DS groups, and the RTS group contained a significantly higher proportion than the DS group. For the Autism cut off, post hoc

comparisons indicated that the ASD group contained a significantly higher proportion of participants meeting the cut off than all the other groups and the FXS group contained a significantly higher proportion than the RTS and DS groups.

2.4.2. Matched Sample Analysis

2.4.2.1. *Demographic characteristics*

Between group analyses of the matched samples indicated that participants in all four groups did not differ with regards to age, ability, mobility and verbal ability. However, significant group differences were found for gender, hearing, and vision. These results are presented in Table 1 (right hand side). As expected, the FXS group contained a significantly higher proportion of male participants than all other groups and the ASD group contained a higher proportion of male participants than the RTS and DS groups. Individuals with DS and RTS evidenced poorer hearing than the ASD and FXS groups. For vision, the ASD group had a significantly higher proportion of individuals showing 'normal vision' than the RTS and DS groups. It was also found that the DS group had poorer vision than the FXS group.

2.4.2.2. *Overview*

The total sample analysis above allowed the RTS group to be positioned and described relative to representative samples of ASD, FXS, and DS. However, it is of note that in this analysis individuals with RTS were significantly less able than all other groups. Consequently, the aim of the matched sample analysis was to investigate whether the same pattern of results remained after controlling for age, ability, verbal ability, and mobility. To achieve this, between group analyses were repeated on a subgroup of participants matched on these variables. The results of these analyses are shown in Table 3.

Table 3: *Matched sample mean scores and standard deviations for all measures and results of statistical analyses comparing groups.*

		Syndrome Group							
		A ASD	B FXS	C RTS	D DS				
		Mean (*SD*)				*df*	χ^2	*p* value	Post hoc Mann Whitney tests (<.001)
Activity Questionnaire	Impulsive	16.54 (5.85)	17.14 (6.81)	12.96 (7.48)	9.44 (6.41)	3	30.60	< .001	ASD,FXS>DS
	Overactive	18.47 (10.38)	21.25 (10.66)	12.43 (9.57)	9.40 (9.31)	3	30.85	< .001	FXS>RTS,DS ASD>DS
	Impulsive speech[a]	6.15 (3.25)	5.18 (3.90)	3.65 (2.51)	3.71 (3.17)	3	13.86	.003	-
Mood Interest and Pleasure	Mood	18.36 (3.53)	20.42 (2.92)	20.68 (3.26)	21.57 (1.95)	3	24.16	< .001	RTS,DS>ASD
	Interest/Pleasure	12.48 (4.26)	16.02 (4.89)	17.38 (4.70)	19.07 (3.67)	3	41.84	< .001	FXS,RTS,DS>ASD
	Total	30.83 (6.78)	36.45 (7.07)	38.06 (7.44)	40.64 (4.36)	3	44.45	< .001	FXS,RTS,DS>ASD
Social Communication Questionnaire	Communication[b]	9.91 (2.43)	8.27 (2.08)	5.91 (3.12)	4.57 (3.52)	3	53.11	< .001	ASD,FXS>RTS,DS
	Repetitive behaviour	5.67 (1.79)	5.36 (2.45)	4.16 (2.29)	2.29 (2.01)	3	44.53	< .001	ASD,FXS,RTS>DS
	Social interaction[b]	11.24 (2.680	9.32 (2.68)	6.75 (2.92)	4.41 (3.84)	3	62.26	< .001	ASD,FXS>RTS,DS
	Total	27.72 (5.44)	24.11 (5.41)	17.34 (5.53)	11.45 (8.27)	3	71.81	< .001	ASD,FXS>RTS,DS RTS>DS
	% ASD[c]	100	100	65.7	29.4	3	66.81	< .001	ASD,FXS>RTS,DS[e]
	% Autism[d]	83.3	62.2	22.9	14.7	3	47.95	<.001	ASD,FXS>RTS,DS

ASD Autism Spectrum Disorder, *FXS* Fragile X Syndrome, *RTS* Rubinstein- Taybi Syndrome, *DS* Down Syndrome

[a] calculated only for verbal participants

[b] a higher score on the social communication questionnaire indicates greater impairment

[c] percentage of participants scoring a total of 15 or over on the social communication questionnaire (Berument et al, 1999)

[d] percentage of participants scoring a total of 22 or over on the social communication questionnaire (Berument et al, 1999)

[e] The difference between RTS and DS approached significance at 0.003

Note. A letter missing from the post hoc analyses column indicates that the group did not differ from the other groups.

2.4.2.3. *Impulsivity, overactivity and impulsive speech*

Between group analyses of the matched sample revealed that significant group differences were now only apparent for the impulsivity and overactivity subscales of the TAQ. The previously noted group differences on the impulsive speech subscale were no longer significant. Post hoc comparisons for the impulsivity subscale revealed that the ASD and FXS groups evidenced significantly higher impulsivity scores than the DS group. Individuals with RTS were no longer significantly different to any other group on this subscale. Post hoc comparisons for the overactivity subscale indicated that FXS group evidenced significantly higher overactivity scores than the RTS and DS groups, and the ASD group scored significantly higher than the DS group. However, individuals with RTS were no longer significantly different to those in the ASD or DS groups.

2.4.2.4. *Mood, interest and pleasure*

Between group analyses of the matched sample indicated that significant group differences remained for both subscales of the MIPQ. However, post hoc comparisons revealed a different pattern of results. For both the mood, and interest and pleasure subscales, individuals with ASD still displayed significantly lower mood, interest, and pleasure than the RTS and DS groups. However, results showed that the ASD group no longer scored significantly lower than the FXS group on these subscales. Furthermore, on the interest and pleasure subscale, the FXS group no longer scored significantly lower than the DS group.

2.4.2.5. *Communication, social interaction and repetitive behaviour.*

Between group analyses of the matched samples revealed that significant group differences remained on each of the three domains of the SCQ. However, post hoc

comparisons now revealed a different pattern of results for each subscale. For the communication and social interaction subscales, findings showed that the ASD and FXS groups scored significantly higher (greater impairment) than both the RTS and DS groups. These results indicate that following matching, the ASD group no longer scored significantly higher than the FXS group, and the RTS group no longer scored significantly higher than the DS group. For the repetitive behaviour subscale, findings showed that the ASD, FXS, and RTS groups all showed significantly higher scores than the DS group. This result indicated that following matching the ASD group no longer differed from the FXS and RTS groups on this subscale.

The proportions of each subgroup scoring at or above the cut off for ASD (scoring 15 or above on the SCQ) and Autism (scoring 22 or above on the SCQ) are also displayed in Table 3. Between group analysis revealed significant differences in the proportion of participants scoring at or above the ASD and Autism cut offs. For the ASD cut off, post hoc comparisons indicated that the ASD and FXS no longer differed in the proportions of participants reaching the cut off, but both groups contained a significantly higher proportion of participants meeting the cut off than both the RTS and DS groups. The RTS group contained more participants reaching ASD cut-off than the DS group, but this difference now only approached significance ($p=.003$). For the Autism cut off, post hoc comparisons indicated that the ASD and FXS no longer differed in the proportions of participants reaching the cut off, but both groups contained a significantly higher proportion of participants meeting the cut off than both the RTS and DS groups.

2.5. Discussion

The current chapter aimed to extend the behavioural phenotype of RTS by using both total and matched sample approaches to position the group relative to ASD, FXS, and DS on behavioural characteristics relating to affect, overactivity, and ASD symptomatology. A strength of this study is that the use of standardised, valid measures applicable to people with ID along with the inclusion of comparable contrast groups enabled the consideration of the specificity of findings to RTS. Comparative analysis revealed several important findings.

The presence of ADHD- type behaviours such as impulsivity and hyperactivity have previously been described in RTS (Hennekam, 2006; Stevens et al, 1990b; Stevens et al, 2011). However, these studies were cohort descriptions and therefore unable to establish the specificity of these behaviours to the group. In the current study, between group comparisons provide evidence that these behaviours do occur at relatively high levels in RTS. Analysis of the total sample revealed that although the ASD and FXS groups scored significantly higher on measures of impulsivity and overactivity than both the RTS and DS groups, individuals with RTS scored significantly higher on these subscales than the DS group. Although DS is not known to be characterised by particularly high levels of impulsivity and overactivity (Chapman & Hesketh, 2000), this finding indicates that the presence of these behaviours in the total group sample of RTS is comparatively higher than at least one syndrome group of known genetic aetiology.

When the samples were matched, thus controlling for level of ID, individuals with RTS were no longer significantly different to any of the groups on the impulsivity subscale, but ASD and FXS scored significantly higher on this subscale than DS. The matched comparisons for the overactivity subscale indicated that the FXS group scored significantly higher overactivity scores than the RTS and DS groups, and the ASD group

scored significantly higher than the DS group. High levels of overactivity have been reported in FXS (Oliver et al, 2011) so the description and positioning of RTS as 'less overactive' than this group when matched is informative.

Findings from the Mood, Interest, and Pleasure Questionnaire revealed that individuals with RTS scored significantly higher scores (more positive affect) than the ASD group on mood, interest, and pleasure, for both the total sample and matched sample analyses. The RTS group were found to be comparable to both DS and FXS on these subscales for both analyses. Prior to this study, individuals with RTS had been described as 'emotional and excitable' and 'happy, loving and friendly' (Baxter & Beer, 1992; Goots & Liemohn, 1977; Hennekam, 2006; Padfield et al, 1968; Rubinstein & Taybi, 1963; Stevens et al, 2011) but no study had specifically looked at the behavioural characteristics of affect and made comparisons to other groups. The presence of low mood in ASD has been previously described (Hill & Furniss, 2006). In contrast, individuals with FXS have been found to display higher levels of mood than a number of other genetic syndromes (Oliver et al, 2011) and reports for DS suggest a sociable and engaging demeanour (Fidler, Most, Booth-LaForce, & Kelly, 2008). When considered alongside these descriptions, the current findings suggest that RTS is not characterised by low mood, interest, and pleasure, but instead appear to display levels that are at least comparable to two other groups of known genetic aetiology.

The proportions of individuals with RTS meeting the cut-off for ASD on the Social Communication Questionnaire were relatively high at 64.9% and 65.7% for the total and matched groups respectively. The proportions of these individuals meeting the cut off for Autism were 23.4% and 22.9 % for the total and matched groups respectively. These findings are novel as although the presence of 'autistic like behaviours' have been previously noted in the group (Galéra et al. 2009; Stevens et al, 2011), no study has

specifically examined the proportions of individuals reaching cut-off criteria. Between group comparisons for the total sample indicated that both the ASD and FXS groups contained significantly more individuals reaching the ASD cut-off than the RTS and DS groups, and the RTS group contained significantly more individuals reaching cut-off than the DS group. When the groups were matched, the ASD and FXS groups continued to have significantly more individuals reaching cut-off than the RTS and DS groups, but the difference between the RTS and DS group only approached significance. However, the difference in proportions between the RTS and DS groups was still relatively large (65.7% and 29.4% respectively) and it is likely that this difference did not reach significance because power was differentially affected by missing SCQ data in these groups resulting in a smaller n. For the Autism cut off, between group comparisons for the total sample indicated that the ASD group contained a significantly higher proportion of participants meeting the cut off than all the other groups and the FXS group contained a significantly higher proportion than the RTS and DS groups. When the groups were matched ASD and FXS no longer differed with regards to the proportions of participants reaching the cut off, however both groups continued to have significantly more individuals reaching cut-off than the RTS and DS groups.

Although the proportions of ASD across the groups allows RTS to be positioned relative to other groups in a way that has not been done previously, it is the profile of ASD symptomatology across the three subscales of the SCQ that is of particular interest. As discussed in section 2.2, anecdotal descriptions in the literature would suggest a dissociation across the ASD triad of impairments in RTS, with a high level of repetitive behaviour but competent social functioning. Given these descriptions it was expected that when compared to ASD, FXS, and DS, RTS might be positioned more closely to ASD and FXS on measures of repetitive behaviour, but closer to DS on measures of social

behaviour. Findings from the total sample analysis partly confirmed these predictions. More specifically, with regards to repetitive behaviour, the analyses indicated that the RTS group showed higher levels than the DS group, comparable levels to the FXS group, but lower levels than the ASD group. For social communication, the RTS group showed less impairment than the ASD and FXS groups but more impairment than the DS group, and for social interaction the RTS group showed less impairment than the ASD group but more impairment than the DS group. However, as noted previously, the role of ID needs to be considered carefully when studying the ASD symptomatology as many of the core features of ASD are developmentally weighted (Moss et al., 2013). In the total sample, the RTS group was significantly less able than all three other groups and therefore this may have masked some of the differences across the groups.

When the groups were matched, the noted dissociation between the ASD characteristics in RTS and subsequent group differences became more apparent. As predicted, for the social aspects of the ASD triad (social communication and social interaction) RTS and DS were comparable and both significantly less impaired than the ASD and FXS groups. However, for repetitive behaviour, RTS was comparable to the ASD and FXS groups, all of whom showed significantly higher levels of repetitive behaviour than the DS group. These findings are of interest as they demonstrate that although a relatively large number of individuals with RTS may meet the 'cut-off score' for ASD, it suggests that the behaviours that contribute to this 'score' are qualitatively different in RTS than in idiopathic ASD. This highlights the importance of examining ASD phenomenology in genetic syndromes beyond the level of clinical cut off scores.

The findings of the current chapter need to be considered alongside methodological limitations. Although the questionnaire measures used are standardised and validated for people with ID, they rely on retrospective carer reports and so have obvious limitations.

The use of observational assessments such as the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2000) were not possible within the current study but would have been preferable and should be used in future studies to refine the assessment of behavioural characteristics in the group. Limitations relating to statistical analysis should also be noted. Due to different group sizes in the total sample analysis and missing data in the matched sample analysis, power was differentially affected. This means that despite similar levels of difference, analysis between smaller groups did not reach significance. However, the use of the total sample and matched sample approaches together allowed the consideration of which findings may have been affected by difficulties with power. Finally, participants with RTS were recruited via a syndrome support group and so it is possible that these participants may not be representative of the wider population of individuals with RTS as a whole. However, group comparisons remain valid as the comparison groups used in the study were recruited in the same way meaning that any potential bias would be consistent across groups.

2.6. Conclusions

It has been suggested that understanding the presentation of ASD characteristics in genetic syndromes that display a dissociation of the triad of impairments may be helpful in extending our understanding of the aetiology of ASD (Persico & Bourgeron, 2006). Chapter 1 drew attention to the specific study of ToM development in syndrome groups that showed a high prevalence of ASD but divergent social profiles. Overall, the current chapter has provided evidence that points towards RTS as a syndrome group from which to do this. The chapter has described that although a large proportion of the RTS group meet the 'cutoff' criteria for ASD, the profile of ASD symptomatology in the group shows a divergent social profile relative to repetitive behaviour.

Running Head: Development of a Social Cognition Scale

CHAPTER THREE

MAPPING THE DEVELOPMENTAL TRAJECTORY OF EARLY SOCIAL COGNITIVE ABILITY: THE DEVELOPMENT OF A SOCIAL COGNITION SCALE.

3.1. Preface

In chapter 1 it was argued that the study of ASD phenomenology in genetic syndromes can aid understanding of the aetiological pathways underpinning ASD. It was subsequently highlighted how syndrome groups that displayed fractionated ASD profiles could provide a useful vehicle by which to study each aspect of the ASD triad separately. More specifically the chapter drew attention to the potential study of ToM development in syndrome groups that showed a high prevalence of ASD but fractionated social profiles. In chapter 2, a total group and matching approach was used to examine the behavioural phenotype of a potential syndrome of interest; Rubinstein-Taybi syndrome (RTS). Findings from this chapter confirmed RTS as a syndrome group that showed a comparatively high prevalence of ASD but a dissociation across the ASD triad of impairments. For social aspects of the ASD triad, RTS was comparable to Down syndrome (DS) and significantly less impaired than an Autism Spectrum Disorder (ASD) group and a Fragile X syndrome (FXS) group. However, for repetitive behaviour RTS was comparable to the ASD and FXS groups, and showed significantly higher levels of repetitive behaviour than the DS group. In the following chapter, the focus returns to the study of Theory of Mind (ToM) development in genetic syndromes. As highlighted in chapter 1, despite the potential benefits of studying ToM in genetic syndromes, research in this area is constrained by the use of single task methodologies and the cognitive demands of typical ToM tasks. In an attempt to overcome these constraints, the current chapter describes the development of a 'ToM precursor' social cognition scale, suitable for individuals with intellectual disability (ID).

3.2. Introduction

ToM refers to the social cognitive ability to attribute mental states (i.e. beliefs and desires) to others. This ability is fundamental to human social development as it allows a person to predict, explain and manipulate the behaviour of others (Premack & Woodruff, 1978). For instance, if you see your friend looking inside a cookie jar, you are likely to explain this by making the assumption that he *wants* a cookie, and he *believes* that there is one in there. Importantly, you can understand his behaviour even if you *know* that there are no cookies left. Alternatively, you might find it funny if you *know* that you have hidden them in a different place but that he does not *know* this. The understanding of mental states is also crucial for typical reciprocal social interaction: for understanding the *intended meaning* in communication; for understanding *humour* and *sarcasm*; for understanding if/when a person may not *want* to talk to you; and for comprehending the difference between imaginary and real events (Frith, 1989).

As discussed in section 1.5, there is a wide body of evidence linking the characteristic social interaction and communicative impairments in ASD to deficits in ToM (Baron-Cohen, 2000). The impact of these deficits on social functioning has been illustrated in first person accounts of Autism that detail how the social world can be a confusing a frightening place. In a personal account of autism, Joliffe, Landsdown & Robinson (1992) describe the difficulties that ensue from the inability to understand others' mental states:

> Human beings are the hardest of all to understand because not only do you have to cope with the problem of seeing them, they move about when you are not expecting them to, they make varying noises and along with this, they place all kinds of demands on you which are just impossible to understand. (Joliffe, Lansdown & Robinson, 1992, p.16).

Given how important understanding others' mental states can be for navigating the social world, the study of ToM and its relationship to social behaviour has now extended to many

other disorders characterised by social difficulties including: rare genetic syndromes (Campbell et al. 2011; Cornish et al. 2005; Karmiloff-Smith et al. 1995); Schizophrenia (Frith & Corcoran, 1996); Dementia (Gregory et al. 2002); Deafness (Peterson et al. 2005); and Anorexia Nervosa (Russell, Schmidt, Doherty, Young & Tchanturia, 2009).

The field of ToM research is extensive and hundreds of studies have examined the age at which ToM ability typically develops in children. The 'false belief task' has dominated much of this research, with authors of studies debating the age at which children pass the task reliably and thus demonstrate their understanding of *belief* (Doherty, 2008). However, it is now widely accepted that, regardless of task manipulations, typically developing children fail false belief tasks at around three years old but then undergo a conceptual change at around four-to-five years and start passing reliably (Wellman, Cross, & Watson, 2001).

In more recent years, research has broadened to include the study of the development of social cognitive abilities that occur during the first two years of life. Research has examined the presence of implicit false belief understanding (Onishi & Baillargeon, 2005) and the presence of other early developing explicit abilities such as joint attention, and shared intentionality (e.g. Tomasello, 1995; Tomasello, Carpenter, Call, Behne & Moll, 2005; Warneken, Chen, & Tomasello, 2006). There has been evidence for impairment in both of these implicit and explicit abilities in ASD (Leekam & Ramsden, 2006; Liebal, Colombi, Rogers, Warneken, & Tomasello, 2008; Senju, Southgate, White & Frith, 2009). The current thesis focuses on early explicit abilities. It has been proposed that these early abilities lay the foundations for later ToM development. For instance, Baron-Cohen (1989, 1993, 1995) discussed the concept of *joint attention*; the shared focus of two individuals on an object (indicated by behaviours such as proto-declarative pointing and gaze following). He argued that the understanding of 'attention' in

these episodes was a 'critical precursor' to ToM understanding. Similarly, Tomasello and colleagues (1993, 2005) discussed the understanding of *intentions* and *shared intentionality*. They propose that infants' understanding of others as 'intentional agents' is one of the earliest developing social cognitive abilities and subsequently paves the way for more sophisticated social cognitive understanding. Recent longitudinal studies have started to provide evidence for these proposed developmental sequences.

Charman et al. (2000) conducted a study that examined *joint attention, imitation,* and *play* in 13 children aged 20 months. The children were followed up longitudinally at 44 months with a battery of ToM tasks. Although imitation ability was found to be longitudinally associated with expressive language, *only* early joint attention abilities were found to be associated with later ToM ability at 44 months. In a similar study, Wellman, Phillips, Dunphy-Lelii & Lalonde (2004) used data from Philips, Wellman, & Spelke's (2002) preferential looking study that assessed 32, 14-month olds' understanding that actors' intentional actions are directed by their perceptual-emotional regard. Wellman et al. (2004) followed up 18 of the original infants and tested them on Wellman and Liu's (2004) ToM scale. Their findings indicated that 14 month olds' habituation to human intentional action significantly predicted their later ToM. In the most recent of these longitudinal studies, Colonnesi, Rieffe, Koops & Perucchini (2008) displayed convergent findings. The authors examined whether *pointing gestures* and *intention understanding* at 12 and 15 months was related to later ToM performance at 39 months in 35 infants. Results indicated that infants' understanding of adult's pointing at 12 and 15 months, and understanding others' intentions at 15 months did indeed contribute to the understanding of mental states 2 years later.

Taken together these studies certainly strengthen the suggestion of a causal relationship between early social cognitive ability and later ToM understanding. This

finding is critical because, as discussed in section 1.8, the literature examining ToM in rare genetic syndromes is currently constrained by the cognitive demands of typical false belief tasks. As the evidence suggests that early social cognitive skills pave the way for later ToM understanding, the studies point to the potential that tasks assessing these early skills have for assessing the ToM development of individuals with ID who are too young or too cognitively impaired to complete traditional false belief tasks.

As outlined in section 1.11, the aim of this thesis is to address the question: *How does the development of ToM relate to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles?* Section 1.9 also outlined the potential benefits of adopting a developmental trajectory approach, particularly because it is proposed that there is not a 'single' ToM but rather a developmental succession of different accomplishments (e.g. Flavell & Miller, 1998; Gopnik et al. 1994; Gopnik & Wellman, 1992). Although a scale mapping the sequential steps of preschool ToM development has been devised and validated by Wellman and Liu (2004), there is currently no battery that maps the developmental progression of the more recently studied 'early precursor skills'. Consequently, the aim of the current chapter is to develop a scaled battery of early social cognitive 'ToM precursor' tasks suitable to study the developmental trajectory of ToM abilities in individuals with ID. This scale can then be used to examine the development of ToM in RTS, a model syndrome of interest.

3.3. Selecting Tasks for Inclusion

3.3.1. Search strategy

In order to select the tasks that would be used in the social cognition scale a literature review was conducted that examined tasks that assessed early developing, explicit social cognitive abilities. The review yielded a number of possible research studies for consideration. However, tasks to be selected were required to fit inclusion criteria in

order for them to be appropriate for a scale that would ultimately be used to assess individuals with ID. The selection criteria are outlined below.

3.3.2. Selection criteria:

- To enable tasks to be stacked in terms of developmental difficulty (and thus form a scale), studies needed to report findings that outlined an age at which infants demonstrated a particular skill/ability.
- Tasks should be interesting and engaging for typically developing individuals and individuals with an ID.
- Tasks should place minimal demands on expressive and receptive language.
- Tasks should be short in duration so the entire battery can be administered in the same day.
- Tasks should be appropriate to perform in participants' homes with limited space.
- Tasks should only require simple equipment that can be built by the experimenter and transported to participants' homes easily.
- Tasks should require a maximum of two experimenters.
- Selected tasks should aim to examine a diverse range of early social cognitive skills to enable the examination of the possibility that certain skills may be selectively preserved or impaired in atypical individuals.

3.4. Selected Tasks

The following section describes the tasks that were selected following the review of the literature. Each task is discussed with reference to its social cognitive underpinnings, original methodology and findings, and specific rationale for selection. Necessary modifications and the rationale for these modifications are also discussed. For instance, as

each task was now required to form part of a scale, to be administered to a single participant at a time, changes to the number of trials or experimental procedure was sometimes necessary so a pass/ fail scoring criteria could later be applied.

3.4.1. 'Helping'

Warneken & Tomasello (2006, 2007) developed and carried out tasks to assess helping behaviour in infants. They argued that in order to help someone, a person must possess two skills: the altruistic motivation to act on behalf of another; and the social cognitive ability to understand another person's intentions and unachieved goals. Subsequently, it was reasoned that evidence of helping behaviours in infants would therefore indicate the acquisition of these skills. Warneken & Tomasello (2006, 2007) carried out two studies to examine the age at which helping behaviour (and thus underpinning abilities) developed in infants.

The studies presented twenty four, 18 month old infants and twenty four, 14 month old infants with a set of experimental situations. In each situation an experimenter was observed to experience a problem that would require help from the infant. For instance, in one situation infants observed an examiner 'accidentally' dropping a pen and then unsuccessfully reaching for it. To ensure that each situation was actually assessing an infant's helping behaviour and not just an aim to reinstate the original situation, each experimental situation had a corresponding control task. In each control task the same basic situation was present but there was no indication that there was a problem for the experimenter. For instance, in the 'pen' control condition the experimenter threw the pen on the floor intentionally and did not attempt to reach for it. Each experimental situation and corresponding control condition used by Warneken and Tomasello (2006, 2007) is outlined in Table 4. A total of six situations were developed and each infant in the study

participated in three experimental trials and three control trials. Each task was analysed between subjects with N= 12 in each condition.

Results from the studies indicated that the 18month old infants reliably helped in all six tasks, and did so significantly more often in the experimental than the control conditions (Warneken & Tomasello, 2006). However, findings showed that the 14 month old infants only reliably helped in the 'out of reach' trials (Warneken & Tomasello, 2007). The authors concluded that, although not yet as general as at 18months, 14 months old infants possess the early social cognitive understanding of another person's intentions and goal directed action, and they demonstrate this by handing out-of reach objects to a person who requires their help.

3.4.1.1. *Selection rationale and modifications*

The specific selection of these tasks from the literature was determined not only because they fulfilled the initial selection criteria (i.e. allowing the assessment of social cognitive understanding in individuals with ID), but also because they could potentially tap other interesting differences between typical and atypical populations as well. In section 1.3 of chapter 1 it was outlined how different syndrome groups associated with ASD exhibit fractionated social profiles, and in section 2.2 of chapter 2 it was outlined how individuals with RTS can be described as 'over friendly' (Stevens et al., 2011). Given that Warneken & Tomasello's (2006, 2007) helping scenarios require an individual to possess altruistic social motivation *in addition to* social cognitive understanding, when used in the assessment of a *number* of syndrome groups, they may enable understanding of whether behavioural difference (such as fractionated social profiles) impacts upon the developmental trajectory of a fundamental skill. For instance, it may be that differences in social profiles might affect or alter the point at which these tasks are passed relative to

other tasks in the scale. In summary, the inclusion of these tasks not only allows assessment of the social cognitive development of individuals with ID but also when used to assess a number of syndrome groups with differing social profiles they could potentially provide other useful information.

Due to time constraints it would not be feasible to include all the helping situations used in the original studies by Warneken and Tomasello. Instead, the situations that evidenced helping at the youngest age (the 'out-of-reach' trials) were considered and the 'pen' and 'paper balls' trials were selected to form task one of the experimental battery. The rationale for selecting these particular tasks was twofold. Firstly, the age of attainment of the 'out-of-reach' trials fulfilled the aim of developing a battery of tasks of increasing difficulty as they fit developmentally alongside the other tasks that were being considered (the out of reach tasks were developmentally 'younger' than the other tasks being considered for the battery). Secondly, the 'pen' and 'paper balls' were specifically selected as they were the tasks that elicited the highest rate of helping behaviours in the original study.

As the control trials and experimental trials had been administered previously between infants, the procedure needed to be changed so it was suitable for within participant testing. To achieve this, the procedure was modified so that the control trials would be administered first by experimenter 1, and then the experimental trials administered separately by experimenter 2.

3.4.1.2. *Estimated age of acquisition*

The age at which the literature would suggest that typically developing infants would reliably pass this task is *14 months.*

Table 4: *Warneken & Tomasello (2006, 2007) 'Helping' tasks: experimental and corresponding control trials.*

Category	Task	Problem
Out-of-reach	**Clothespin**	**Experimental:** The experimenter used clothespins to hang towels on a line. He accidentally dropped a clothespin and unsuccessfully reached for it. To help, the infant was required to pass the clothespin to the experimenter. **Control:** The experimenter intentionally threw the clothespin on the floor and did not reach for it.
	Pen	**Experimental:** The experimenter used a pen for writing, accidentally dropped it and unsuccessfully reached for it. To help, the infant was required to pass the pen to the experimenter. **Control:** The experimenter intentionally threw the pen on the floor and did not reach for it.
	Paper Ball	**Experimental:** The experimenter sat at a table opposite the infant. The experimenter collected three balls with tongs from his side of the table and put them in a container. The experimenter then unsuccessfully reached for three balls that were on the infant's side of the table. To help, the infant was required to pass the balls to the experimenter. **Control:** The experimenter picked up each of the three paper balls and placed them back down.
Wrong Means	**Flap**	**Experimental:** While E1 was outside the room, E2 showed a box to the infant and showed the infant a side flap that could be opened to access things inside. When E1 returned he put his teacup on the box so his spoon 'accidentally' slipped through a hole in the top of the box. E1 then attempted to reach through the hole, which was too small for his hand. To help, the infant was required to access the teaspoon through the flap at the side. **Control:** The experimenter intentionally threw the spoon in the box, and then placed his hands on the box.
Wrong End	**Books**	**Experimental:** The experimenter put a stack of books next to where the infant was sat at the table. He then sat at the other end of the table and repeatedly attempted to put another book on top of the stack but kept missing so that the book landed next to the stack. To help, the infant was required to place the book on top of the stack. **Control:** The experimenter put the pile of books in front of the child, and then placed another book right next to it.
Physical Obstacle	**Cabinet**	**Experimental:** The experimenter opened the door of a cabinet, then took a pile of parcels from the side of the room and placed them inside the cabinet. He then closed the doors and fetched more parcels. On returning he tried to put them away but instead bumped into the closed doors as his hands were full. To help, the infant was required to open the door for the experimenter. **Control:** The experimenter initially put the parcels on top of the cabinet. Upon return he bumped into the doors as he tried to lift the parcels on to the cabinet top.

3.4.2. 'Seeing-is-knowing'

Effective social understanding involves the ability to understand the perception, attention and knowledge of others. An important early social cognitive skill is the ability to know what other people 'do' and 'do not know' based on what they have previously experienced. Moll & Tomasello (2007) carried out research to investigate at what age, and under what conditions, infants develop this early social cognitive understanding.

In their study, infants observed an adult experiencing two objects under one of three conditions: in the 'joint engagement' condition, the infant and adult played with the two objects together; in the 'individual engagement' condition, the infant observed the adult playing with, and manipulating the objects herself; and in the 'on-looking' condition, the infant observed the adult simply 'watching on' as they played with the object themselves. For each condition, the adult then left the room and the infants played with a third object together with an assistant while the adult was outside. After a short period the adult returned to the room and exclaimed "Ohhh look! Look at that! Can you give it to me?" The authors reasoned that if infants possess an understanding of what others 'do' or 'do not know' based on their previous experiences, then they should pass the adult the third (unexperienced) object.

Eighty four, 18 month old infants and eighty four, 14 month old infants were randomly assigned to one of the three experimental conditions. Each infant received a single trial. Moll and Tomasello's (2007) findings showed that 18 month olds reliably handed over the target item in the joint engagement condition and individual engagement condition, but not the on-looking condition. For 14 month olds, findings showed that they reliably handed the target item in *only* the joint engagement condition. The authors therefore concluded that infants register an adult's experience only under specific circumstances, and these circumstances change with age. However, importantly, the results

of the study demonstrate that by14 months, although not yet as general as 18 month olds, infants demonstrate the early social cognitive understanding of 'what others know'.

3.4.2.1. *Selection rationale and modifications*

The specific selection of this study from the literature was because the design used by Moll & Tomasello (2007) fulfilled the selection criteria and thus would enable the assessment of social cognitive understanding in individuals with ID. To fit developmentally with other tasks selected in the battery it was decided that the condition that demonstrated social cognitive understanding at the youngest age would be used- the joint engagement condition (14 months). However, as the original study assessed the *average* performance of a *group* of infants, the number of trials needed to be modified so a pass/fail scoring criteria could be applied. Modifications were made so that each infant would receive two trials of the joint engagement condition, using new materials for each trial. Modifications to the task materials were also made. In the original study, the objects included a gardening utensil, a birdcage item, and a slide rule. However, as these tasks were to be used with individuals with ID it was deemed important to change the materials so that they would be more appealing and improve the likelihood that participants would not become bored and disengage from the task. The new materials that were selected were toys that all made a different sound by being manipulated in a particular way. All were distinguishable by colour and shape, approximately the same size, and deemed equal in terms of attractiveness.

3.4.2.2. *Estimated age of acquisition*

The age at which the literature would suggest that typically developing infants would pass this task reliably is *14 months.*

3.4.3. 'Re-enactment of intended acts'

Studies have shown that infants can imitate adults' behaviour from a young age (Meltzoff & Moore, 1977, 1983, 1992). This imitation can occur on a purely physical basis, with an infant mimicking an adult's surface behaviour, without any social cognitive understanding of what the adult is intending or wanting to do. Bellagamba and Tomasello (1999) used a behavioural re-enactment procedure designed by Melztoff (1995) to demonstrate that by a certain age infants not only imitate surface behaviours, but that they *also* possess the social-cognitive understanding to interpret behaviour in terms of a person's underlying intentions and goals.

In their study, Bellagamba and Tomasello (1999) randomly assigned forty, 12-month olds and forty, 18-month olds to *one* of *four* different re-enactment conditions. In each condition there were five pairs of objects that could be manipulated to perform a target act. These were: a dumbbell that could be pulled apart to form two separate pieces; a buzzer that could be switched on using a stick; a loop that could be hung over a protruding peg; some beads that could be dropped into a cup; and a square with a hole in it that could be stacked onto a vertical peg (Figure 1). In the 'Demonstrate Target' condition infants were presented with each object pair in its initial state and then the target act was modelled by the experimenter. For example, for the loop, the experimenter picked up the loop and placed it so that it hung over the protruding peg. Following this demonstration the object was returned to its original state and placed in front of the child. In the 'Demonstrate Intention' condition the experimenter did not demonstrate the target act. Instead, the experimenter was seen 'trying' but failing to achieve the act. For example, for the loop, the experimenter repeatedly tried but failed to put the loop over the prong. The loop was released slightly too low, or too far to the left or right so that each time it fell to the table instead of being hung over the prong. For each object the experimenter modelled *the*

intention to perform the act, but not the *actual* target act. The object was then returned to its original state and placed in front of the child. In the 'Demonstrate Endstate' condition the experimenter did not explicitly demonstrate the target act. Instead, the experimenter presented each object already in its end state, then took each object behind her back and restored it to the initial state. For example, for the loop, the experimenter presented the equipment to the infant with the loop already hung over the prong. She then took the objects behind her back, returned the objects to their original state and placed in them front of the infant. Finally, in the 'Control Manipulation' condition the experimenter did not demonstrate the target act. Instead the experimenter presented the objects in their initial states and then modelled an arbitrary act. For example, for the loop, the loop was moved along the edge of the screen below the prong and then released. Therefore, the experimenter released the loop but showed no evident intention that she was attempting to place the loop over the prong. The object was returned to its original state and placed the object in front of the infant. For each object trial the infant's behaviour was coded for whether or not they performed the target act. As there were five different object trials per condition, each infant could perform up to five target acts.

It is important to note that an additional control trial was included in Meltzoff's (1995) original study that ruled out the possibility that the objects themselves held certain behavioural 'affordances' that were elicited just from seeing the objects. It was found that when infants were presented just with the objects, and no adult demonstration, the target acts were not common baseline behaviours. More specifically, the infants did not reliably produce the target acts spontaneously through chance or because the objects 'afforded' a particular response.

Bellagamba and Tomasello's (1999) findings indicated that for 12-month olds, the mean number of target acts performed between conditions differed only for the

'Demonstrate Target' condition. More specifically, the younger infants *only* imitated adult acts when they saw a *full demonstration* of the act. They did *not* perform the target act when they saw an adult *intending but failing* to perform the act or when only the end state was presented. However, for 18- month olds the findings were quite different. The mean number of target acts performed in the 'Demonstrate Target' condition and 'Demonstrate Intention' condition did not differ significantly from each other (mean number of target acts being 4.2 and 3.6 respectively) but *both* these conditions *did* differ from the 'Control Manipulation' and 'Demonstrate Endstate' conditions (2.2 and 1.4 respectively). These findings indicate that although not yet prolific in producing target behaviours when only an endstate is presented, by 18-months infants possess the social cognitive understanding to imitate an adult's intended act even when they did not see the action being conducted.

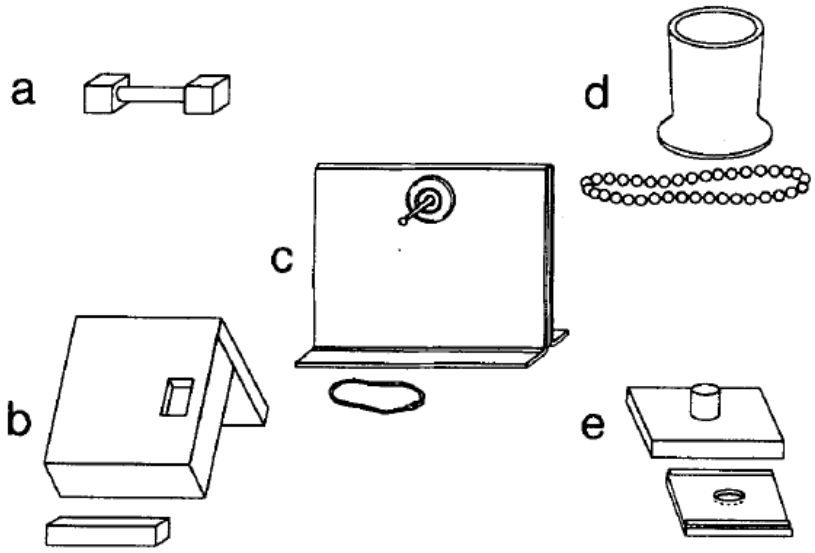


Figure 1: The five test objects used by Bellagamba and Tomasello (1999): a) dumbbell b) buzzer box and stick c) peg and loop d) beads and cup e) peg and square.

3.4.3.1. *Selection rationale and modifications*

The specific selection of this study from the literature was because the design used by Bellagamba & Tomasello (2007) fulfilled the selection criteria and thus would enable the assessment of social cognitive understanding in individuals with ID. However, due to the time constraints of administering a number of different tasks to one child in a scale, modifications to the number of conditions and trials included for this method were made. It was decided that only the 'Demonstrate Intention' condition would be included in the test battery. This was because it was felt that the control trials in previous studies had successfully ruled out other alternative explanations and it was considered that this condition was the critical condition in assessing whether an infant possessed the social cognitive understanding of intentions of this kind. To reduce test time further it was decided that only three of the object pairs needed to be used. The 'loop', 'beads with cup', and 'square with hole' were chosen due to the ease of which these object pairs could be built.

3.4.3.2. *Estimated age of acquisition*

The age at which the literature would suggest that typically developing infants would reliably pass this task is *18 months.*

3.4.4. 'Gestures'

Nonverbal point and gaze gestures are often used to direct one's attention to something of interest or relevance. However, in order to comprehend the communicative intention of a gesture one must not only be able to follow the direction of the gesture but also possess the social cognitive ability to understand that a person *intends* to direct attention. Behne, Carpenter, and Tomasello (2005) used a simple hiding game to

demonstrate the age at which infants acquire this ability. They presented twenty, 14 month old; twenty, 18 month old; and twenty, 24 month old infants with a pair of empty containers and a small toy. If the infants showed interest in the toy, the experimenter placed a screen in front of the containers and hid the toy in one of the containers saying "Look! Now I'll hide it". After hiding the toy the experimenter removed the screen and gave either a communicative point or gaze gesture to indicate where the toy was hidden. The infants were then prompted to retrieve the toy. All infants participated in four point trials and four gaze trials and the mean percentage of their correct and incorrect responses was recorded.

Results indicated differences in performance between the three age groups: the 24-month old infants showed a very high success rate on *both* the point and gaze trials; the 18-month old infants showed a very high success rate on the point trials but *less so* on the gaze trials; and the 14-month old infants made a number of errors with *both* communicative cues.

Importantly, in order to check that the infant's success was indeed due to a social cognitive understanding and not simply a result of low level attentional cueing, the authors also ran a control study. Similar 'surface behaviours' were used after the hiding procedure but these behaviours lacked *communicative intent*. More specifically, instead of a communicative gaze the adult looked at the container 'absent- mindedly'. Similarly, instead of a communicative point the adult extended her hand in the same manner as a point but instead of looking *communicatively* at the infant, stared distractively at her wrist. In this study infants' search performance did not differ significantly from chance.

Taken together these results indicate that by 18months infants have acquired the social-cognitive ability to make inferences regarding the communicative intention of

pointing gestures. Furthermore, by 24 months this ability has been extended to include the understanding of the communicative intention of gaze gestures.

3.4.4.1. *Selection rationale and modifications*

The specific selection of this study from the literature was not only because it fulfilled the initial selection criteria but also because the methodology allowed the ease of assessment of two developmentally stacked abilities (point *and* gaze understanding) in one task. Furthermore, as it has been documented that some syndrome groups with fractionated social profiles show differences in eye gaze (i.e. the gaze avoidance in FXS and prolonged eye gaze in CdLS discussed in Section 1.3 of chapter 1), it was considered that when used in the assessment of a *number* of syndrome groups, the methodology may enable us to disentangle whether behavioural difference (e.g. in eye gaze) is reflected in the developmental trajectory of these given skills. For instance, it may be that differences in social profiles might affect or alter the point at which the 'gaze' trials are passed relative to the 'point' trials as well as other tasks in the scale.

As the original study assessed the *average* performance of each *group* of infants, the number of trials each participant would receive needed to be modified so a pass/fail scoring criteria could be applied. Modifications were made so that each participant would now receive two point trials (with two corresponding control trials) and two gaze trials (with two corresponding control trials). Furthermore, as the control trials and experimental trials had previously been administered in a separate study, this procedure needed to be changed so it was suitable for within subject testing. To achieve this, the procedure was modified so that the control trials would be administered first by experimenter 1, and then the experimental trials administered separately by a different experimenter.

3.4.4.2. *Estimated age of acquisition*

The age at which the literature would suggest that typically developing infants would reliably pass these tasks is: *18 months* for pointing trials; and *24 months* for gaze trials.

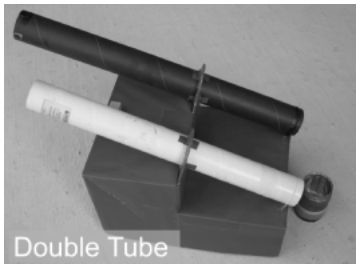
3.4.5. 'Cooperation'

In order to cooperate successfully with someone, a person must possess the social cognitive ability to share intentions with them. More specifically, they not only have to react to another's actions but they must also read the intentions of the other and incorporate them with their own intention. Warneken, Chen, and Tomasello (2006) developed a number of tasks to assess the age at which infants can successfully coordinate their actions with others in cooperative activities. The tasks required the infants to form a 'joint goal' with another and to develop joint intentions for achieving that goal. The authors discussed that having a joint goal implies commitment to a goal. Therefore, if one person reneges, the other should try and re-engage them. The presence of re-engagement attempts was therefore used by Warneken et al. (2006) as evidence that infants possessed the social cognitive understanding to form a joint goal.

The authors developed four tasks for their study, each outlined separately in Figure 2. Two of the tasks were problem solving tasks and two were social games. Each required either complementary or parallel roles.

Elevator Task *(Problem solving task with complimentary roles):* The goal of this task was to retrieve the object that was inside a vertically moveable 'elevator' tube. However, in order for a person to retrieve the object from one side (role A), another person has to push the cylinder up from the other side (role B). Due to the transparent screens of the apparatus it is impossible for a person to carry out the task on their own. In order to complete the task, both partners have to develop a joint goal and perform their actions simultaneously.

Tubes with Handles *(Problem solving task with parallel roles):* The goal of this task was to retrieve an object that was hidden inside a large tube. The tube can be opened by two people pulling it from either end simultaneously. Due to the length and size of the tube it is impossible for a person to carry out the task on their own. In order to complete the task, both partners have to develop a joint goal and perform their actions simultaneously.



Double tube task *(social game with complimentary roles):* This game involves two tubes that are mounted on a box to form two shutes. Playing the game involves one person dropping a wooden block in the top of the tube (role A), and the other person catching it at the other end (role B). Due to the nature of this game, it cannot be played alone and therefore both partners have to develop a joint goal to play the game together.

Trampoline task *(social game with parallel roles):* This game involves bouncing a wooden block up and down on a handheld trampoline. The trampoline has two joints on either side and therefore will collapse if not held by two people either side. Due to the joints in the trampoline, this game cannot be played alone and therefore both partners have to develop a joint goal to play the game together.

Figure 2: The 'cooperation' tasks designed by Warneken, Chen and Tomasello (2006).

The general procedure for each task was very similar. Each task began with a familiarisation period during which infants were shown the apparatus. A demonstration period then followed with two experimenters demonstrating how the game/task was completed. Following the demonstration period, each infant was invited to participate in

the game by the experimenter alternating his gaze between the apparatus and the infant. If the infant was successful this trial was deemed trial 1. However, if the child was not immediately successful, up to two more demonstrations, with additional cues, were given before the task was terminated. For infants that were successful in trial 1, trial 2 followed immediately and was an exact replication of trial one. Trials 3 and 4 were administered in exactly the same way except that each of these trials were characterised by an 'interruption period' where the experimenter stopped his actions for 15 seconds. For instance, in the elevator task the experimenter let the tube drop when the infant was reaching for the object (role A) or reached towards the object when the infant pushed up the tube but then withdrew his hand (role B).

In their study Warneken et al. (2006) tested sixteen, 18 month olds and sixteen, 24 month olds on all tasks twice, in two separate sessions, three days apart. For tasks with complimentary roles each infant performed each role once. All task orders and roles were counterbalanced across infants. To code infants' performance, each trial received one score on a rating scale that assessed the infant's level of coordination. For interruption periods the infant's behaviour was coded for whether they made re-engagement attempts, waited for the experimenter to continue, made individual attempts, or disengaged from the game. The authors then examined: the age difference in infants' level of overall coordination and the age difference in infants' behaviour during the interruption periods. Analysis of the interruption periods across tasks revealed that re-engagement attempts occurred in both groups with only a tendency to increase with age. However, in three out of four of the tasks (elevator task, tubes with handles task and double tubes task) children at 24 months coordinated their actions with that of a partner more skilfully than 18 month olds. Only the trampoline task failed to elicit differences between ages. For this task, infants of both ages

displayed low levels of engagement with play consisting of passive play and / or frequent stopping.

Based on the above findings, the authors concluded that at both ages infants comprehended their own and their partner's actions as interconnected parts of a joint activity towards a joint goal. However, they argued that it was not until 24 months old that infants demonstrated the ability to coordinate their actions successfully enough to reliably execute a joint intention towards a joint goal.

3.4.5.1. *Selection rationale and modifications*

Due to time constraints it was decided that only the 'Tubes with handles' and the 'Trampoline' tasks would be selected to form part of the battery. The specific rationale for selecting these two tasks was that both tasks required complementary rather than parallel roles and therefore would reduce administration time. The fact that the trampoline task was shown not to be successfully acquired by either 18 month olds or 24 month olds was considered during the selection process. However, in a similar manner to the helping task outlined in section 3.4.1.1, due to the inherently 'social' nature of 'play' it was felt that the inclusion of the cooperative social game might tap interesting differences between populations with fractionated social profiles. More specifically, it is possible that performance on this task (and subsequent developmental positioning) may be different for more 'sociable' populations. Including this task allows examination of whether behavioural difference may alter the developmental trajectory and the point at which this task is passed relative to others in the scale.

3.4.5.2. *Estimated age of acquisition*

The age at which the literature would suggest that typically developing infants would reliably pass these tasks is: *24 months* for the 'Tubes with Handles' trial; and *>24 months* for 'Trampoline' trial.

3.5. The Experimental Scale

The studies described above outline the ages at which infants have been found to possess the social cognitive abilities necessary to successfully complete a range of different tasks. By arranging these tasks in terms of increasing age (as depicted in Figure 3) we can gain some insight into how these skills may be developmentally ordered and therefore propose a preliminary developmental scale to be tested.

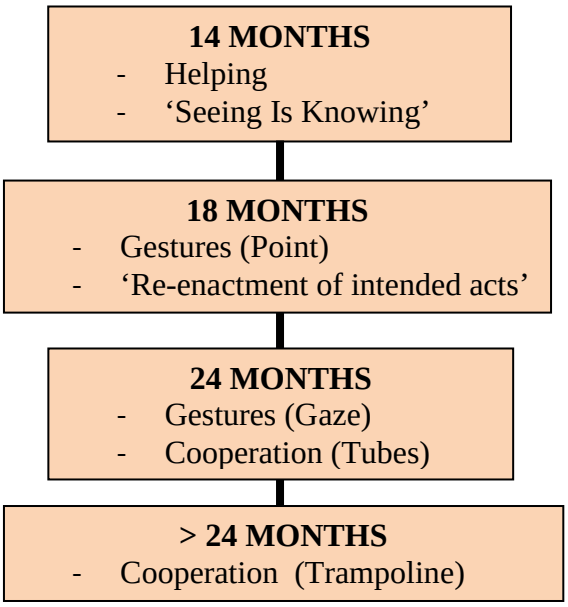


Figure 3: Preliminary social cognition scale

3.6. Summary

At present there is no scaled task battery that enables the measurement of social cognitive development in individuals with ID who are too young or cognitively impaired to pass standard false belief tasks. This chapter has outlined the background, rationale and selection process used to compile a selection of tasks that will be scaled to map the developmental progression of early social cognitive skills in typical development. In turn, this will provide an invaluable normative measure from which to compare individuals with genetic syndromes, developmental disorders and ID.

Running Head: Validating the Social Cognition Scale

CHAPTER FOUR

VALIDATING THE SOCIAL COGNITION SCALE: A NORMATIVE DATASET.

4.1. Preface

Chapter 1 highlighted how, at present, most studies examining ToM in genetic syndromes typically compare the performance of a single standard false belief task to the performance of matched controls, finding the sample either comparatively delayed or atypical. However, it was argued that such methods provide relatively limited information with no insight into the developmental pathway or causal mechanisms that occur prior to, or following false belief understanding. The chapter outlined a rationale for moving away from the traditional methodology used to investigate the cognitive abilities/ deficits in genetic syndromes and towards a developmental trajectory approach. The application of this methodology for studying ToM in atypical populations was demonstrated by Peterson, Wellman and Liu (2005) in their study utilising Wellman and Liu's (2004) ToM scale to examine the developmental progression of ToM in late signing deaf children and individuals with autism.

However, it was argued that despite the advantages of Wellman and Liu's (2004) scale, the tasks included in the scale loaded heavily on cognitive processes therefore making them unsuitable for individuals with ID who were too young or too cognitively impaired to meet these general cognitive demands. Consequently, chapter 3 outlined the development of a preliminary scale that was designed to enable a developmental trajectory approach to be applied to the measurement of social cognitive development in younger and less able individuals with ID. The scale incorporated a set of tasks that assessed early social cognitive skills that are considered 'precursors' to fully fledged ToM. Based on findings from the developmental literature, tasks included in the scale were predicted to be of increasing difficulty and thus were hypothesised to form a progressive developmental scale.

4.2. Aims

The current chapter aims to test the hypothesis that the tasks selected in chapter 3 would be of increasing difficulty and thus form a progressive developmental scale. The scale is validated by examining the performance of a group of typically developing infants on each task and assessing whether they pass the tasks in a scaled series of progressive accomplishments.

4.3. Method

4.3.1. Recruitment

Infants were recruited from 13 private nurseries schools from across Birmingham and the surrounding local area. Local nurseries were sent a letter describing the nature of the study (Appendix E) and then telephoned to enquire if they would like to participate. The recruited nurseries then distributed opt out consent forms to parents (Appendix F).

4.3.2. Participants

Ninety eight infants were recruited into the study. However, 12 infants were not tested due to an inability to settle with the experimenters (mean age = 21 months, range = 14 months – 25 months). Therefore, eighty- six infants were tested on the battery of tasks (mean age = 22 months, range = 14 months – 34 months). Figure 4 demonstrates the distribution of ages for the infants recruited. Nursery leaders were consulted to ensure that all infants were considered to be of typical development with no known developmental disorder or difficulties.

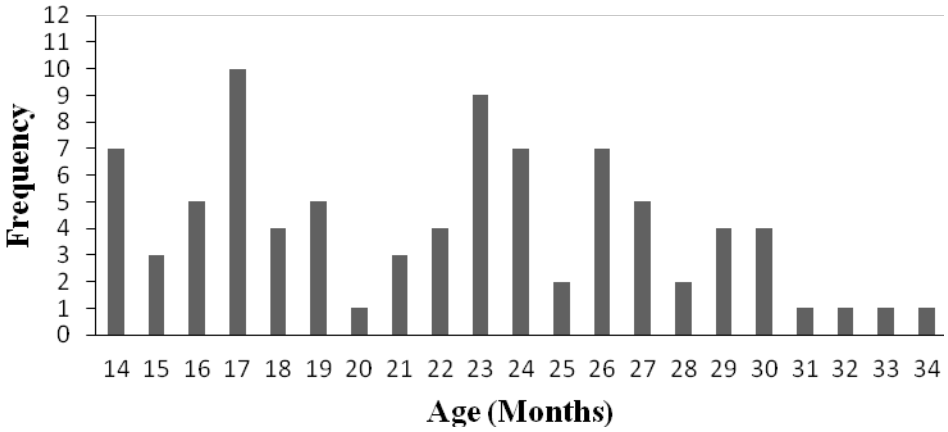


Figure 4: The distribution of ages across the infants recruited.

To enable later analyses, order was imposed on the continuous range of ages. As the subsequent research question aimed to test for age-related change rather than for changes at particular ages, the sample was split into bands of equal size rather than by age. Splitting groups into equal size avoids the potential for smaller groups to have their mean disproportionally inflated or deflated by a few individuals. A similar methodology was adopted by Wellman and Liu (2004). Age band one contained 29 infants aged between 14 and 18 months (mean = 16.03 months; 13 females and 16 males); age band two contained 29 infants aged between 19 and 24 months (mean = 22.10 months; 17 females and 12 males); and age band three contained 28 infants aged between 25 and 34 months (mean = 28.18 months; 10 females and 18 males). Infants were predominately White British, but approximately 10 % of infants were of other ethnicities.

4.3.3. Procedure

Infants were tested in a quiet room in their nursery. Before each experimental session the experimenters conducted a 'warm up phase' and played with each infant for around 10 to 15 minutes. This was to ensure that infants felt comfortable with the experimenters before testing began. Each infant was tested on all tasks in the experimental battery which were presented in one of four orders (outlined in Table 5). Each order began

with two tasks deemed particularly engaging. This was to encourage the infant to feel comfortable and to avoid early frustration. The experimental battery was administered over two separate test sessions to ensure that infants did not become tired. All infants completed the two sessions on the same day.

Table 5: *Orders for task administration*

Order 1	**Order 2**	**Order 3**	**Order 4**
'Seeing-is-knowing' (1)	'Cooperation' Trampoline	'Seeing is Knowing' (1)	'Cooperation' Tubes
'Cooperation' Tubes	'Seeing-is-knowing' (1)	'Cooperation': Trampoline	'Seeing-is-knowing' (1)
'Helping' (Control)	'Helping' (Control)	'Gestures' (Point & Gaze)	'Re-enactment of intended acts'
'Re-enactment of intended acts'	'Cooperation': Tubes	Helping – Control	'Helping' (Control)
	SESSION	***BREAK***	
'Seeing-is-knowing' (2)	'Helping' (Experimental)	'Seeing is Knowing' (2)	'Gestures' (Point & Gaze)
'Cooperation': Trampoline	'Re-enactment of intended acts'	'Cooperation' Tubes	'Seeing-is-knowing' (2)
'Gestures' (Point & Gaze)	'Gestures' (Point & Gaze)	'Helping' (Experimental)	'Cooperation' Trampoline
'Helping' (Experimental)	'Seeing-is-knowing' (2)	'Re-enactment of intended acts'	'Helping' (Experimental)

4.3.4. Coding

As outlined in chapter 3, each task was selected as the age of acquisition suggested that, when examined together, they would form a scale of increasing difficulty. However, to analyse whether these tasks did indeed form a series of progressive accomplishments, it was essential that infants' performance on each task could be coded as either 'pass' or 'fail'. Consequently, a pass/fail coding criterion was applied to each task. The coding

criterion and rationale is outlined below for each measure. As experimenters were not permitted to video record, coding was conducted live. As outlined below, the vast majority of coding was very simple (i.e. whether the infant performed a target behaviour or not). However, for tasks that required slightly more subjective coding (i.e. level of cooperation in cooperation tasks), the two experimenters made a joint coding decision following a short discussion.

4.3.5. Measures

4.3.5.1. *'Helping'*

To 'help' someone, one must possess the social cognitive ability to understand another person's intentions and unachieved goals (Warneken & Tomasello, 2006, 2007). This task enables the assessment of this social cognitive skill. To ensure infants' responses indicated their motivation to help the experimenter, rather than a desire to reinstate the original situation or get the adult to repeat the action, infants received two corresponding control trials *before* the two experimental trials. In these trials the same basic situation was present but there was no indication that there was a problem for the experimenter. Control trials were administered first because it was felt that a previous experience of someone requiring help in a very similar situation could potentially prime the same response even if help was not required. To further avoid possible 'carry over effects' from the control to the experimental conditions, the experimental and control trials were administered over two separate testing sessions and by different experimenters.

4.3.5.1.1. *Control trials*

Following a short warm up period infants were sat at a table opposite experimenter one (E1). For the 'pen' condition, E1 was seen to use a pen for drawing. The experimenter then stopped drawing, put the lid on the pen, intentionally threw it on the floor and did not

reach for it. For the 'paper balls' condition, E1 set up three paper balls on her side of the table and three paper balls on the infant's side of the table. The experimenter then sat back down and picked up each of the paper balls 'one-by-one' using a pair on tongs and then placed them back on the table.

4.3.5.1.2. *Experimental trials*

For the 'pen' condition, experimenter two (E2) was seen to use a pen for drawing, she then 'accidentally' dropped the pen on the floor and unsuccessfully reached for it. For the 'paper balls' condition, E2 picked up each paper ball with a pair of tongs and placed them in a cardboard container. She then attempted to reach for the three papers balls on the infant's side of the table but failed because they were too far away.

4.3.5.1.3. *Coding*

In each trial, infants' behaviour was coded for whether or not they performed the required *target* behaviour. For the pen trial this involved the infant passing the pen back to the experimenter. For the paper balls trial, it involved the infant passing or pushing the paper balls towards the experimenter. To control for the possibility that the infant may have collected the object primarily for themselves, rather than to help the experimenter, each infant's behaviour was also coded for whether or not they took *possession* of the object before handing it over. More specifically, it was noted whether or not the experimenter was reaching for the object while the infant kept it in their hands - creating a situation that resembled a 'handover' rather than 'helping'.

4.3.5.1.4. *Pass/ fail criterion and rationale*

Infants were coded as having 'passed' the helping task if they successfully demonstrated one of the target behaviours. This was considered appropriate as unlike some of the other tasks included in the scale, 'helping' behaviour was considered unlikely to occur by chance. Therefore one demonstration was deemed sufficient to indicate that the infant had acquired the skill and passed the task.

4.3.5.2. *'Seeing-is-knowing'*

An important social cognitive skill is the ability to know what other people 'do' and 'do not' *know* based on what they have previously experienced. This task enables the assessment of an infant's social cognitive ability to understand the perception, attention and knowledge of others. For this task each infant first received a pre-test to ensure that they could understand what was to be asked of them in the subsequent experimental trials. The infants then received two experimental trials that were administered over two separate testing sessions. Each trial involved the same experimental procedure but different toys were used.

4.3.5.2.1. *Pre-test*

In the pre-test the infant sat at a table with two experimenters and played with a ball, a teddy bear and a toy car one at a time for 30 seconds each. E2 then placed each toy on a tray and held it out in front of the infant. E1 then requested the infant to pass each toy successively by name. To pass the pre-test each infant had to successfully pass at least one of the first two toys requested by the experimenter.

4.3.5.2.2. *Experimental trials*

In each trial the infant sat at a table with two experimenters. E2 began the trial by bringing out the first toy, handing it to E1, and saying "Look what I've got here". E1 and the infant then played with the toy together for 60 seconds. During this time E1 showed the infant that the toy could make an interesting sound if you handled it a particular way. The experimenter also made comments during the play such as "Oh look at that", "That's exciting" and "How nice!" Following the 60 seconds play, E2 took the object and placed it on a tray saying "I'll put this here now". E2 then brought out a second toy and the procedure was repeated. After play with the second toy had finished and E2 had placed it on the tray, E1 announced that she was leaving "I am going outside now – bye bye" and left the room. After E1 had left, E2 then looked at the infant and said "E2 is outside, she can't see us, but we'll keep playing anyway". E2 then brought out the third and final (target) toy and played with the infant for 60 seconds. After 60 seconds E2 placed the toy on the tray along with the other two toys saying "I'll put this here now". At this point E1 returned to the room and exclaimed "Oh look, look at that! Wow! Look at that!" pointing in the general direction of the tray which E2 then held towards the infant. E1 then added "Wow...Can you pass it to me?" with an outstretched hand pointed in the general direction of the tray. E1 was allowed to repeat this request up to five times if necessary, during this time E1 did not look directly at the target object but looked only at the infant or the general direction of the tray.

4.3.5.2.3. *Materials*

The materials in each trial consisted of toys that were easily distinguishable by colour and shape. All toys were of similar size and made a sound or action when manipulated in a particular way. In trial one the toys used were: a tambourine with a

mirror on the back, a maraca, and the target item was a yellow block with a button on the top which when pressed opened a door on the side of the block. For trial two the toys used were: a soft snail rattle with a stretchy tail and ears, a water filled jelly car with sparkles that moved when shaken, and the target item was a blue block with a button on the top which when pressed made a butterfly and bee spin around.

4.3.5.2.4. *Coding*

For each trial each infant's behaviour was coded for whether or not they passed the target item.

4.3.5.2.5. *Pass/ fail criterion*

Infants were coded as having passed the task if they successfully passed the correct target item in *both* experimental trials. This pass/fail criterion was deemed necessary to reduce the possibility that infants might 'pass' the task simply by selecting the correct item by chance. It was considered much less likely that infants would select the correct item by chance on *two* consecutive experimental trials.

4.3.5.3. *'Re-enactment of intended acts'*

Infants can imitate an adult's behaviour on a purely physical basis, without social cognitive understanding (Meltzoff, 1988). In contrast, this task assesses an infant's social cognitive ability to interpret a person's behaviour in terms of their underlying intentions and goals when they try but fail to undertake an action. For this task infants were sat at a table opposite the experimenter. Three experimental trials were administered to each infant and all followed the same procedure. For each trial the experimenter presented the infant with an object pair that could be used to perform a target act– a loop that could be hung

over a protruding peg, some beads that could be dropped into a cup, or a square with a hole in it that could be stacked upon a protruding peg. For each trial the experimenter modelled the intention to perform the target act but ultimately failed to perform the act.

For the loop and peg, the experimenter picked up the loop and moved her hand towards the peg but released it inappropriately each time so that instead of hanging over the peg, the loop 'accidentally' fell to the table. Initially the loop was released slightly too far to the left, then too far to the right and then too low.

For the beads and cup, the experimenter picked up the beads and attempted to drop them into the cup but released them inappropriately each time so that they 'accidentally' fell to the table instead. Initially the beads were lowered just so that they touched the lip of the cup but then released so that they fell to the side. On the next attempt the beads were suspended too far in front of the cup and so fell to the table when released. On the final attempt the experimenter gathered the beads loosely in her hand but then scraped her hand over the top of the cup so that the beads fell to the side rather than inside the cup.

For the square and protruding peg the experimenter picked up the square and attempted to place it upon the peg, however each time the experimenter failed to align it correctly so that it 'accidentally' overshot the peg. Initially the square overshot to the right, then to the left and finally to the front.

After the experimenter had demonstrated the three failed attempts she offered the object pair to the infant. During the experimental procedure the experimenter did not provide the infant with any prompts or cues , however the experimenter gained the infant's attention by saying " Oh, look what I have here" , What's this?" and "Now it's your turn".

4.3.5.3.1. *Coding*

For each trial infant's behaviour was coded for whether or not they went on to perform the target act themselves: for the loop and peg this involved them hanging the loop over the protruding peg; for the beads and cup this involved them dropping the beads inside the cup; and for the square and peg this involved them stacking the square over the protruding peg.

4.3.5.3.2. *Pass/ fail criterion*

Infants were coded as having passed the task if they successfully performed the target act in *two or more of the three trials*. This pass/fail criterion was deemed necessary to reduce the possibility that infants might 'pass' one trial simply by chance or because the apparatus 'afforded' a particular response from that infant. It was decided that two or more target acts were less likely to occur 'just by chance' and therefore it was deemed that this provided sufficient evidence that the infant possessed the social cognitive skill.

4.3.5.4. ***'Gestures' (point and gaze)***

In order to comprehend the communicative intention of gestures one must not only be able to follow the direction of the gesture but also possess the social cognitive ability to understand that a person *intends* to direct attention. The following task enabled the assessment of this social cognitive skill. Although the developmental literature proposes that infants comprehend the communicative intent of 'points' before they comprehend 'gaze' (Behne, Carpenter & Tomasello, 2005), due to the identical experimental procedures used to assess these communicative cues, trials for both cues were administered together in one procedure.

4.3.5.4.1. *Warm up phase*

Before the task began each infant took part in a warm up phase. This was to familiarise them with the hiding procedure and the containers used. Infants were sat at a table next to E2 and across a table from E1. E1 placed a pair of open containers in front of the infant and then brought out a small toy. E1 then announced "Look, I'll hide it". As the infant watched, E1 placed the toy in one of the containers and then placed the lids on both. E2 then encouraged the infant to retrieve the toy by saying "Where's the toy?" and "Can you get the toy?" This warm up hiding procedure was repeated three times with three different sets of containers.

4.3.5.4.2. *Control trials*

Following the warm up phase each infant participated in four control trials. These control trials were administered to check that search performance was indicative of understanding the experimenter's intentions and not simply due to low level attentional cueing. For each control trial E1 placed a pair of open containers on the table then produced a small toy. If the infant showed interest in the toy E1 then placed a movable screen in front of the two containers, lowered the toy behind the screen and said 'Now I'll hide it'. At this point E1 then quickly pushed the containers together, hid the toy in one, and then moved them apart again. The distance between each container ensured that the infant could not grab both containers at the same time. Following the hiding procedure E1 removed the screen and gave one of two non-communicative control cues:

- ***Control Point*** **-** E1 performed a 'distracted point' by holding out her hand and slightly extending her index finger. E1 simply looked down at her hand with an expression that indicated she was preoccupied by something on her hand.

- ***Control Gaze*** **-** E1 gazed at the container with an absent minded facial expression, eyes unfocussed and a neutral facial expression.

Following each non communicative cue E2 then encouraged the infant to retrieve the toy by saying "Where's the toy?" and "Can you get the toy?" Each infant received two control gaze trials and two control point trials which were presented in one of four different counterbalanced orders.

4.3.5.4.3. *Experimental trials*

After the control trials had been completed the experimenters moved positions so that E2 was sat opposite the infant and E1 was knelt at the side of the table midway between E2 and the infant. The four experimental trials then followed. As before, for each trial E1 placed a pair of containers in front of the infant and produced a toy. If the infant showed interest in the toy E1 then placed a movable screen in front of the two containers, lowered the toy behind the screen and said 'Now I'll hide it'. During this hiding procedure E2 showed the infant that she was watching by alternating her gaze between the containers and the infant then announcing "I can see". After the hiding had been completed E1 pushed the containers apart and removed the screen. E1 then turned away from the table in order to place the screen behind her. At this point, while E1 was not looking, E2 established eye contact with the infant and gave one of two communicative gestures:

- ***Point*** **-** E2 extended her index finger and pointed at the container expressing intent through raised eyebrows.

- ***Ostensive Gaze*** **-** E2 gazed at the target container and then back to the infant expressing intent through raised eyebrows.

Following each communicative cue E1 then turned back to the table and encouraged the infant to retrieve the toy by saying "Where's the toy?" and "Can you get the toy?". Each infant received two gaze trials and two point trials which were presented in one of four different counterbalanced orders.

To minimize the possibility of perseveration errors being made, each pair of containers were different in both colour and shape and the same pair were never used on successive trials. For each trial, if the infant attempted to open a container but could not quite manage to, then one of the experimenters assisted the infant. Furthermore, if the infant chose the incorrect box and did not find the toy, then the experimenters opened the correct box and gave the toy to the infant. This was done to ensure that the infant did not become frustrated and disengage from the task.

4.3.5.4.4. *Coding*

For each trial the box that the infant first selected and attempted to open was recorded. If the infant selected the container that the toy was hidden in this was coded as correct. If the infant selected the container without the toy this was coded as incorrect.

4.3.5.4.5. *Pass/ fail criterion*

Infants were coded as having passed the point trials if they successfully chose both of the correct containers following each point gesture. Similarly, infants were coded as having passed the gaze trials if they successfully chose both the correct containers following each gaze gesture. This pass/fail criterion was deemed necessary to reduce the

possibility that infants might 'pass' the task simply by selecting the correct location by chance. It was considered much less likely that infants would select the correct location by chance on *two* consecutive experimental trials.

4.3.5.5. *'Cooperation' (tubes with handles and trampoline)*

In order to cooperate successfully with someone a person must possess the social cognitive ability to read the intentions of another and incorporate them with their own intention. The following two tasks assess this social cognitive ability by testing infant's ability to form a '*joint goal*' with another. A joint goal implies commitment to a goal and thus if one person reneges then the other should try and re-engage them. The following tasks utilize the presence/absence of reengagement attempts to assess infant's social cognitive understanding.

4.3.5.5.1. *Tubes with handles*

In the 'tubes with handles' task the infant's goal was to retrieve a toy that had been hidden inside a tube. This tube could be pulled apart by pulling the handles on each end of the tube. However, the length of the tube made it impossible for the infant to perform this goal alone and therefore to be successful the infant was required to 'work together' and cooperate with the experimenter. For each infant, the experimental procedure included a number of steps.

- ***Familiarisation and demonstration:*** The task began with a brief familiarisation period in which the infant was shown the tube and encouraged to hold each of the handles. After the infant was familiar with the apparatus, E1 and E2 pulled the tube apart and E1 placed an attractive object inside. The two experimenters pushed the tube back together and placed it on the floor. E1 and E2 then proceeded to demonstrate how the toy could be retrieved by each of them pulling the handles at each end. Following this demonstration E1

produced another attractive object and placed it inside the tube as before, then pushed it back together with E2.

•***Experimental trial one:*** Following the familiarisation and demonstration period E1 invited the infant's participation by alternating gaze between the infant and the tube. If the infant was immediately successful and cooperated with the experimenter to open the tube then trial 2 was administered. However, if the infant was not successful within 30 seconds E1 and E2 carried out the demonstration phase again. Following the second demonstration the infant was encouraged to participate again this time using verbal cues such as "Come and try" and "Look, tube!" If the infant was still unsuccessful the demonstration was repeated for a third time but this time E2 also encouraged the infant to stand by her and hold the handle together with her. If the infant was unsuccessful after three demonstrations the task was discontinued.

•***Experimental trial two:*** Following trial one, E1 produced another toy and placed it inside the tubes as before. The infant's participation was then prompted by E1. Once the object was retrieved trial 3 was administered. If the infant was not successful after 60 seconds then the task was discontinued.

•***Experimental trial three:*** Following trial two, E1 produced another toy and placed it inside the tube, as before. The infant's participation was once again prompted by E1. However, in this trial, unlike trials one and two, when the infant picked up their side of the tube E1 dropped her side of the tube and placed her hands and face downwards for an interruption period of 15 seconds. Following the interruption period E1 looked back up, picked up the tube and continued as before. If the infant had disengaged E1 prompted the infant's participation to continue. After the infant had retrieved the object trial four was administered.

•***Experimental trial three:*** The procedure for trial three was repeated.

4.3.5.5.2. *Trampoline*

The procedure for the 'trampoline' task was very similar to the 'tubes with handles' task. However, in this task the infant's goal was to bounce a wooden block up and down on a handheld trampoline. Importantly, due to joints on the side of the trampoline if two people did not hold it at the same time it would collapse. Therefore to be successful on this task the infant was required to 'work together' and cooperate with the experimenter. For each infant the experimental procedure included a number of steps.

- ***Familiarisation and demonstration:*** The task began with a brief familiarisation period where the infant was shown the trampoline and encouraged to hold it on each side. After the infant was familiar with the apparatus E1 and E2 demonstrated how a wooden block could be made to bounce up and down by shaking the trampoline at the rim.

- ***Experimental trial one:*** Following the demonstration period E1 invited the infant's participation by alternating gaze between the infant and the trampoline. If the infant was immediately successful and cooperated with the experimenter to bounce the block on the trampoline then trial 2 was administered. However, if the infant was not successful within 30 seconds E1 and E2 carried out the demonstration phase again. Following the second demonstration the infant was encouraged to participate again this time using verbal cues such as "Come and try" and "Look, trampoline!" If the infant was still unsuccessful the demonstration was repeated for a third but this time E2 also encouraged the infant to stand by her and hold the trampoline together with her. If the infant was unsuccessful after three demonstrations the task was discontinued.

- ***Experimental trial two:*** Following trial one, E1 briefly removed the wooden block then after a short period placed it back on the trampoline and invited the infant's participation again. After 5 seconds of play, trial 3 was administered. If the infant was not successful after 60seconds then the task was discontinued.

• ***Experimental trial three:*** Following trial two, E1 briefly removed the wooden block then after a short period placed it back on the trampoline. The infant's participation was once again prompted by E1. However, in this trial, unlike trials one and two, when the infant picked up their side of the trampoline E1 dropped her side and placed her hands and face downwards for an interruption period of 15 seconds. Following the interruption period E1 looked back up, picked up her side, and continued as before. If the infant had disengaged, E1 prompted the infant's participation to continue. After 5 seconds of play trial four was administered.

• ***Experimental trial four:*** The procedure for trial three was repeated.

4.3.5.5.3. *Coding*

The same coding schema used by Warneken and Tomasello (2006, 2007) was used to code infant's behaviour. For each trial of the 'Tubes with handles' task and 'Trampoline' task infant's behaviour was coded according to their level of coordination (Table 6). Infant's behaviour during each interruption period was also coded (Table 7).

Table 6*: Coding schema for level of coordination.*

Category	Definition
Tube with handles	
No success	Tube is not being opened
Uncoordinated	Success after more than 5 seconds of inappropriate actions such as standing on wrong side, letting tube drop more than once, individual play, or individual attempts
Coordinated	Success, but some inappropriate actions, but not for more than 5 seconds; releasing handle not more than once
Very coordinated	Success after immediate understanding of their role. Infant positions herself in correct location and performs the correct action without any mistakes.
Trampoline	
No success	Infant does not hold and lift trampoline
Low engagement	Joint play but lots of stopping and not too excited. Infant needs a lot of persuasion.
Medium engagement	Some stopping or not too excited
High engagement	Continuous play and rather excited (placing block on trampoline; initiating play; active shaking)

Table 7: *Coding schema for behaviour during interruption periods*

Category	Definition
Disengagement	Infant leaves apparatus or plays on apparatus without pursuing the goal by banging on the apparatus, climbing on it, etc
Individual attempt	Infant attempts to retrieve the object individually in problem solving tasks (infant attempts to hold both handles or peel it open on one side) or attempts to continue the game alone.
Waiting	Infant remains on correct side of the apparatus and is ready to perform their role.
Reengagement	Infant is ready to perform their role and in addition tries to re-engage E1, for example, by pushing the tube, pointing at the object and vocalising while looking at the partner.

4.3.5.5.4. *Pass/ fail criterion and rationale*

For each infant a median cooperation score was calculated across the administered trials. In each trial 'no success' received a score of zero, 'uncoordinated'/ 'low engagement' received a score of one, 'coordinated'/ 'medium' engagement received a score of two, and 'very coordinated'/ 'high engagement' received a score of three. Infants were coded as having passed the 'tubes with handles' task if they showed at least one re-engagement attempt during interruption periods *and* their median cooperation score was three. Similarly, infants were coded as having passed the 'trampoline' task if they made at least one re-engagement attempt during interruption trials *and* their median score three. These criteria were decided upon for two reasons. Firstly, as highlighted in the previous literature the re-engagement attempt provided the indication that the infants possessed the social cognitive understanding to form a joint goal. Secondly, in the original experimental study it was not until 24 months, with the tubes with handles task, and later, with the trampoline task, that infants were able to coordinate their actions skilfully enough to execute a joint intention reliably towards a joint goal. A median cooperation score of three was decided upon as this represented 'skilful and reliable coordination' and would therefore be in line with the ages of developmental accomplishments noted in the original literature.

4.4. Results

4.4.1. Analysis of control trials

Although the main analysis involved examining whether the administered tasks formed a progressive developmental scale, two tasks had corresponding control trials to check for alternative explanations for behaviour. These control trials were examined to ensure that the tasks were working, at a group level, as expected.

4.4.1.1. *'Helping' control trials*

For each helping trial there was a corresponding control trial in which the same basic situation was present but there was no indication that help was required. Results indicated that, out of the 76 infants that handed over an item during the experimental trials, only three also handed over an item in the control trials. Therefore, it was judged that the task was working as expected, infants were 'helping' rather than merely trying to reinstate the original situation or to get the adult to repeat the action. Furthermore, in order to ensure that infants were not collecting the object primarily for themselves rather than to help the experimenter, each infant's behaviour was also coded for whether or not they took possession of the object before handing it over. The results indicated that out of the 76 infants that handed over an item during the experimental trials, only two infants took possession of the item before handing it over. Therefore, it was judged that the task was working as expected and the infants were indeed 'helping' the adult rather than collecting the object primarily for themselves.

4.4.1.2. *'Gesture' control trials*

To ensure that successful performance on this task was not due to low level attentional cueing, the control trials were analysed for the infants that passed the task (successful on 2/2 searches). Paired t tests were conducted to compare the number of correct vs. incorrect searches for both control cues. Results indicated that search performance did not differ significantly from chance for either cue type. ['Control Point': $t(57) = .622$, $p=.54$; 'Control Gaze': $t(36) = .466$; $p=.64$]. Therefore, it was judged that the infants passing this task were passing due to their understanding of intentions rather than due to low level cueing.

4.4.2. Overall task performance

Table 8: *The percentage of infants that passed each task in the battery.*

Task	Expected developmental age	Pass rate
'Helping'	14 months	88%
'Gestures' (Point)	18 months	67%
'Re-enactment of intended acts'	18 months	63%
'Gestures' (Gaze)	24 months	43%
'Cooperation' (Tubes)	24 months	37%
'Seeing-is-knowing'	14 months	36%
'Cooperation' (Trampoline)	> 24 months	22%

Table 8 is ordered from the easiest task (highest percentage of infants passing) to the hardest task (lowest percentage) and therefore outlines a progressive sequence. A comparison between this sequence, and the preliminary sequence suggested in chapter 3, indicates that all tasks –except for the 'seeing-is-knowing' task - follow the hypothesised developmental progression. According to the literature the 'seeing-is-knowing' task should have been one of the easiest tasks, but instead (based on the proportions of infants passing the task) it would appear to be one of the hardest.

As noted in chapter 3, modifications were made to this task in attempt to make it more appealing for individuals with ID for later testing. However, following testing it appeared that altering the task materials may have affected performance. More specifically, based on infants' reactions during testing it was thought that some of the toys used in the two trials may have been too appealing and subsequently caused infants to become too excited and distracted. For example, for some toys infants appeared reluctant

to hand them back or attempted to reach for them again after another toy had been presented. Because it was unclear exactly what caused this task to be so much harder than originally expected it was removed from the subsequent scaling analyses.

To explore differences in performance across age bands an initial one way analysis of variance (ANOVA) was conducted. Each infant was given a total score representing the number of tasks that they passed in the scale (out of a possible six). Analysis revealed a significant main effect of age on the number of tasks passed, $F(2,83) = 19.759$, $p < 0.001$. Tukey post hoc analyses revealed significant differences between each age band. Infants in age band one ($M = 2.10$, $SD = 1.47$) passed significantly fewer tasks than infants in age band two ($M = 3.03$, $SD = 1.30$), $p=0.032$. Furthermore, infants in age band two passed significantly fewer tasks than infants in age band three ($M = 4.39$, $SD = 1.37$), $p=0.001$. Therefore, with increasing age infants passed more tasks.

4.4.2.1. *Individual pairwise task comparisons: McNemar's*

The proportions displayed in Table 8 appear to indicate that the tasks form a progressive scale of increasing difficulty. However, from these percentages alone it is not possible to ascertain whether the tasks do in indeed follow a reliable scale. To investigate whether the ordered tasks reliably followed a general progression, initial analysis used a series of paired task sequences. McNemar's tests with Yate's correction for continuity were conducted between each pair of tasks, increasing in difficulty, as ordered in Table 8. Furthermore, given that two of the pairs of tasks ('Point' *and* 'Re-enactment of intended acts; and 'Gaze' *and* 'Tubes') were estimated in the original literature to be of equal difficulty, additional comparisons were made between the tasks either side that spanned different age brackets but had not already been compared. Therefore, in total, eight pairwise comparisons were made- as outlined in Figure 5.

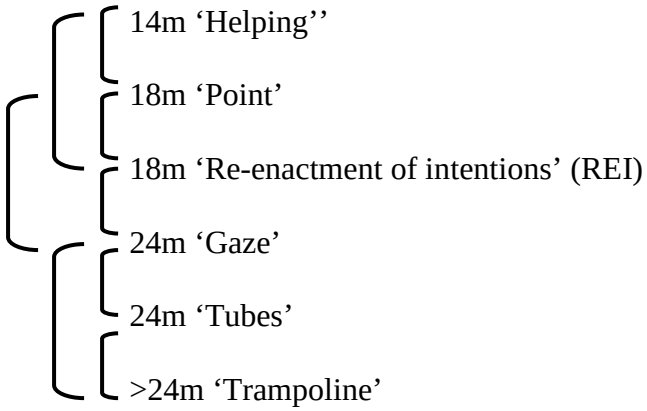


Figure 5 – McNemar pairwise comparisons.

As multiple comparisons were being conducted, Bonferroni-Holm corrections were used to control for family wise error. As displayed in Figure 6, results indicated significant pairwise differences between the ‘helping’ task and ‘point’ task (McNemar’s χ^2 (1) = 12.04, p<.01); the ‘helping’ task and ‘REI’ task (McNemar’s χ^2 (1) = 15.75, p<.01) the ‘point’ task and ‘gaze’ task, (McNemar’s χ^2 (1) = 11.43, p<.01); the ‘gaze’ task and ‘trampoline’ task (McNemar’s χ^2 (1) = 9.03, p<0.05); the ‘REI’ task and the ‘gaze’ task, (McNemar’s χ^2 (1) = 7.76, p<.05); and the ‘tubes’ task and the ‘trampoline’ task (McNemar’s χ^2 (1) = 6.26, p<.05).

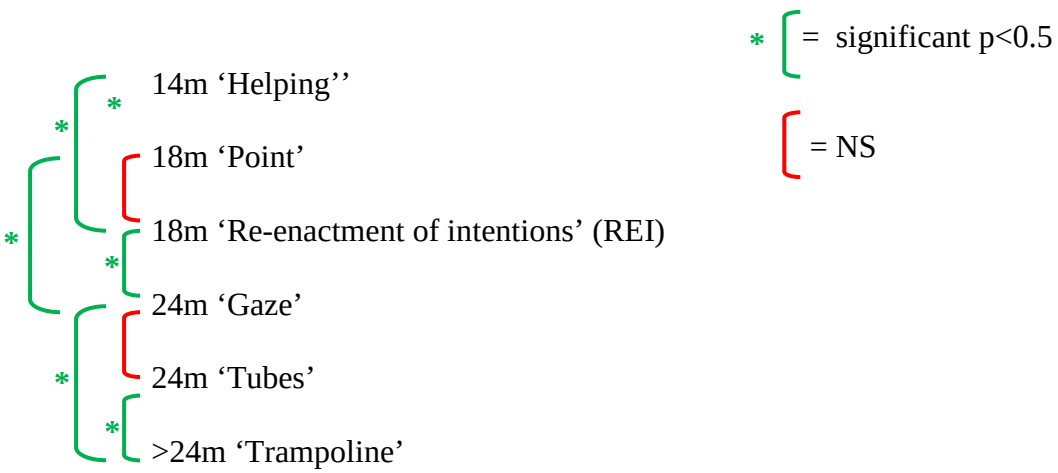


Figure 6: McNemar pairwise comparison results.

More specifically, results showed that: the 'helping' task was easier than the 'point' task and 'REI' task; the 'point' task and 'REI' tasks were easier than the 'gaze' task; and the 'gaze' and 'tubes' tasks were easier than the 'trampoline' task. Importantly, no differences were found between the 'point' and 'REI' task (McNemar's χ^2 (1) = .32, p=*ns*), and the 'gaze' and 'tubes' tasks (McNemar's χ^2 (1) = .52, p=*ns*), which is what would be expected given the ages of acquisition suggested by the original literature.

4.4.3. Guttman scale

The pairwise comparisons conducted indicate that the tasks form a reliable general progression. However, this information does not capture whether infants pass each task in succession, reach a task that they fail, and then fail all subsequent tasks. Guttman (1944, 1950) proposed a stringent and conservative method of scalogram analysis which outlined that for items to constitute a true scale they should be arranged in an order so that if an individual responds positively to one item they should also respond positively to all items of lower rank. Wellman and Liu (2004) used this conservative method of analysis in the construction of their ToM scale and consequently it was considered appropriate to analyse the current data in the same way.

In scalogram analysis the amount by which a scale deviates from an ideal pattern is represented by the *co-efficient of reproducibility*. It measures the degree with which the distribution of task passes and failures corresponds to the distribution of the 'perfect' Guttman scale. More specifically, it measures the number of deviations from the scale made by the infants. For example, an ideal pattern of responses along the scale would be to pass, fail, fail, fail, fail, fail (+,--,--, --, --, --) or to pass, pass, fail, fail, fail, fail (+, +, --, --, --, --) and so on. One deviation from this scale could be to pass, fail, pass, pass, fail, fail (+,--, +, +,--,--) and so would be recorded.

To calculate the co-efficient of reproducibility (rep) for the tasks in the battery, Green's (1956) method of estimation was used. For this method the first step is to eliminate '*first order errors*' from the response pattern – these are *adjacent* items that follow the incorrect sub pattern, e.g. *adjacent* items that show fail – pass (--, +) instead of pass – fail (+,--). The next step involves eliminating all (--, +) sub patterns from the newly reduced pattern; these are second order errors. This process then continues for third, fourth and higher order errors. So we have:

$$Rep = 1 - \frac{1}{Nk}\sum(-+) - \frac{1}{Nk}\sum(-+) - \ terms\ of\ higher\ order$$

Where *N* is the number of respondents, and *k* is the number of items. Simplified, the formula used is:

$$Rep = 1 - \frac{E}{Nk}$$

Where *E* is the total number of errors, *N* is the number of respondents, and *k* is the number of items. In practice it is unlikely that any scale will be perfectly reproducible therefore in Guttman scaling an approximation of the perfect scale is set at 90% (0.90) reproducibility.

Importantly, Guttman (1944, 1950) outlined that reproducibility by itself is not sufficient to constitute scalability. He argued that four other features should be taken into account, these included: a) The range of marginal distributions; b) the pattern of errors; c) the number of items in the scale; and d) the number of response categories. However, Green (1956) highlighted that apart from the requirement regarding the random pattern of errors, the other features were borne out of the possibility that the co-efficient of reproducibility could be achieved by chance alone. Consequently, Green's (1956) index of consistency is included to analyse whether the observed co-efficient of reproducibility is significantly greater than what could be achieved by chance alone. For this calculation, Rep_I (the rep that would be expected by chance if the items had their observed popularities

but were mutually independent) is calculated first and then the index of consistency is calculated using the following formula:

$$I = \frac{\text{Rep} - \text{Rep}_{\text{I}}}{1 - \text{Rep}_{\text{I}}}$$

Items are considered scalable if Rep is significantly greater than Rep_{I} . For this, *I* should be .50 or more.

The initial Guttman analysis was conducted with all six tasks in ranked order. Table 9 outlines the responses of infants on the six item battery. It shows that 56% of the sample fit the six item scale exactly. The coefficient of reproducibility for these data was 0.92. However, the index of consistency was 0.40 and therefore these data could not be considered scalable.

Table 9: *Guttman scalogram for a six item scale.*

Pattern	0	1	2	3	4	5	6	Other Patterns	N
'Helping' task	—	+	+	+	+	+	+		
'Point' task	—	—	+	+	+	+	+		
'REI' task	—	—	—	+	+	+	+		
'Gaze' task	—	—	—	—	+	+	+		
'Tubes' task	—	—	—	—	—	+	+		
'Trampoline' task	—	—	—	—	—	—	+		
Age Band 1	3	6	4	4	3	2	0	7	29
Age Band 2	0	1	3	3	3	1	0	18	29
Age Band 3	0	0	0	1	4	4	6	13	28
Total	**3**	**7**	**7**	**8**	**10**	**7**	**6**	**38**	
Average age (m)	**14**	**16.9**	**19**	**20.3**	**22.9**	**25**	**27.8**	**22.8**	
Age range	14	14-23	16-23	14-27	15-33	17-31	26-34	14-32	

The subsequent analyses examined whether a subset of these items formed a strict Guttman scale. This was to allow for the fact, predicted in the literature and confirmed in the pairwise comparisons, that some of the tasks in the battery were of equal difficulty. To recap, no difference was found between the 'pointing' and 'REI' tasks; or 'Gaze' task and 'tubes with handles' task and therefore it was considered likely that the majority of the deviations found within the scale would lie between these sets of tasks. Inspection of the data indicated that this was indeed the case. Therefore, two further analyses were conducted on scales where the similarity of the age equivalent tasks was accounted for.

In both analyses, similarity was accounted for by combining the tasks of equal difficulty. In the first analysis tasks were combined together by allocating a 'pass' if an infant had passed both the tasks of equal difficulty (i.e. passed the pointing task *and* REI task; or gaze task *and* 'tubes with handles' task). In the second analysis tasks were combined together by allocating a 'pass' if an infant had passed *either one* of the tasks of equal difficulty (i.e. passed the pointing task *or* REI task).

Table 10 outlines the responses of infants on the scale as combined for analysis one, 80% of the sample fit this scale exactly. The co-efficient of reproducibility for these data was 0.95. However, the index of consistency was 0.40 and therefore these data could not be considered scalable. Table 11 outlines the responses of infants on the scale as combined for analysis two, 88% of the sample fit this four item scale exactly. The co-efficient of reproducibility for these data was 0.96. The index of consistency was 0.5 and thus is considered scalable.

Table 10: *Guttman scalogram patterns for analysis one.*

Pattern	0	1	2	3	4	Other Patterns	N
'Helping' task	—	+	+	+	+		
'Point AND REI'	—	—	+	+	+		
'Gaze AND Tubes'	—	—	—	+	+		
'Trampoline' task	—	—	—	—	+		
Age Band 1	6	14	6	2	0	1	29
Age Band 2	2	9	8	1	0	9	29
Age Band 3	0	3	8	3	7	7	28
Total	**8**	**26**	**22**	**6**	**7**	**17**	
Average age (m)	**16.1**	**19.3**	**22.7**	**24**	**27.6**	**25.2**	
Age range	14-22	14-29	14-33	17-30	26-34	17-32	

Table 11: *Guttman scalogram patterns for analysis two.*

Pattern	0	1	2	3	4	Other Patterns	N
'Helping' task	—	+	+	+	+		
'Point OR REI'	—	—	+	+	+		
'Gaze OR Tubes'	—	—	—	+	+		
'Trampoline' task	—	—	—	—	+		
Age Band 1	4	6	9	7	0	3	29
Age Band 2	0	1	8	9	3	8	29
Age Band 3	0	0	2	13	11	2	28
Total	**4**	**7**	**19**	**29**	**14**	**13**	
Average age (m)	**14.8**	**16.9**	**19.7**	**23.6**	**27.1**	**21.5**	
Age range	14-17	14-23	14-27	15-33	22-34	14-27	

4.4.4. Possible order effects

As outlined in section 4.3.3, the experimental battery was presented in one of four orders. Each order began with two tasks deemed particularly engaging. This was to encourage the infant to feel comfortable and to avoid early frustration. However, the result of this methodology meant that some tasks more often occurred earlier in the session. To rule out the possibility that order effects might be contributing to any observed effects, Chi square statistics were employed to examine whether the serial order of task administration affected pass rates. Results confirmed that task order did not influence task success for any of the six tasks included in the battery: Helping (Fisher's exact probability = .24); REI (x2

(3) = .51, p = .92); Point (x2 (3) = 4.97, p = .18); Gaze (x2 (3) = 3.10, p = .41); 'Tubes' (x2 (3) = .96, p = .83); 'Trampoline' (x2 (3) = 2.87, p = .44).

4.5. The Final Experimental Scale

In the final Guttman analyses, similarity of tasks was accounted for by combining the tasks of equal difficulty. The results indicated that these data formed a reliable Guttman Scale if tasks were combined together by allocating a 'pass' if an infant has passed *either one* of the tasks of equal difficulty. However, these data did not form a reliable Guttman Scale if tasks were combined together by allocating a 'pass' only if an infant *passed both* of the tasks of equal difficulty.

Guttman scaling is a stringent and conservative method of scaling which allows for very few deviations from a scale. Given the age of the infants included in the study a certain level of variability should be expected and allowed for. Therefore, based on the combination of results from the Guttman analysis and the initial pairwise comparisons it was considered that the six tasks could be ordered developmentally. The final experimental scale is outlined below in Figure 7.

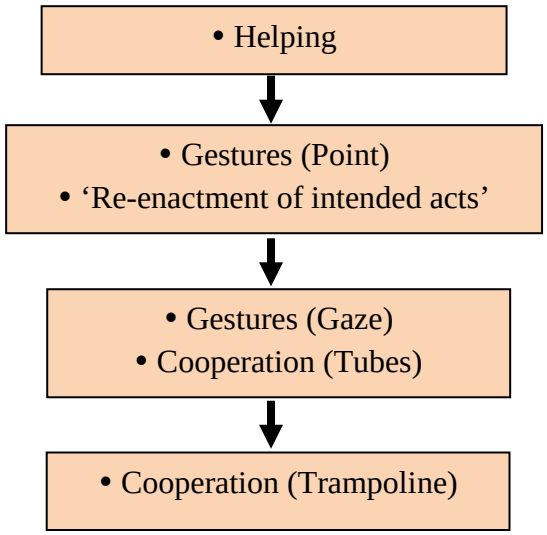


Figure 7: Final social cognition scale

4.6. Discussion

There is an increasing body of literature that outlines the age of acquisition of social cognitive skills that develop in infancy prior to fully fledged ToM understanding. However, until now no study has attempted to investigate whether these skills form a consistent developmental trajectory by examining the performance of several skills within each infant. This study took a set of tasks from the existing literature and arranged them to form a scaled battery predicted to be of increasing difficulty. Developmental progression was examined by administering the battery to infants of various ages.

The findings of the current study demonstrated that six out of the seven original tasks followed the expected developmental scale. Empirically, the findings show that typically developing infants possess the social cognitive understanding and altruistic motivation to 'help' another before they possess the social cognitive ability to: a) understand the communicative intent of a pointing gesture and b) re-enact a person's underlying intentions and goals. After these accomplishments, infants then develop the ability to: a) understand the communicative intent of a gaze gesture and b) coordinate their intentions and actions with another person to form a joint goal and cooperate skilfully in a problem solving 'tubes' game. Finally, after these accomplishments, infants then develop the ability to coordinate their intentions and actions with another person to cooperate skilfully in a social 'trampoline' game.

The one task that did not 'sit' where the literature would have predicted was the 'seeing-is-knowing' task; the task that accessed the point at which infants understood what others 'have and have not seen'. In the original literature, findings indicated that at around the age of 14 months, infants would preferentially hand an adult the toy that they knew that that adult had not previously seen. Therefore, in the preliminary scale, it was predicted that the infants in the sample would demonstrate this ability at approximately the same time as

the ‘helping’ task. However, the proportions of infants passing the task indicated that for the majority of infants this was not passed until much later.

One possible explanation for this finding is that the original study may have included a set of infants that were simply more able than the majority of infants in the wider population, thus causing the age of acquisition to be unrepresentative and much lower than the general population. However, this possibility seems unlikely given that this study was conducted by the same research team that conducted the ‘helping’ study. In both of these studies participants were recruited from a database of parents from a German city who had volunteered to take part in child development studies. Given the publication dates of the studies it is likely that both studies contained a very similar, if not the same, cohort of infants. As the helping task was ordered in accordance with the literature it seems unlikely that the delayed performance seen in the ‘seeing-is-knowing’ task was caused by an unrepresentative sample of infants.

A more plausible explanation is that methodological changes to the task caused the unexpected findings. In the original study the task objects included a gardening utensil, a birdcage item and a slide rule. When designing the battery it was decided that these items were unlikely to be appealing enough for individuals with ID and therefore more appealing items were selected. This was done to avoid the possibility that individuals with ID may become bored and disengage from the task. However, it seems that the new items may have been too appealing and thus caused the infants to become distracted by a preferred object. During testing several infants’ behaviour suggested that they had a strong preference for a particular toy. These behaviours included reaching for a toy after it had been placed on the tray and the reluctance to hand a toy back after the allocated play time. Although the preferred toy seemed to differ across infants, on many occasions it seemed that it was the preferred item that was selected when the adult experimenter returned to the

room and requested an item. Consequently, the later acquisition of this task in the current study may be due to an increased load on the infant's cognitive processes. More specifically, unlike the original study where infants showed no preference between items, in this study the infants needed to not only reason about another person's perspective but also *inhibit* their preference for a particular item. Despite this possible hypothesis, the exact cause for the delayed task acquisition still remains uncertain and therefore it was felt that the task should be removed from the battery.

Although the final six tasks did not conform to a strict Guttman scale, the series of pairwise differences was sufficient to constitute a reliable and valid scale. Guttman scaling is a stringent and conservative method of scaling and due to its deterministic nature does not allow for the occurrence of items of equal difficulty. The use of pairwise comparisons allowed the exploration of task differences between the tasks without excluding those of equal difficulty. The results of the comparisons mirrored the predictions based on the findings from the previous literature. More specifically, significant differences were found between the tasks expected to be of differing difficulty and no differences were found between the tasks expected to be of equal difficulty. Given this agreement with the literature it was felt that these pairwise comparisons were sufficient to constitute a reliable and valuable scale. Additional support was provided when Guttman scaling was conducted with the items of equal difficulty combined together; either by allocating a 'pass' if an infant had *passed either* one of the tasks or; allocating a 'pass' only if an infant *passed both* of the tasks of equal difficulty. Although only the '*passed either*' scale reached Green's (1956) index of consistency for significance, it was found that high proportions of infants conformed to both scales. When taken together with the pairwise comparisons, obtaining such high proportions of scale conformity with infants allowed confidence that

these tasks were developmentally ordered in this way. Furthermore, it is important to note that given the age of the infants included in this study, variability should be expected.

The findings of this study support and extend the current literature describing early social cognitive abilities in infants. All of the tasks included in this study, with one exception, were developmentally stacked in accordance with the ages of acquisition reported by the previous studies. However, in addition to adding support to these studies, these findings extend the literature by moving away from the measurement of single social cognitive accomplishments to the measurement of developmental trajectories. This study has produced a reliable scale that maps the progressive development of social cognitive skills during infants' early years that no single cognitive test or task could capture. The development of such a scale has important theoretical and clinical implications.

Flavell (1972) proposed a classification system to explain the developmental sequences of cognitive acquisitions. He proposed that early developing cognitive items are likely to be related to later ones either by substitution, addition, modification, or mediation. The current data indicate that the infants' development of early social cognitive skills was not one of substitution. Although the older infants passed later items they continued to pass the earlier items as well, showing that their later understanding did not *replace* their earlier understanding. Similarly, development was not by addition. The infants' later understandings were not equivalent to their earlier understandings; the tasks tapped qualitatively different and seemingly more difficult skills. Instead, these data would suggest that early social cognitive skills develop by modification or mediation.

Modification involves the broadening and generalising of early understanding to encompass later understanding. The current data are certainly consistent with such an interpretation; the scale represents a progressive and broadening of developmental skills. However, mediation goes a little further and suggests that earlier insights enable or aid the

acquisition of later insights through scaffolding. To this end, one might hypothesise that the earlier social cognitive abilities in the scale scaffold the development of the social cognitive abilities falling later in the scale. For instance, it may be that it is not possible for an infant to read another's intentions ***and*** incorporate them *together* with their *own* intentions in order to 'cooperate' until they can understand another person's intentions and unachieved goals to 'help'. Similarly, it may be that the ability to make inferences regarding the communicative intention of pointing gestures is necessary to scaffold the ability to makes inferences regarding the communicative intention of gaze.

At present, the current data cannot disentangle whether it is modification or mediation that occurs. However, it does provide a normative measure that can be used to examine further and possibly disentangle these different possibilities. For example, although it has been shown here that performance on these tasks follows a reliable developmental progression in typical development, it could be that atypical populations show a different developmental sequence. If this were the case, then one could argue that the acquisition of a given 'later' skill may not necessarily require, or be reliant upon, the sequential acquisition of a given 'earlier' skill. Such findings would not be possible using single task methodologies.

The current scale may also enable the examination of the role that other known factors play in the development of social cognition, such as executive functioning, language, and social experience. Doherty (2009) outlines that "any cognitive task measures two factors: the conceptual competence that is being tested, and performance factors required to take the test" (p.132). 'Emergence' theorists argue that executive functions (EFs) play a fundamental role in the development of ToM (Doherty, 2009). For instance, one theory proposes that EFs are a necessary prerequisite for mental state development (Moses, 2005; Russell, 1996). Another theory proposes that young children possess mental

state understanding but fail ToM tasks because they lack the necessary framework (i.e. EFs) to implement their understanding (e.g. Moses, 2001). Although it will not be possible to disentangle the intricacies of such theories, when used alongside Wellman and Liu's (2004) ToM scale, the current scale may go some way to examining the influence of factors such as EF and language ability on ToM development in atypical populations. The current scale places comparatively few demands on executive functioning and language. Consequently, it may be that atypical individuals successfully pass these earlier tasks but then fail later tasks when the cognitive loading becomes greater. Alternatively it may be that individuals find tasks assessing mental states understanding difficult irrespective of the cognitive demands. Such an examination would not be possible using single task methodologies.

Sociocultural accounts of social cognition argue that social experiences and conversational interactions are the building blocks of social cognitive development (e.g. Hughes et al 2005; Perner, Ruffman & Leekam, 1994). Therefore, if this scale is used to assess the social cognitive trajectory in individuals who show fractionated social profiles it may help further explore the relationship between social behaviour and social cognition. More specifically, one can compare whether individuals with atypical social behaviour show the same social cognitive development as typically developing individuals. Do atypical individuals follow the same progression or do they show a unique profile of social cognitive strengths and weaknesses? Is development 'preserved', advanced or delayed? If development is atypical or delayed, what impact may this difference have on social functioning? The answers to such questions will provide new insights into how the development of ToM relates to the social behaviour of syndrome groups that show fractionated social profiles.

As the current scale taps very early social cognitive skills it will enable assessment of social cognition in individuals that previously would have not been assessed because their level of cognitive impairment meant 'typical' ToM tasks were unsuitable. In terms of clinical implications, this may prove useful for highlighting early impairments in development and could consequently aid the early intervention of social cognitive difficulties. Furthermore, when used in conjunction with Wellman and Liu's ToM scale, it will enable tracking of the development of social cognitive development over a much broader age range than has been possible previously.

4.7. Summary

Until now, there has been no scaled battery that enables the measurement of social cognitive development in individuals with ID who are too young or cognitively impaired to pass standard ToM tasks. Chapter 3 presented the development of preliminary scale incorporating tasks that assessed early social cognitive skills considered to be 'precursors' to fully fledged ToM. In the current chapter the scale was validated by examining the performance of a group of typically developing infants. Findings showed that six tasks formed a reliable scale. Typically developing infants possessed the social cognitive understanding and altruistic motivation to 'help' another before they possessed the social cognitive ability to understand the communicative intent of a pointing gesture and re-enact a person's underlying intentions and goals. Infants then developed the ability to understand the communicative intent of a gaze gesture and coordinate their intentions and actions with another person to form a joint goal and cooperate skilfully in a problem solving 'tubes' game. Finally, infants developed the ability to coordinate their intentions and actions with another person to cooperate skilfully in a social 'trampoline' game. The current chapter outlined the potential theoretical and clinical implications of using the scale to assess

atypical individuals. In the following chapter, these potential implications are explored for the first time by using the scale to assess the social cognitive development of a model syndrome group of interest, Rubinstein Taybi syndrome (RTS), a group that displays a fractionated social profile. Examining social cognitive development in this group, in this way, is important as it will contribute towards refining cognitive models of ASD by exploring how the development of ToM relates to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles. Similarly, the study will also contribute to refining models of ToM more generally. If individuals with RTS demonstrate a different developmental sequence of social cognitive skills it may imply that 'later' social cognitive skills do not require, or are not reliant upon, the sequential acquisition of earlier social cognitive skills.

Running Head: Social Cognition in RTS

CHAPTER FIVE

SOCIAL COGNITION IN RUBINSTEIN-TAYBI SYNDROME

5.1. Preface

In chapter 1 it was argued that the study of Autism Spectrum Disorder (ASD) phenomenology in genetic syndromes can aid understanding of the aetiological pathways underpinning ASD. It was subsequently highlighted how syndrome groups that displayed fractionated ASD profiles could provide a useful vehicle by which to study each aspect of the ASD triad separately. More specifically the chapter drew attention to the potential study of ToM development in syndrome groups that showed a high prevalence of 'ASD' but fractionated social profiles.

In chapter 2, a total sample and then a group matching approach was used to highlight Rubinstein-Taybi syndrome (RTS) as a syndrome of interest. Findings from this chapter confirmed that RTS showed a high prevalence of ASD but a dissociation across the ASD triad of impairments, notably a fractionated social profile.

The methodological constraints of studying ToM in genetic syndromes have been discussed throughout the thesis. Chapters 3 and 4 presented the development and validation of an 'early' social cognition scale that would enable the developmental assessment of ToM 'precursors' in individuals with intellectual disability (ID) who are too young or too cognitively impaired to complete traditional ToM tasks. The potential theoretical and clinical implications of using this 'early' scale in combination with Wellman and Liu's (2004) 'later' ToM scale were discussed. Consequently, the current chapter aims to explore these implications by piloting this new methodology to examine social cognitive development in a sample of individuals with RTS.

5.2. Introduction

With the exception of ASD and Williams syndrome (WS) there has been relatively little research examining the social cognitive development of individuals with ID and genetic syndromes. Cebula, Moore and Wishart (2010) outline the current tendency for researchers to "focus more on studying children's immediate social needs than exploring the socio-cognitive processes that underpin social behaviours and drive more complex forms of social learning" (p. 113) and "...focus on providing increasingly detailed behavioural descriptions, rather than on testing competing theoretical accounts" (p.123). Although understandable, this is certainly the case for RTS and the majority of research is limited to genetic studies and broad behavioural descriptions. At present, there is no research that examines the social cognitive profile of RTS.

There are several benefits to examining social cognition in RTS. As has been discussed throughout this thesis (i.e. sections 2.5 and 2.6) the social cognitive abilities of RTS are of particular interest as they provide an opportunity to examine how the development of ToM relates to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles. Findings from chapter 2 showed that although a large proportion of individuals with RTS met the 'cut off' criteria for ASD, the profile of ASD symptomatology in the group showed a fractionated social profile relative to repetitive behaviour. For social aspects of the ASD triad, RTS was comparable to Down syndrome (DS) and significantly less impaired than an ASD group and a Fragile X syndrome (FXS) group. However, for repetitive behaviour, RTS was comparable to the ASD and FXS groups, and showed significantly higher levels of repetitive behaviour than the DS group.

Given the link between ToM deficits and the social interaction and communicative impairments in ASD (Baron-Cohen, 2000), it may be that the fractionated 'sociable' social

profile reported in RTS is underpinned by a relative 'sparing' in social cognitive abilities. However, the WS literature discussed in section 1.7, suggests that the relationship between ToM and social behaviour may not be quite this simple i.e. 'sociability' may not necessarily represent 'spared' ToM. More specifically, despite the phenotypic 'hypersociable' behaviour in WS being considered the 'polar opposite' of ASD, recent findings suggest that ToM ability in WS may actually be delayed (Tager-Flusberg & Sullivan, 2000; Tager-Flusberg, Sullivan, & Boshart, 1997). Consequently, it may be that despite the fractionated 'sociable' profile of RTS; social cognitive deficits may still be present in the group. Disentangling these different possibilities will contribute towards refining cognitive models of ASD phenomenology. Moreover, the use of a developmental trajectory approach will provide a much more detailed and informative contribution than has been possible previously with insight into developmental pathways and/or possible causal mechanisms. If developmental sequences differ in RTS, it may help pinpoint the processes involved in fractionated social profiles.

The developmental study of social cognition in RTS also has the potential to inform models of ToM more generally. In typical development it has been shown that a number of social cognitive tasks follow a reliable developmental progression (see Wellman and Liu, 2004 and chapter 4). As discussed in section 4.6, it is possible that these developmental progressions may occur via the process of mediation, in which the acquisition of later social cognitive skills is dependent on the acquisition and scaffolding of earlier social cognitive skills. However, if individuals with RTS demonstrate a different developmental sequence when they are assessed using the same developmental batteries, then it may imply that 'later' skills do not require, or are not reliant upon, the sequential acquisition of 'earlier' skills.

Studying social cognition in RTS may also contribute to the wider literature that implicates the role of other relevant factors in the development of social cognition, such as executive functioning, language, and social experience. As discussed in section 4.6, sociocultural accounts of social cognition argue that social experiences and conversational interactions are the building blocks of social cognitive development (e.g. Hughes et al. 2005; Perner, Ruffman & Leekam, 1994). EF accounts propose that EFs are a necessary prerequisite for social cognitive development (e.g. Moses, 2005; Russell, 1996). Although it will not be possible to disentangle the intricacies of such theories by examining the developmental trajectory of RTS in isolation, the study of RTS may lead to deliberation and discussion about the relationship between ToM development and these factors. For example, taking the descriptions of RTS as "friendly" individuals who "love adult attention" together with the findings from chapter 2, that RTS show superior social interaction and social communication skills when compared to ASD and FXS, if social experiences are particularly influential, it could be that their social cognitive development is either 'advanced' or 'spared' relative to their mental age.

Furthermore, as the scaled social cognition battery developed in chapters 3 and 4 places very few demands on EF, when it is used alongside Wellman and Liu's (2004) ToM battery it could provide useful information regarding the influence and importance of EFs. For instance, it may be that individuals with RTS pass early tasks but then fail later tasks when cognitive load becomes greater. Such findings would add to EF accounts and implicate EFs as necessary prerequisites for more sophisticated social cognitive development in RTS.

There are also important clinical implications for studying social cognitive development in RTS. Although the behavioural descriptions of sociability noted in the literature (outlined above and in section 2.2) suggest that those with RTS are "happy",

"loving" and "friendly" individuals who "love adult attention" (Baxter & Beer, 1992; Hennekam, 2006; Padfield, et al. 1968; Rubinstein & Taybi, 1963; Stevens, Pouncey & Knowles, 2011; Stevens et al. 1990a), reports also state that individuals may be "over friendly" (Stevens, Pouncey & Knowles, 2011). More recently, parents and carers have expressed concern that the people they care for appear to lack "stranger danger awareness", and there have been descriptions of instances where adults with RTS have been victims of exploitation, particularly with regards to money and inappropriate relationships (Oliver, 2007 personal communication). As outlined in section 3.2, the ability to attribute mental states to others is fundamental for successful social interactions as it allows a person to predict, explain, and manipulate the behaviour of others (Premack & Woodruff, 1978). Quantifying the social cognitive abilities of RTS may provide important preliminary insights that could contribute towards explaining some of the emerging social difficulties in RTS. It could be that these difficulties are partly underpinned by social cognitive deficits. If this were the case, these findings would be invaluable for informing intervention strategies. Furthermore, by using a developmental trajectory approach and a scale that incorporates the assessment of early social cognitive skills, it may be possible to pinpoint specific early abilities and/or deficits that could inform the focus of early intervention strategies.

As discussed above, there are numerous possibilities and hypotheses that could be explored by examining the social cognitive development in RTS. Consequently, the current chapter aims to investigate these possibilities by addressing the following questions:

- Do individuals with RTS demonstrate advanced, preserved or delayed social cognitive ability relative to their mental age?

• Regardless of delay or ability, do individuals with RTS display the same social cognitive developmental trajectory as typically developing individuals or do they demonstrate some other developmental path or pattern?

5.3. Method

5.3.1. Participants

The participants were 32 children and adults with RTS (16 males, mean chronological age: 222 months; age range: 45-533 months; SD: 121.03) recruited via the RTS support group and from a syndrome database held at The University of Birmingham (see Appendix G for recruitment pack). All participants were mobile and had received a clinical diagnosis of RTS. As chromosomal or molecular abnormalities are only found in around 55% of cases (Hennekam, 2006), diagnosis is based largely on the identification of clinical characteristics. Consequently, the majority of individuals in the current study did not have a genetic confirmation of RTS. However, reports suggest that clinical differences between individuals with and without genetic confirmation are minimal (Bartsch et al, 1999). Informed consent was obtained from all participants aged over sixteen years. For participants less than sixteen years informed consent was obtained from parents and carers. All participants were of moderate to high economic status and of White Caucasian ethnic origin.

5.3.2. Measures

5.3.2.1. *Mental age assessment*

Psychometric tests were administered to all individuals with RTS to assess mental age. Due to the range in age and ability across the sample, participants either completed

the Mullen Scales of Early Learning (MSEL: Mullen, 1995) or the Wechsler Abbreviated Scales of Intelligence – Second Edition (WASI-11: Wechsler, 1999). The MSEL is suitable for individuals aged from birth to a MA of 5:6 years and the WASI-11 is suitable for individuals with a MA between 6:0 years and 90:11 years. The examiners selected the appropriate assessment for each individual based on an estimation of their general ability. This was done during a discussion with the participant and participant's family member prior to testing.

Typically, when scoring these assessments, subscale raw scores are converted into t-scores that correspond to the participant's chronological age. However, for the MSEL, normative data and subsequent t-scores are only available for participants with a CA of 66 months or younger. As only two individuals with RTS were under 66 months of age, t-scores could not be calculated. Furthermore, for global MAs to be calculated on the WASI-11, individuals need to obtain sufficient scores on all four subscales of the test. As none of the participants assessed using the WASI-11 achieved this, a global MA score could not be calculated. Due to these difficulties, the current study employed the method used by Richler, Bishop, Kleinke, and Lord (2007) to derive global MAs for participants assessed with the WASI-11. More specifically, subscale MAs were calculated using raw score tables and then a mean overall MA was calculated from the subscale MAs. For the MSEL, overall MA was derived in a similar manner, by calculating the mean of the expressive language, visual reception, receptive language, and fine motor subscales. The gross motor subscale of the MSEL was omitted as the highest possible MA achievable on this subscale was 33 months and thus including it could have disproportionately decreased the overall MA and made it unrepresentative of a participant's ability.

5.3.2.2. *Social cognitive development assessment*

Social cognitive development was assessed by utilising two experimental batteries: The Early Social Cognition Scale (ESCS); and the Theory of Mind Scale (ToMS, Wellman and Liu, 2004). The ESCS was developed in chapter 3 and validated with typically developing infants in chapter 4. The ESCS examines early social cognitive abilities that develop prior to fully fledged ToM. Typically the ESCS contains six experimental tasks: The 'helping' task; the 're-enactment of intended acts' task; the 'pointing' and 'gaze' tasks; the 'cooperation - tubes' task; and 'cooperation -trampoline' task. However, it is of note that the 're-enactment of intended acts' task was not included in the current study. The absence of this task was due to the task being added to the normative battery at a slightly later date. More specifically, data for both studies were collected in parallel and the 're-enactment of intended acts' task was added because shortly after data collection started it was seen that administration time was quicker than expected. As time allowed, the 're-enactment of intended acts' task was added to improve the battery by assessing an even broader range of skills. However, due to the fact that a number of RTS participants had already been assessed using the smaller battery and a need to retain maximum N in a rare syndrome group, it was decided that the 're-enactment of intended acts' task would not be administered to this group. It is important to note here that removing an item from a scale does not affect scalability as reduction of item simply reduces variance. Consequently comparisons between the larger and smaller scales remain valid.

The ToMS was developed by Wellman and Liu (2004) and contains five experimental tasks: Diverse Desires, Diverse Beliefs, Knowledge Access, Contents False Belief, and Real Apparent Emotions. It has been shown that in typical development these tasks form a strict Guttman scale (Wellman & Liu, 2004). The co-efficient of reproducibility, using Green's (1956) method of estimation is .96 (values greater than .90

indicate scalable items). Green's index of consistency, which tests that the reproducibility was over what could be achieved by chance, is .56 (values equal to or greater than .50 are significant). Therefore, typically developing preschool children pass earlier tasks, reach a task that they fail and then fail all subsequent tasks. Furthermore, as children get older they pass more tasks in succession.

When used together the ESCS and ToMS span a developmental MA range from approximately 14 months to 5.4 years.

5.3.2.3. *Administration of the scales*

Individuals with RTS were tested in a quiet room in their home. Before each experimental session the experimenters conducted a warm up phase and either played or chatted with the participant for around 10-15 minutes. Due to differences in age and ability across the sample it was not always possible to administer all tasks (i.e. both scales) to each participant. More specifically, as the batteries spanned such as wide ability range, some of the tasks at the extreme ends of the batteries were not age or ability appropriate for the older/more able individuals or younger/less able individuals. Therefore, there were two different administration start points – start point 'A' (The ESCS battery) and start point 'B' (the ToMS battery). The examiners selected the appropriate start point for each individual based on an estimation of their general ability. This was done during a discussion with the participant and participant's family member prior to testing.

The administration protocol is outlined in Figure 8. Participants who displayed limited receptive and expressive language skills started at point 'A'(the ESCS Battery). Tasks 1-5 were then administered in one of four counterbalanced orders (outlined in Table 12). Each counterbalanced order began with a task deemed particularly engaging. This was to encourage the participant to feel comfortable and to avoid early frustration. Participants'

performance was then used to determine whether any further tests would be administered. More specifically, if individuals passed tasks 4 or 5 they were then administered Tasks 6-10 (The ToMS battery) in order. However, if it was deemed that the participant was finding the tasks in this battery far too difficult and failure was causing the participant to become frustrated the experimenter discontinued the battery following two consecutive fails. This discontinuation rule was implemented to reduce the risk of disengagement. However, if participants were happy and showed no signs of frustration, all tasks of the ToMS battery were administered.

Participants who displayed good receptive and expressive language skills started at start point 'B'. Tasks 6-10 were then administered in one of four counterbalanced orders (outlined in Table 13). Each counterbalanced order began with either the Diverse Desires or Diverse Belief task. These tasks were simpler and were used first to encourage the participant to feel comfortable and to avoid early frustration. Participants' performance was then used to determine whether any further tests would be administered. More specifically, if individuals failed Task 6 they were then administered Tasks 5-1 in reverse order. However, if it was deemed that the participant was finding that the tasks were inappropriate for their age or ability the experimenter discontinued the battery following two consecutive passes. This discontinuation rule was implemented to reduce the risk of disengagement. However, if participants were happy to continue, all tasks of the ESCS battery were administered.

All tasks were administered on the same day but frequent breaks were given between social cognition tasks and between the IQ assessment sub domains. This was to ensure participants did not become fatigued or disengaged.

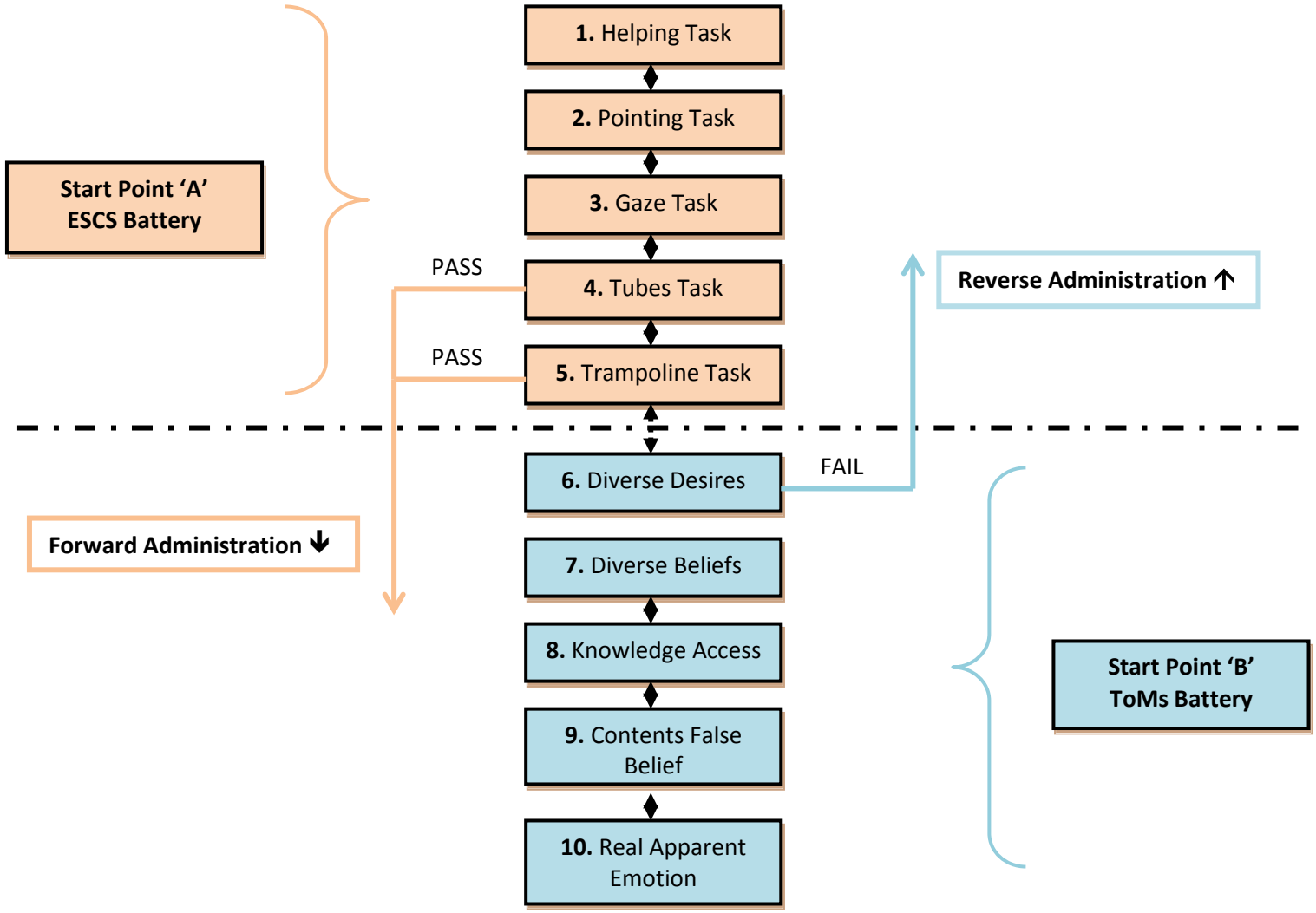


Figure 8: Task administration order of the Social Cognition Scales

Table 12: *Orders of task administration for participants starting at start point 'A'*

Order 1	**Order 2**	**Order 3**	**Order 4**
'Cooperation' Tubes	'Cooperation' Trampoline	'Cooperation' Trampoline	'Cooperation' Tubes
'Helping' (Control)	'Helping' (Control)	'Gestures' (Point & Gaze)	'Helping' (Control)
'Cooperation' Trampoline	'Cooperation' Tubes	'Helping' Control	'Gestures' (Point & Gaze)
'Gestures' (Point & Gaze)	'Helping' (Experimental)	'Cooperation' Tubes	'Helping' (Experimental)
'Helping' (Experimental)	'Gestures' (Point & Gaze)	'Helping' Experimental	'Cooperation' Trampoline

Table 13: *Orders of task administration for participants starting at start point 'B'*

Order 1	**Order 2**	**Order 3**	**Order 4**
Diverse Desires	Diverse Beliefs	Diverse Desires	Diverse Beliefs
Diverse Beliefs	Knowledge Access	Knowledge Access	Real Apparent Emotion
Real Apparent Emotion	Contents False Belief	Contents False Belief	Diverse Desires
Knowledge Access	Diverse Desires	Real Apparent Emotion	Contents False Belief
Contents False Belief	Real Apparent Emotion	Diverse Beliefs	Knowledge Access

5.3.2.4. *Individual task procedures*

Full task descriptions and procedures for the ESCS are outlined in section 4.3.5. of chapter 4. However, as the ToMS has not been fully described elsewhere in the thesis the individual task descriptions and procedures are described below. For all tasks in the ToMS the participant sat at a table next to the experimenter.

5.3.2.4.1. *Diverse desires (DD)*

This task assessed the participants' mental state understanding of 'desire' - the ability to reason that two persons (themselves and another) can hold different preferences (and thus different mental states) about the same object. This task forms the first task in Wellman and Liu's (2004) scale and is derived from an original task devised by Repacholi and Gopnik (1997).

The experimenter began the task by showing the participant a doll depicting a young boy, and two laminated pictures – one of a carrot, and one of a cookie. The experimenter then said to the participant: "This is Ben, it is snack time and Ben wants something to eat. Here are two snacks – a carrot and a cookie". The participant was then asked an initial *own desire question*: "So, [name], which snack would *you* like best, the carrot or the cookie?" If the participant chose the cookie (the typical response) the experimenter then said "Well that's a good choice [name], but Ben...Ben really likes carrots....he doesn't like cookies." The participant was then asked the *target question:* "So, now it's time to eat. Ben can only choose one snack – what will he chose the carrot or the cookie?" (If the participant had initially responded that they liked carrots best, the script was altered so that they were informed that Ben liked cookies and disliked carrots). To be coded as correct, and subsequently pass the task, the participant was required to answer the target question with the opposite response to their own desire question response.

5.3.2.4.2. *Diverse beliefs (DB)*

This task assessed the participants' mental state understanding of 'belief' - the ability to reason that two persons (themselves and another) can hold different beliefs about the same object, when they do not know which belief is true or false. This task forms the second task in Wellman and Liu's (2004) scale and is derived from original tasks devised by Bartsch (1989) and Wellman, Hollander, & Schult (1996).

The experimenter began the task by showing the participant a doll depicting a young girl, and a laminated picture of a garage and some bushes. The experimenter then said to the participant: "This is Mary. Mary wants to find her cat. Her cat might be hiding in the bushes or it might be hiding in the garage (pointing to the picture). The participant was then asked an initial *own belief question*: "So, [name], where do you think the cat is - in the garage or in the bushes?" If the participant chose the bushes the experimenter then said "Well that's a good idea [name], but Mary thinks her cat is in the garage" (If the participant responded they thought the cat was in the garage the script was altered so they were informed Mary thought her cat was in the bushes). The participant was then asked the *target question:* "So, where will Mary look for her cat? In the garage or in the bushes?" To be coded as correct, and subsequently pass the task, the participant was required to answer the target question with the opposite response to their own belief question response.

5.3.2.4.3. *Knowledge access (KA)*

This task assessed the participants' ability to reason about the knowledge state of another person who has not seen inside a box that they (the participant) have seen inside. This task forms the third task in Wellman and Liu's (2004) scale and is derived from original tasks devised by Pratt & Bryant (1990) and Pillow (1989).

The experimenter began the task by showing the participant a black box with a pull-out drawer -"Here's a drawer, [name] what do you think is inside the drawer?" (The participant says whatever they like or states that they don't know). The experimenter then opened the drawer to reveal what was inside – a small plastic duck. "Let's see...oh, it's really a duck inside!" The experimenter then closed the drawer and asked "Okay, what's inside the drawer?" Following the participant's answer, the experimenter then produced a doll depicting a young girl and said "This is Polly, Polly has *never* seen inside the drawer..." The experimenter then asked the *target question* – "So, [name], here comes Polly, does Polly know what is inside the drawer?" Regardless of the answer the experimenter then immediately asked the participant a *memory question* – "Did Polly see inside the drawer?" To be coded as correct, and subsequently pass the task, the participant was required to answer both the target and memory questions "*no*".

5.3.2.4.4. *Contents false belief (CFB)*

This task assessed the participants' mental state understanding of 'false belief', the ability to reason that another person can hold a belief that is at odds with what they (the participant) know to be true. This task forms the fourth task in Wellman and Liu's (2004) scale and is derived from original tasks devised by Perner, Leekham & Wimmer (1987).

The experimenter began the task by showing the participant a closed Smarties tube - "Here's a smarties tube. What do you think is inside the smarties tube?" (typical response is 'smarties' or 'sweets'). The experimenter then opened the smarties tube and revealed that there were actually pencils inside – "Let's see...it's really pencils inside". The experimenter then closed the tube and asked "Okay, [name] what's inside the smarties tube?" Following the participant's answer, the experimenter then produced a doll depicting a young boy and said "This is John, John has *never* seen inside the smarties tube..." The

experimenter then asked the *target question* – "So, [name], here comes John, what does John think is inside the tube? Smarties or pencils?" Regardless of the answer the experimenter then immediately asked the participant a *memory question* – "Did John see inside the tube?" To be coded as correct, and subsequently pass the task, the participant was required to answer the target question "smarties" and the memory question "no".

5.3.2.4.5. *Real – apparent emotion (RAE)*

This task assessed the participants' mental state understanding of 'hidden emotions' - the ability to reason that another person can feel one thing but display a different emotion. This task forms the fifth and final task in Wellman and Liu's (2004) scale and is derived from an original task devised by Harris, Donnelly, Guz, and Pitt-Watson (1986).

The experimenter began the task by showing the participant a laminated sheet with three faces printed on it: a happy face, a neutral face, and a sad face. To check the participants' knowledge of these emotional expressions they were asked which face was 'happy', which was 'sad', and which was 'just ok'. If participants were successful they were then presented with a laminated cut-out that depicted the back of a boy, so his facial expressions could not be seen. The experimenter said "I'm going to tell you a story about a boy. I'm then going to ask you how the boy *really feels inside* and how he l*ooks on his face.* He might really feel one way inside but look a different way on his face. Or, he might really feel the same way inside as he looks on his face. After the story, I want you to tell me how he really feels inside and how he looks on his face." The experimenter paused briefly and then started the story: "This story is about Matt, Matt's friends were all playing together and telling jokes. One of the older children, Rosie, told a mean joke about Matt and everybody laughed. Everyone thought it was very funny, but *not* Matt. But, Matt

didn't want the other children to see how he felt about the joke, because they would call him a baby. So, Matt tried to *hide how he felt*". Immediately after the story the experimenter asked two *memory check* questions – "What did the other children do when Rosie told a mean joke about Matt?" and "In the story, what would the other children do if they knew how Matt felt?" To pass the memory questions, participants needed to answer the first question "laughed/ thought it was funny" and the second question""call Matt a baby/tease him". Following the participant's responses the experimenter pointed towards the three emotion pictures and asked the *target-feel question*: "So how did Matt really feel, when everyone laughed? Did he feel happy, sad or just ok?" The experimenter then asked the *target-look question*: "How did Matt try to look on his face, when everyone laughed? Did he look happy, sad or just ok?" To be coded as correct, and subsequently pass the task, the participant was required to answer the memory questions correctly and then rate the *target- feel question* more negatively than the *target-look* question.

5.3.2.5. *Coding of the social cognition scales*

Performance on each task was coded as either 'pass' or 'fail'. For the tasks in the ESCS battery the coding criteria used in chapter 4 was conducted. For the tasks in the ToMS battery the coding criteria used by Wellman and Liu (2004) was conducted, as outlined above. It is of note that, for the KA, CFB and RAE tasks of the ToMS, to pass the tasks participants were required to pass the associated memory/control questions *as well* as the critical test questions. This was to ensure that the participants understood and remembered all the relevant information and that their answers were therefore based on meaningful reasoning rather than random responses or 'guesses'.

5.3.2.6. *Inter-rater reliability for coding of the social cognition scales.*

All tasks were initially coded by the primary experimenter by reviewing video clips of participant's performance on each task. To ensure this coding was accurate and reliable, a second coder was introduced and asked to code a random 25% of each administered task. Visual comparison between coding reports showed perfect agreement between both coders across all tasks.

5.3.3. Overview of analysis and results sections

As outlined in the introduction, the current chapter intended to fulfil two aims. Firstly, to describe the *overall* social cognitive level of individuals with RTS to ascertain whether their social cognitive abilities were preserved, advanced, or delayed relative to their mental age. Secondly, to examine whether, regardless of delay or ability, individuals with RTS followed the same social cognitive developmental trajectory shown in typical development, or whether they showed a different developmental path or pattern. The following sections of this chapter report the analyses and results of these aims.

Both the ESCS and ToMS batteries included control trials and/or questions. Examination of the control trials for the ESCS are analysed and presented first to ensure that the tasks were working, at a group level, as expected. As the control questions in the ToMS were included to assess the influence of memory and general understanding on task failures, rather than whether or not the tasks were working per se, the examination of these questions are presented last, after the ToM trajectory analysis.

5.4. Results

5.4.1. Analysis of ESCS control trials.

5.4.1.1. *'Helping' control trials*

For each helping trial there was a corresponding control trial in which the same basic situation was present but there was no indication that help was required. Results indicated that out of the 21 participants that handed over an item during the experimental trials, only two also handed over an item in the control trials. Therefore it was judged that the task was working as expected – participants were 'helping' rather than merely trying to re-instate the original situation or to get the adult to repeat the action. Furthermore, in order to ensure that participants were not collecting the object primarily for themselves rather than to help the experimenter, each participant's behaviour was also coded for whether or not they took possession of the object before handing it over. The results indicated that out of the 21 participants that handed over an item during the experimental trials, none took possession of the item before handing it over. Therefore, it was judged that the task was working as expected and the participants were indeed 'helping' the adult rather than collecting the object primarily for themselves.

5.4.1.2. *'Gesture' control trials*

To ensure that successful performance on this task was not due to low level attentional cueing, the control trials were analysed for the participants that passed the task (successful on 2/2 searches). Paired t tests were conducted to compare the number of correct vs. incorrect searchers for both control cues. Results indicated that search performance did not differ significantly from chance for either cue type. ['Control Point': t (16) = -.368, p=.72; 'Control Gaze' – t (11) = .000; p=1.00]. Therefore, it was judged

that the participants passing this task were passing due to their understanding of intentions rather than due to low level cueing.

5.4.2. Analysis: Description of overall social cognitive ability.

There are various ways that can be used to investigate whether the cognitive abilities in genetic syndromes are typical or atypical. The first of these involves the examination of whether behaviour is 'age typical'. The second involves the examination of whether performance follows a typical developmental pattern.

To examine whether behaviour is age typical, the strongest testing method is to compare performance on a cognitive task to two matched comparison groups, one matched for chronological age (CA) and one matched for mental age (MA). If the syndrome group demonstrates a deficit relative to the CA matched group, but not the MA matched group, the group is considered developmentally delayed on the task. Alternatively, if the syndrome group demonstrates a deficit relative to both the MA and CA comparison groups, it is instead considered to be developmentally atypical (Hodapp, Burack & Zigler, 1990). However, an alternative, albeit weaker, approach to this method is to compare a group to age norms. Throughout this thesis, the added benefits of adopting a developmental trajectory approach have been discussed and subsequently this methodology was selected over recruiting matched comparison groups (see section 1.9 for discussion). Consequently, in this section the analysis of overall social cognitive ability in RTS is described using age norms derived from the typically developing literature.

For this descriptive analysis, each participant with RTS was allocated a 'scale position point' based on how far they progressed through the social cognitive batteries. The allocated scale position was determined by the last task the participant successfully passed before failing two tasks consecutively. For example, if the participant passed the

'cooperation - trampoline' task and Diverse Desires task but then failed the Diverse Belief and Knowledge Access tasks their scale position point would be 6. Similarly, if a participant passed the 'helping' task and 'pointing' task but then failed the 'gaze' task and 'cooperation – tubes' task, their scale point position would be 2. If participants progressed to point 9 in the scale, but then failed at point 10, they were allocated a scale position point of 9. This was because it was not possible to accrue two consecutive fails.

Each scale position point had a 'corresponding MA' based on the average age data derived from the typically developing literature. For the ESCS tasks, these were the ages of acquisition proposed by the original experimental studies reported in chapter 3. For the ToMS tasks, these were the average ages reported in Wellman & Liu's (2004) original study. Each participant's scale position point could then be plotted alongside their mental age and the average age data derived from typical development studies to provide an overview of whether performance was generally advanced, preserved or delayed overall.

5.4.3. Results: Description of overall social cognitive ability.

Two individuals who reached ceiling (achieved a scale position point of 10), and two individuals who were nonverbal and had not accrued two consecutive fails before task 6, were excluded from the analysis. For these individuals it was felt that it was not possible to accurately determine their level of social cognitive understanding. More specifically, for the individuals who reached ceiling it was possible that they may have gone on to pass more complex tasks, therefore allocating a scale position of '10' may have underestimated their ability. Similarly, for non verbal individuals it was not possible to progress past point 6 in the scale as tasks 7 – 10 required verbal responses. Therefore, allocating a scale position of 6 might have underestimated their ability. Consequently, twenty eight children and adults with RTS were included in the analysis (14 males, mean chronological age: 221

months; age range: 63 - 533 months; SD: 118.67). The individuals who were excluded from the analysis due to reaching ceiling had mental ages of 147 and 144 months, and chronological ages of 353 and 361 months, respectively. The individuals who were excluded due to being nonverbal and not accruing two consecutive fails before task 6 had mental ages of 29 and 21 months, and chronological ages of 45 and 144 months, respectively.

To provide a descriptive overview of whether ability was preserved, advanced, or delayed relative to mental age, individuals with RTS were ordered by increasing mental age and their scale position points plotted on a graph, alongside the average age data (Figure 9).

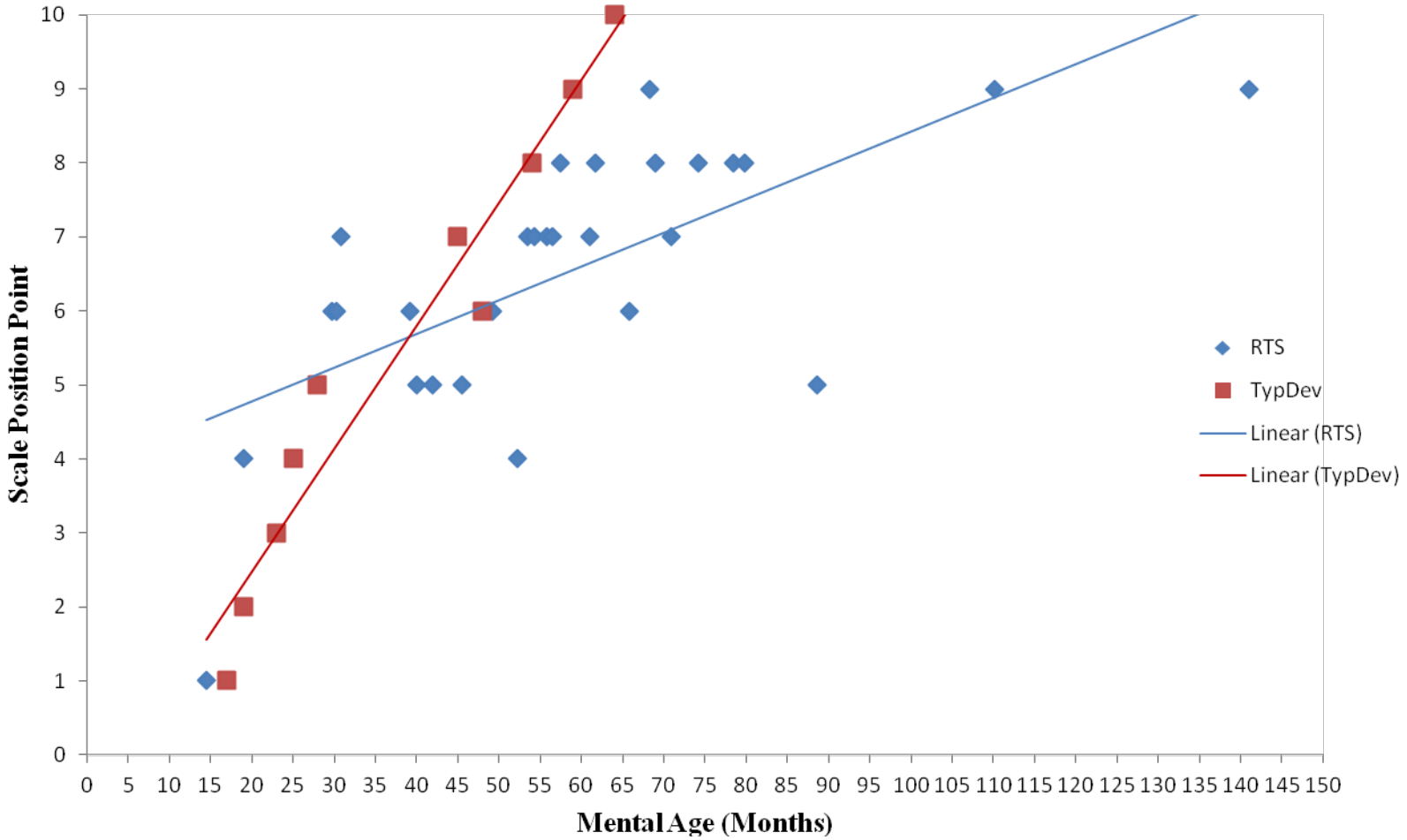


Figure 9. The scale position points and corresponding mental ages for individuals with RTS together with average age data derived from typical development studies.
RTS = Rubinstein Taybi syndrome ; TypDev = Average age data derived from developmental literature.

Correlation analysis indicated that for individuals with RTS, scale position increased significantly with mental age: $r(28) = .76$, $p<.01$. Therefore, with increasing mental age, individuals with RTS progressed further up the social cognition scales and demonstrated more sophisticated social cognitive ability.

Although interpretation requires caution, visual inspection of these data provides some potentially interesting findings. The graph indicates that at the lower end of the scale (scale points 1-7) there were 6 participants who reached scale point positions *above* what would have been predicted given their MA (i.e. their plotted points lay to the left of the 'typical' average age plotted points), perhaps suggesting an advanced ability relative to MA. Conversely, at the higher end of the scale (scale points 8-10) there were no points lying to the left of the average age points. Twenty-two of the participants had scale point positions below what would have been predicted given their MA (i.e. their plotted points lay to the right of the 'typical' average age plotted points), perhaps suggesting that the majority of the group showed delayed ability relative to MA. However, the extent of this relative delay appears to vary substantially across participants, with some participant's points lying relatively close to the average age points, and others lying much further away.

5.4.4. Analysis: Social cognitive developmental pattern.

The second aim for the thesis was to explore whether, regardless of delay, individuals with RTS progressed along the same developmental sequence as typically developing individuals or whether they showed an atypical developmental path or pattern. To achieve this, Guttman analysis of the data was required.

Guttman analysis requires that each participant completes all tasks in a scale. However, as previously discussed, due to differences in age and ability across the sample it was not possible to administer all tasks from the ESCS and ToMS to each participant. To

recap, participants who displayed limited receptive and expressive language skills started at point 'A' (The ESCS battery) and tasks 1-5 were administered. If these individuals passed task 4 or 5 they were then administered tasks 6-10 in order unless the experimenter deemed that the participant was frustrated or distressed due to repeated failure. In these cases the administration of tasks 6-10 was discontinued following two consecutive failures. Participants who displayed good receptive and expressive language skills started at start point 'B' (The ToMs battery) and tasks 6-10 were administered. If individuals failed task 6 they were then administered tasks 5-1 in reverse order unless the experimenter deemed that the participant was finding the tasks inappropriate for their age or ability. In these cases the administration of tasks 5-1 was discontinued following two consecutive passes. The result of this method of administration meant that some participants only completed one of the batteries fully (i.e. either the ESCS or the ToMS) and some completed both of the batteries fully (i.e. both the ESCS and the ToMS). Therefore, as only a small proportion of participants (n= 15) completed both batteries, Guttman analyses (and any necessary subsequent analyses) were conducted separately for the ESCS and ToMS batteries, and are described in turn.

5.4.5. Results: Early social cognitive developmental pattern (the ESCS).

Twenty one children and adults with RTS fully completed the ESCS battery (12 males, mean chronological age: 179 months; age range: 45 - 403 months; SD: 95.20). According to the sequence reported and validated in chapter 4, if individuals with RTS showed the same developmental trajectory as typically developing individuals, the data should follow the developmental progression shown in Figure 10.

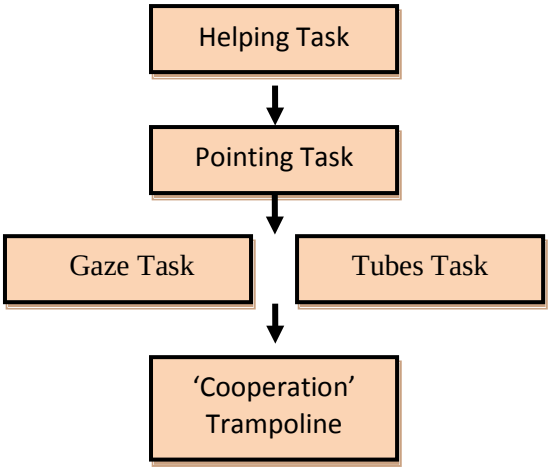


Figure 10: The typical developmental progression through tasks in the ESCS.

To ascertain whether individuals with RTS passed tasks in the same order as typically developing individuals, an initial Guttman analysis was conducted with all five tasks ranked in the order of difficulty outlined in Figure 10. As two of the tasks ('gaze' and 'cooperation' -tubes) are considered to be of equal difficultly, an arbitrary order for these two tasks was adopted, as outlined by Green (1956). Table 14 reports the performance of individuals with RTS on this five item scale. It shows that only 43% of the sample fit the five item scale exactly. The coefficient of reproducibility for these data was 0.91 and the index of consistency was - 0.41, clearly showing that these data could not be considered scalable.

Table 14: *Guttman scalogram for five item ESCS battery.*

Pattern	**0**	**1**	**2**	**3**	**4**	**5**	**Other Patterns**	**N**
'Helping' task	—	+	+	+	+	+		
'Point' task	—	—	+	+	+	+		
'Gaze' task	—	—	—	+	+	+		
'Tubes' task	—	—	—	—	+	+		
'Trampoline' task	—	—	—	—	—	+		
RTS	**0**	**0**	**0**	**0**	**2**	**7**	**12**	21
Mean mental age (m)	**0**	**0**	**0**	**0**	**35.5**	**49.9**	**41.7**	
Age range (m)					19-52	31-80	15-89	

The result that the RTS data did not conform to the progression shown in typically developing infants could have occurred for three reasons. It could be that individuals with RTS showed vast variance in performance across tasks and subsequently the data could be 'noisy' and show no clear sign of any developmental pattern. Conversely, it could be that individuals do follow the same general developmental progression shown by typically developing infants, but as occurred in chapter 4, the stringent and conservative nature of Guttman scaling, which allows very few deviations from the scale, may not have allowed for a realistic level of variability. Finally, and perhaps more interestingly, it could be that individuals with RTS follow a different developmental pathway in their early social cognitive development.

In an attempt to disentangle some of these possibilities, Table 15 was constructed to display the percentage of individuals with RTS that passed each task in the battery. The table is ordered from the 'easiest' task (highest number of individuals passing) to the 'hardest' (lowest number of individuals passing). When compared to the task progression shown in typical development (Figure 10) the percentages in the table appear to suggest that individuals with RTS may find certain tasks easier (i.e. 'Cooperation – tubes' task) and certain tasks harder (i.e. 'Gaze' task) than typically developing infants. However, from these percentages alone it is not possible to ascertain whether the tasks do in indeed follow a reliable scale.

Table 15: *The percentage of individuals with RTS that passed each task in the ESCS battery and corresponding order in typical development.*

Task	RTS Pass Rate	'Typical' Order (as depicted in Figure 10)
'Helping' task	100%	# 1
'Cooperation' – tubes task	100%	# 3 =
'Pointing' task	81%	# 2
'Cooperation' – trampoline task	81%	# 4
'Gaze' task	57%	# 3 =

To investigate whether the ordered tasks did reliably follow a general progression, analysis used a series of paired task sequences. As reflected in Table 15, two pairs of tasks yielded equal pass rates: 'Helping' and 'Cooperation - tubes'; and 'Pointing' and 'Cooperation -trampoline'. Therefore, McNemar's tests with Yates's correction for continuity were conducted only between the tasks of increasing difficulty. In total, three pairwise comparisons were made, as outlined in Figure 11.

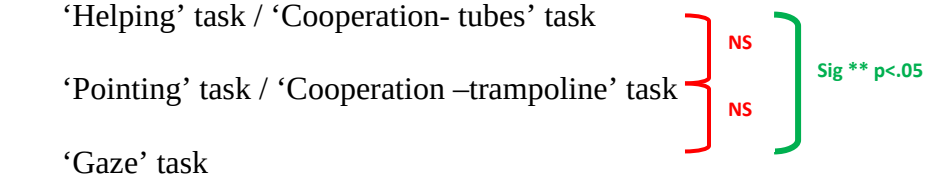


Figure 11: McNemar pairwise comparisons.

As multiple comparisons were being conducted, Bonferroni-Holm corrections were used to control for family wise error. Results indicated a significant pairwise difference between the 'helping' / 'cooperation – tubes' tasks and 'gaze' task (McNemar's χ^2 (1) = 7.11, p<.05. No differences were found between the 'helping' / 'cooperation- tubes' tasks

and the 'Pointing' / 'cooperation - trampoline' tasks (McNemar's χ^2 (1) = 2.25, p=*ns*) or the 'Pointing' / 'Cooperation - trampoline' tasks and the 'Gaze' task (McNemar's χ^2 (1) = 1.45, p=*ns*).

To clarify, results showed that the 'gaze' task was not significantly harder than the 'pointing' and 'cooperation - trampoline' tasks, and the 'pointing' and 'cooperation - trampoline' tasks were not significantly harder than the 'helping' and 'cooperation - tubes' tasks. However, results did indicate that the 'gaze' task was significantly more difficult than the 'helping' and 'cooperation- tubes' tasks (Figure 11)

In the typically developing sample, the 'cooperation - trampoline' task was found to be significantly harder than the 'gaze' and 'cooperation - tubes' tasks; the 'gaze' and 'cooperation – tubes' tasks were of equal difficulty but both were significantly harder than the 'pointing' task; and the 'pointing' task was significantly harder than the 'helping task' (i.e. Figure 10). The fact that these same progressive differences are not found in RTS is of interest. However, one cannot argue that these tasks do not show a general increase in difficulty in RTS, it may be that individuals were just performing near ceiling and therefore a more general developmental progression was not picked up. The high percentage pass rates would certainly suggest this as a possibility.

The finding that the 'gaze' task was significantly harder than the 'cooperation – tubes' task *is* particularly interesting, as the typically developing data would suggests that these two tasks are of *equal developmental difficulty*. Therefore, even *if* individuals with RTS *were* performing at ceiling, if their developmental pathway was the same as typically developing individuals, given their success with the 'cooperation - tubes' task, one would expect them to have equal success with performance on the 'gaze' task. However, they do not, the gaze task is significantly harder. Therefore it appears that, for early social cognitive development, individuals with RTS do follow a slightly different developmental

progression than typically developing individuals, with gaze understanding developing later.

5.4.6. Results: Later social cognitive developmental pattern (the ToMS)

Twenty six children and adults with RTS fully completed the ToMS battery (12 males, mean chronological age: 239 months; age range: 78 – 533 months; SD: 122.65). According to the sequence reported and validated by Wellman & Liu (2004) if individuals with RTS showed the same developmental trajectory as typically developing individuals, the data should follow the developmental progression shown in Figure 12.

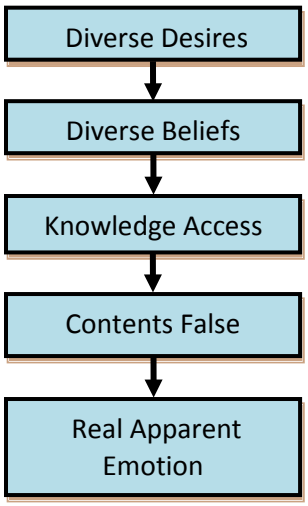


Figure 12: The typical developmental progression through tasks in the ToMS.

To ascertain whether individuals with RTS passed tasks in the same order as typically developing individuals, a Guttman analysis was conducted with all five tasks ranked in the order of difficulty outlined in Figure 12. Table 16 reports the performance of individuals with RTS on this five item scale. It shows that 76% of the sample fit the five item scale exactly. The coefficient of reproducibility for these data was 0.94 and the index of consistency was 0.50 and therefore it was found that for the ToMS battery, individuals with RTS do follow the same developmental trajectory as typically developing individuals.

Table 16: *Guttman scalogram for five item ToMs battery.*

Pattern	0	1	2	3	4	5	Other Patterns	N
Diverse Desires	—	+	+	+	+	+		
Diverse Beliefs	—	—	+	+	+	+		
Knowledge Access	—	—	—	+	+	+		
Contents FB	—	—	—	—	+	+		
Real Apparent Emotion	—	—	—	—	—	+		
RTS	**2**	**4**	**6**	**3**	**2**	**2**	**7**	26
Mean mental age (m)	**43.8**	**46.0**	**54.9**	**69.7**	**125.6**	**145.0**	**67.7**	
Age range (m)	42-46	30-66	31-71	62-78	110-141	144-147	52-89	

To provide further information regarding the performance on individuals with RTS on the ToMS, the percentage pass rates for each task in this battery are displayed in Table 17. This table shows that relatively high proportions of the individuals with RTS tested on this battery passed the tasks at the beginning of the scale. However, as the scale progressed, percentage pass rates decreased, with very few participants passing the final task.

Table 17: *The percentage of individuals with RTS that passed each task in the ToMS battery and corresponding order in typical development.*

Task	RTS Pass Rate	'Typical' Order (as depicted in Figure 12)
Diverse Desires	73.1%	# 1
Diverse Beliefs	65.4%	# 2
Knowledge Access	46.2%	# 3
Contents False Belief	19.2%	# 4
Real Apparent Emotions	7.7%	# 5

Results: Analysis of control/memory questions (the ToMS)

As outlined in section 5.3.2.5 of this chapter, to pass the KA, CFB and RAE tasks, participants were required to pass the associated memory/control questions *as well* as the critical test questions. This was to ensure that the participants understood and remembered all the relevant information and that their answers were therefore based on meaningful reasoning rather than random responses or 'guesses'. Inspection of the control/ memory questions for these tasks indicated that a high number of the participants who failed the tasks also failed the associated control questions. For the KA task, for the 14 participants who failed the task, 10 also failed the control questions (71.4%). For the CFB task, out of the 21 fails, 11 also failed the control questions (52.4%). For the RAE task all of the 24 participants that failed also failed the control questions (100.0%). These findings suggest that although individuals with RTS follow the same developmental trajectory as typically developing individuals on the ToMS, a high proportion of failures may be attributable to memory difficulties.

5.5. Discussion

The current chapter utilised two scaled experimental batteries to examine the social cognitive abilities in RTS. The first aim of the chapter was to explore whether individuals with RTS showed advanced, preserved or delayed social cognition relative to their MA. The second aim was to examine whether, regardless of delay or ability, individuals with RTS displayed the same social cognitive developmental trajectory as typically developing individuals or whether they displayed a unique developmental pathway or pattern.

To describe social cognitive ability relative to MA, individuals were allocated a scale position point based on how far they progressed through the developmental batteries. This scale position point was then plotted alongside each individual's MA as well as average age data derived from typical development studies. Descriptive visual analysis

indicated that six participants reached scale position points *above* what would have been predicted given their MA. Twenty-two participants had scale position points *below* what would have been predicted given their MA. These findings suggest that a small proportion of the group may show advanced abilities relative to their mental age, but that the majority show delayed ability. The distribution of scale position points suggests that the extent of this delay varies substantially across participants.

Of the six participants that evidenced relative 'advanced' ability, it is of interest that all six of these points were located at the lower end of the scale (points 1-7). At the higher end of the scale (8-10) no participants evidenced 'advanced' scale position points. Although interpretation requires appropriate caution, these findings *may* indicate that early social cognitive abilities in RTS could be relatively advanced, or 'spared' relative to mental age but then this ability then 'slows down' when social cognitive reasoning becomes more sophisticated. Considering the results of the later analysis of control/memory questions for these tasks (8-10), which indicated that a high proportion of individuals who failed these tasks did so because they failed the corresponding memory check questions, it could be hypothesised that this 'slowing down' may be attributable to memory difficulties rather than fundamental difficulties with social cognitive ability per se.

The interpretation of these data must be treated cautiously. However, the benefits of this initial examination is that it provides a 'first look' and potential hypothesis that can be taken forward and examined more systematically in the future. Future studies could focus more specifically on early social cognitive abilities in younger individuals with RTS. If it is suspected that individuals with RTS display relatively preserved or advanced *early* social cognitive ability but this then slows down, this can be tested using research that uses a similar, but longitudinal follow up methodology. For instance, the six individuals who

potentially display 'advanced' social cognitive ability could be followed up to ascertain whether their advanced abilities are maintained or whether they slow down when social cognitive reasoning becomes more sophisticated.

To examine developmental trajectory, Guttman scaling and individual pairwise comparisons were utilised to ascertain whether individuals with RTS passed tasks in the ESCS and ToMS in the same general progression as typically developing individuals. For the ESCS, findings revealed a different developmental sequence. Although a more general developmental progression was difficult to ascertain because individuals were performing near ceiling, pairwise comparisons showed that the 'gaze' task was significantly harder than both the 'helping task' and the 'cooperation- tubes' task. The finding that the 'gaze' task was harder than the 'cooperation- tubes task' is the finding of interest, as typically developing data would suggest that these two tasks are of equal developmental difficulty. It could be argued that this difference may have simply occurred because participants with RTS just viewed the task differently to typically developing children. For example, it could have been that those with RTS failed the task simply because they found it less engaging than the other tasks. However, this explanation seems unlikely given that the 'point' task trials were incorporated in the same experimental task but did not show the same difference. Consequently, it seems more likely that the difference was attributable to a difficulty with eye gaze understanding in RTS rather than any task idiosyncrasies.

In chapter 4 it was shown that, in typical development, the tasks in the ESCS followed a reliable developmental progression. It was subsequently discussed in section 4.6 that it was possible that these developmental progressions may occur via the process of mediation, where the acquisition of later social cognitive skills is dependent on the acquisition and scaffolding of earlier social cognitive skills. Baron-Cohen (1994, 1995) presents a neuro-cognitive model of infant social cognition that takes this position but

specifically proposes that eye gaze has particular significance. The model implicates modules that operate in sequence during the first four years of life. The earliest mechanism is the Intentionality Detector (ID) which interprets actions as volitional and builds dyadic representations of behaviour. Another early mechanism is the Eye Direction Detector (EDD), which spontaneously detects and responds to eye-like stimuli, computing a dyadic communicative relationship between the 'eyes' and objects of attention. It is proposed that these two mechanisms then feed into a later developing Shared Attention Mechanism (SAM) which computes triadic representations. More specifically, it is held that the SAM takes information from the EDD about the perceptual state of others, to enable joint attention behaviours. The final mechanism, the Theory of Mind Mechanism (ToMM), then feeds from the SAM with children developing mental state understanding by using triadic interactions from the SAM and converting them into meta-representations. This mindreading model therefore makes the claim that eye gaze detection and understanding (EDD) is necessary for the acquisition of joint attention behaviours (SAM). However, findings from the current study present a conflicting picture, individuals with RTS were able to demonstrate joint attention behaviours (i.e. cooperation), despite their gaze understanding being impaired. These findings therefore challenge the assumption that the SAM *needs* direct input from the EDD. Instead, the current findings would appear to suggest that these early social cognitive developments are more likely to occur via modification than mediation i.e. a progression and broadening of developmental skills rather than a sequential acquisition of skills than are dependent on the acquisition and scaffolding of earlier skills.

Due to differences in age and ability across the sample it was not possible to administer all tasks from both the ESCS and ToMS to each participant and subsequently the batteries were analysed separately. Consequently, it is not possible to discuss any

sequential ordering of earlier social cognitive skills (as measures by the ESCS) in relation to later ToM skills (as measures by the ToMS) and examine claims, such as those by Baron-Cohen's model, that the development of mental state understanding (e.g. ToMM) is reliant upon triadic interactions such as joint attention behaviours (e.g. SAM). However, the separate analysis of the ToMS did provide other important information. Findings from the Guttman analysis indicated that individuals with RTS followed the same developmental trajectory as shown in typical development i.e. they passed earlier tasks, reached a task that they failed, and then failed all subsequent tasks. However, unlike in Wellman and Liu's (2004) original study in which if children failed an item they tended to pass the relevant control questions, for individuals with RTS, analysis of control trials indicated that a high proportion of those that failed did so because they also failed the associated control questions. There are two possible interpretations of these results. Firstly, it is possible that individuals with RTS demonstrate independent problems with both ToM and working memory. Alternatively, it could be that individuals with RTS fail ToM tasks simply because they lack the necessary working memory abilities to pass them i.e. not because of an independent impairment to a specific neurocognitive module dedicated to mind reading. Although it is not possible to disentangle these two possibilities without further study, the findings of the current study seem to suggest that the latter presents a more realistic possibility. Gaze interpretation aside, pass rates showed that individuals with RTS generally showed good social cognitive ability with tasks that were less dependent on cognitive processes i.e. tasks in the ESCS and earlier tasks in the ToMS (i.e. DD and DB). Consequently, it seems more likely that ToM impairment in RTS is attributable to memory difficulties rather than difficulties with ToM per se. These findings are similar to those outlined by Grant et al. (2007) for FXS (see section 1.7 for discussion).

In addition to their theoretical implications, the findings from the ESCS and ToMS have important clinical implications. Eye gaze perception and understanding is a crucial element in social interaction, as it is a medium through which humans transmit socially relevant information (Macrae, Hood, Milne, Rowe & Mason, 2002). For example, dependent on context it can be used to interpret signs of friendliness, attraction, general interest, hostility, and anger (Argyle & Cook, 1976). The finding that individuals with RTS may show difficulties with eye gaze has not previously been described in the literature. This novel finding is clinically important as it may contribute towards explanations of some of the emerging social difficulties that parents and carers have recently described (see section 5.2) and subsequently contribute towards planning appropriate intervention strategies. However, further research is required to determine the exact nature of this impairment in RTS. It may be that individuals with RTS are gaze avoidant and simply fail to look directly at the eyes of others. Alternatively, it may be that individuals with RTS do look at other's eyes but fail to interpret the communicative intention of gaze.

The finding that a large majority of individuals with RTS showed delayed social cognitive abilities relative to their mental age, together with the finding that high proportions of individuals showed difficulties with the memory check questions on the ToMS, is also of clinical interest. As has been described previously, the ability to attribute mental states to others is fundamental for successful social interaction as it allows a person to predict, explain, and manipulate the behaviour of others (Premack & Woodruff, 1978). Consequently, the fact that this ability is delayed in a number of individuals RTS, may contribute to explanations of some of the social difficulties recently described. Successful strategies to improve ToM understanding in children with autism include social stories and 'thought bubbles' (Ozonoff & Miller, 1995; Wellman et al. 2002). However, the finding

that the impairment in RTS may be attributable to working memory difficulties rather than ToM ability per se, would suggest that intervention strategies that aim to improve ToM understanding may be best to initially focus on training working memory. Cognitive training for individuals with ID has demonstrated the effectiveness of rehearsal strategies for increasing the amount individuals can retain in working memory (e.g. Broadley & MacDonald, 1993; Comblain, 1994; Loomes, Rasmussen, Pei, Manji & Andrew; Van der Molen, Van Luit, Van der Molen, Klugkist & Jongmans, 2010). There is also a growing number of studies that demonstrate that training-related increases in working memory can subsequently yield improvements in other important cognitive skills (Chein & Morrison, 2010; Klingberg et al, 2005). Therefore, it is possible that working memory training could also help improve the ToM abilities in individuals with RTS. Future research is required to obtain more robust findings and to test these potential hypotheses.

As discussed throughout this thesis, (e.g. sections 1.6, 1.12 and 2.2) it has been suggested that syndrome groups that display fractionated ASD profiles provide a vehicle to study each aspect of the ASD triad separately and consequently can aid our understanding of the aetiological pathways underpinning ASD phenomenology. As previously outlined, there is a large body of literature that attributes the social interaction and communicative impairments in ASD to ToM deficits (Baron-Cohen, 2000). However, the current chapter has outlined that ToM deficits also occur in individuals with RTS, who despite showing a high prevalence of 'ASD' when using 'cut off' criteria, display a fractionated social profile and have been described anecdotally as 'sociable'(see sections 2.2, 2.4.1.5, and 2.4.2.5). As discussed in section 1.7, similar findings have been found in WS, who show ToM deficits but also phenotypic 'hypersociable' behaviour. Although preliminary, when taken together these findings may suggest that ToM deficits *alone* cannot fully account for the specific presentation of the social deficits seen in ASD. More specifically, it would appear

that although ToM may contribute to the social difficulties in ASD, there may be other mechanisms that determine relative 'sociability', or 'social motivation' towards social interaction. Potentially different implications of pairing atypical social cognition together with varying degrees of social motivation are discussed further in the following general discussion.

The findings and subsequent discussions of the current chapter need to be considered carefully alongside methodological limitations. For the initial analysis, to explore whether individuals with RTS showed advanced, preserved or delayed social cognition relative to their MA, individuals' scale position point was plotted alongside their MA and average age data derived from typical development studies. This method was chosen as a compromise due to the benefits of prioritising a developmental trajectory approach. However, this method gives rise to two main methodological constraints.

Firstly, as comparisons were drawn against average acquisition ages taken from typical development studies, rather than using matched comparisons, it is possible that these exact same 'average ages' may not 'carry over' to the current study and should therefore only be used as rough estimates. For instance, it is possible that even very small procedural differences between this study, and the original studies, may also affect 'typical' age of acquisition. However, it is of note that during the development of the ESCS procedural changes were kept to minimum, and validation of the scale indicated that tasks stacked developmentally as expected. Given that the typical age of acquisition of the sequential tasks are only 4-6 months apart, it would seem unlikely that they would continue to developmentally stack in accordance with the typically developing literature, if ages of acquisition were widely different. Secondly, due to difficulties with calculating MAs on the WASI and MSEL for individuals with ID, the MAs of individuals with RTS should only be considered as estimates also. Although these methodological limitations are

of note, it is felt that this analysis is still helpful as, as discussed above, it provides a 'first look' at findings that can then followed up using research that adopts more rigorous methods.

An important caveat of the current study is that it did not include any other groups matched for degree of disability. Consequently it is not possible to conclude that the pattern of results and subsequent social cognitive profile shown in this study is specific to RTS. It could be that other groups associated with ID also show the same developmental pathway. Further research using the same developmental batteries should be conducted to examine this possibility and subsequently ascertain the specificity of these results to RTS. Other groups of interest, and potential future studies are discussed further in the following general discussion.

5.6. Summary

Throughout this thesis it has been argued that syndrome groups that display fractionated ASD profiles could provide a useful vehicle to study each aspect of the ASD triad separately. More specifically, the thesis has drawn attention to the study of ToM development in syndrome groups that showed a high prevalence of ASD but fractionated social profiles. However, until now there has been no scaled battery that enables the measurement of social cognitive development in individuals with ID who are too young or cognitively impaired to pass standard ToM tasks. Consequently, chapters 3 and 4 presented the development and validation of the ESCS, an 'early' social cognition scale that would enable the developmental assessment of ToM 'precursors'. In the current chapter the ESCS was used alongside Wellman and Liu's (2004) ToMS to examine the social cognitive development of RTS, a syndrome group that was highlighted in chapter 2 as displaying a fractionated social profile.

The first aim of the chapter was to explore whether individuals with RTS showed advanced, preserved, or delayed social cognition relative to their MA. Findings from descriptive visual analysis showed that early social cognitive abilities may be relatively advanced or 'spared' but then slow down when social cognitive reasoning becomes more sophisticated. As results indicated that a high proportion of individuals failed corresponding 'memory check' questions in later tasks, it was proposed that this 'slowing down' may be attributable to memory difficulties.

The second aim was to examine whether, regardless of delay or ability, individuals with RTS displayed the same social cognitive developmental trajectory as typically developing individuals or whether they displayed a unique developmental pathway or pattern. Findings from the ToMS indicated that individuals with RTS displayed the same developmental trajectory as typically developing infants. However, for the ESCS, findings revealed a different developmental sequence. Pairwise comparisons indicated that the 'gaze' task was significantly harder than expected.

The current chapter discussed these findings in relation to theoretical implications for models of ToM and ASD, clinical implications for individuals with RTS, and potential areas for future study.

Running Head: General Discussion

CHAPTER SIX

GENERAL DISCUSSION

6.1. Introduction

The review in chapter 1 provided a synthesis of key research findings that influenced the development of the empirical work described in this thesis. The association between autism spectrum disorders (ASDs) and genetic syndromes was introduced and it was argued that 'broad level' diagnostic descriptions can often mask important qualitative differences that exist between genetic syndromes and idiopathic ASD. Evidence was presented for Angelman syndrome (AS), Cornelia de Lange syndrome (CdLS) and Fragile X syndrome (FXS) that highlighted how subtle differences, such as fractionated social profiles, exist when 'finer grained' comparisons are made (section 1.3). In line with these findings, the review then introduced evidence for fractionation of the ASD triad of impairments at the behavioural, genetic, cognitive and neural levels (sections 1.4 and 1.5). It was argued that research examining the core impairments in ASD, and the potentially separate pathways underpinning them, may be better understood if studied separately.

The review proposed that syndrome groups that displayed fractionated ASD profiles could provide a useful vehicle by which to study to each aspect of the ASD triad separately. Given the link between Theory of Mind (ToM) and the social interaction and communicative impairments in ASD (see Baron-Cohen, 2000 for a review), the review drew attention to the specific study of ToM development in syndrome groups that showed a high prevalence of ASD but fractionated social profiles. The following question was posed: *How does the development of ToM relate to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles?*

Although the question posed appeared to be a relatively simple one, the review highlighted two main methodological constraints that needed to be addressed; the use of single task methodologies and the cognitive demands of 'typical' ToM tasks. It was described in section 1.8, how studies investigating ToM in genetic syndromes typically

compared performance on a single standard false belief task to the performance of matched controls. Yet, it was outlined how the attainment of false belief understanding represents just *one of many* social cognitive developments that emerge progressively (e.g. Flavell & Miller, 1998; Gopnik & Wellman, 1992) and consequently it was argued that such single task methodologies provide very limited information with no insight into the developmental pathway or causal mechanisms that occur prior to, or following false belief acquisition. Instead, it was proposed that a developmental approach, as used by Wellman and Liu (2004) in their 'ToM scale' (ToMS), provided a preferential platform to examine the interplay between social cognitive development and related factors in individual difference research. However, despite the potential benefits of the ToMS it was highlighted how the tasks included in this scale were not suitable for individuals with ID. It was discussed in section 1.9 how these 'typical' ToM tasks not only require an individual to reason about *belief* but that they also place substantial demands on working memory and executive inhibitory control (e.g. Moses, 2005; Russell, 1996), yielding them unsuitable for individuals with ID who are too young or too cognitively impaired to complete them. It was argued that this was of critical importance for the question posed above, as many genetic syndromes are associated with moderate to severe ID and deficits expressive and receptive language. Drawing from the developmental literature, the review presented a potential solution: the scaling and assessment of early social cognitive 'precursors' that develop prior to fully fledged ToM.

On the basis of the review, the thesis had four broad aims. First, in chapter 2 the aim was to highlight Rubinstein-Taybi syndrome (RTS) as a potential syndrome of interest by extending the behavioural phenotype through the examination of characteristics of ASD, affect, and overactivity. In chapter 3, the aim was to develop a 'ToM precursor' scale that was suitable for the developmental assessment of social cognition in individuals

with ID who are too young or too cognitively impaired to complete more 'traditional' ToM tasks. The aim of chapter 4 was to validate this proposed scale using a normative sample of typically developing infants. Finally, in chapter 5 the aim was to explore the potential theoretical and clinical implications of this new methodology by piloting the approach with individuals with RTS.

In this general discussion, the main findings of the current thesis are revisited. Clinical and research implications are then considered and the possibilities for future study are suggested. Finally, the work is evaluated by considering the strengths and limitations of the methodologies used.

6.2. Main Findings

In the introduction to chapter 2, it was highlighted that the behavioural profile of RTS noted in the literature suggested that these individuals may present with dissociation across the triad of impairments, the presence of repetitive behaviours but a fractionated 'sociable' social profile. Both total group and matched group approaches were utilised to position RTS relative to an idiopathic ASD group, a Down syndrome (DS) group and an FXS group on characteristics of autism spectrum phenomenology, affect, and overactivity. These groups were selected as it allowed the positioning of ASD phenomenology in RTS relative to idiopathic ASD as well as two genetic syndromes of known aetiology with differing behavioural profiles and associations with ASD. It was hypothesised that if the repetitive behaviour and social profile of RTS described in the literature was correct, then when compared to ASD, FXS, and DS, one might expect for RTS to be positioned more closely to ASD and FXS with regards to repetitive behaviour, but closer to DS on measures of social behaviour. Findings from the study confirmed this prediction. It was found that RTS showed a relatively high prevalence of ASD, but a dissociation across the

triad of impairments. More specifically, 64.9% and 65.7% of the individuals with RTS reached 'cut off' criteria for ASD for the total and matched group samples respectively. This was in comparison to 83.5% and 100% in FXS, and 19.2% and 29.4% in DS, for total and matched samples respectively. For social aspects of the ASD triad, RTS was comparable to DS, and significantly less impaired than the ASD and FXS group. However, for repetitive behaviour, RTS was comparable to the ASD and FXS groups but showed significantly higher levels of repetitive behaviour than the DS group. Overall, the current chapter provided evidence that highlighted RTS as a syndrome of interest from which to study the development of ToM and its relationship to social behaviour.

In the introduction to chapter 3 it was highlighted that developmental psychologists have argued that early social cognitive skills such as *joint attention* and *shared intentionality* lay the foundations for later ToM development (e.g. Baron-Cohen, 1989, 1995; Charman et al. 2000; Tomasello et al. 1993, 2005). Consequently, assessing these early social cognitive skills could provide a useful means from which to examine the development of social cognition in individuals with ID who were too young or too cognitively impaired to complete traditional ToM tasks. A review of the literature was conducted to select a set of tasks that, when combined together, would potentially form a developmental scale. Five experimental tasks were selected that assessed seven early social cognitive abilities. By arranging the tasks in terms of increasing age, a preliminary scale was proposed with estimated ages of acquisition ranging from approximately 14 months to over 24 months.

In chapter 4, the proposed preliminary scale was examined using a normative sample. Based on findings from the review in chapter 3, it was predicted that the tasks would be of increasing difficulty and thus form a progressive developmental scale. Results partly confirmed this prediction. Findings indicated that six out of the seven tasks followed

the expected developmental scale. It was found that typically developing infants possessed the social cognitive understanding and altruistic motivation to 'help' another before they possessed the social cognitive ability to: understand the communicative intention of a pointing gesture; and re-enact a person's underlying intentions and goals. Infants then developed the ability to: understand the communicative intention of a gaze gesture; and coordinate their intentions and actions with another person to form a joint goal and cooperate skilfully in a problem solving 'tubes' game. Finally, infants developed the ability to coordinate their intentions and actions with another person to cooperate skilfully in a social 'trampoline' game. The one task that was not positioned as predicted was the task that assessed the point at which infants understood what others 'have and have not seen'. Findings showed that infants passed this task much later than expected. It was subsequently argued that the later age of acquisition was most likely due to the methodological changes made to the task and consequently the task was removed from the final experimental battery entitled the 'early social cognition scale' (ESCS).

In the introduction to chapter 5, the potential theoretical and clinical implications of applying the ESCS together with the ToMs to assess the social cognitive development in RTS were discussed. Given the link between ToM deficits and the social interaction and communicative impairments in ASD, one of the possible hypotheses presented was that the fractionated 'sociable' social profile reported in RTS may be underpinned by a relative 'sparing' in social cognitive abilities. However, an alternative hypothesis was also presented based on findings from studies examining ToM in Williams syndrome (WS). Studies have shown that ToM deficits are present in WS despite their phenotypic 'hypersociable' behaviour (Tager-Flusberg & Sullivan, 2000; Tager-Flusberg, Sullivan, & Boshart, 1997). Consequently, it was hypothesised that social cognitive deficits could also be present in RTS despite their fractionated 'sociable' profile. Findings from descriptive

visual analysis that compared participant's social cognitive performance to 'typical' ages of acquisition are tentative but suggested that six participants showed 'advanced' abilities relative to their mental age and 22 showed 'delayed' abilities. Of the six participants that evidenced relative 'advanced' ability, all were located at the lower end of the scale (tasks 1 – 7). At the higher end of the scale (tasks 8- 10), no participants evidenced 'advanced' scale position points. It was subsequently proposed that these findings may indicate that early social cognitive abilities in RTS could be relatively advanced, or 'spared', but then 'slow down' when social cognitive reasoning becomes more sophisticated. Together with results from the later analysis of control/memory questions for tasks 8-10 (which indicated that a high proportion of individuals failed corresponding memory check questions) it was proposed that such 'slowing down' could be attributable to memory difficulties. These findings are similar to those outlined by Grant et al. (2007) for FXS (see section 1.7 for discussion).

In chapter 5 it was proposed that the developmental study of social cognition in RTS also had the potential to inform models of ToM more generally. In section 4.6 it was suggested that social cognitive developmental progression may occur via the process of mediation, in which the acquisition of later social cognitive skills are dependent on the acquisition and scaffolding of earlier social cognitive skills. However, it was argued that if individuals with RTS demonstrated a different developmental sequence, then it may imply that 'later' social cognitive skills do not require, or are not reliant upon, the sequential acquisition of 'earlier' social cognitive skills. Findings from the ESCS implied that this was the case. Pairwise comparisons indicated that the 'gaze' task was significantly harder than expected, and consequently RTS followed a different developmental trajectory. It was argued that the findings implied that the early social cognitive developments assessed by the ESCS were more likely to occur via modification than mediation i.e. the

progression and broadening of developmental skills rather than a sequential acquisition of skills that are dependent on the acquisition and scaffolding of earlier skills.

Findings from Guttman analysis of the ToMS indicated that individuals with RTS followed the same developmental trajectory as typically developing infants. As each battery was analysed separately, it was not possible to consider the sequential ordering of earlier social cognitive skills (as measured by the ESCS) in relation to later ToM skills (as measured by the ToMS). However, analysis of ToMS control trials indicated that a high proportion of those who failed the 'later' tasks did so because they also failed the associated control questions. Given that the pass rates were good for tasks that were less dependent on cognitive processes (i.e. tasks in the ESCS and the 'earlier' tasks in the ToMS), it was proposed that ToM difficulties in RTS were more likely to be attributable to memory impairment than to difficulties with ToM per se.

6.3. Implications of Findings

The current research has a number of implications. For clarity, the following section discusses these in turn. Firstly, the clinical implications for individuals with RTS are highlighted. Secondly, the implications for a wider population of individuals with ASD are discussed. Finally, the theoretical implications for models of ToM are outlined.

6.3.1. Implications for individuals with RTS

As highlighted in chapter 2, the research literature regarding RTS is in its infancy. Prior to this thesis the majority of studies detailing the behavioural characteristics of RTS have involved case studies or cohort descriptions only. There had been no studies that had examined the social cognitive abilities of the group. The implication of the studies presented in this thesis is that they provide a first step towards the broadening of research

literature that is available for individuals with RTS, their families, and the professionals who support them. The studies have provided novel findings and have opened up further questions to be answered that will promote future work in the area.

The findings of chapter 5 have important clinical implications for individuals with RTS with regards to their social vulnerability. Jawaid et al. (2012) discuss how the combined effect of ID and atypicalities of social cognition may put individuals at increased risk of vulnerability in their social environment. It would seem reasonable to suggest that this risk may be further compounded with *increased levels of social motivation*. For instance, if a person is particularly motivated to engage in social interactions (i.e. is "over friendly"), but they also have social cognitive deficits, they could become 'easy targets' for exploitation and abuse. More specifically, the person may engage in and solicit interactions but then lack the necessary social cognitive understanding to reason if, and when, someone's intentions may not be honourable. It could be argued that these instances would occur more frequently for people who 'seek out' social interaction than for people who are socially withdrawn (i.e. individuals with idiopathic ASD). Indeed, it has been found that the rate of sexual abuse is particularly high in individuals with WS (20%; Rosner et al. 2004) and it has been hypothesised that this problem may occur as a result of the combined effect of people misinterpreting their 'overfriendly' demeanour and individuals with WS making inappropriate social evaluations of people (Jawaid et al. 2012). In a recent study examining 'stranger danger' awareness using a video vignette task, Riby, Kirk, Hanley & Riby (2013) showed that young people with WS displayed difficulties making judgements about whether or not to trust and engage in interactions with unfamiliar people. Importantly, qualitative data showed that individuals with WS were often unsuspecting that a person may try to 'trick' another person. The authors

consequently discuss the importance of future research that explores the relationship between stranger danger awareness and ToM ability.

Given the recent concerns of parents and carers of those with RTS regarding exploitation and a lack of "stranger danger awareness" (Oliver, 2007 personal communication), the finding that social cognitive atypicalities are present in the group offers an important potential point for intervention. The finding that memory difficulties may be causal in these ToM deficits may help to target these interventions more effectively.

6.3.2. Implications for the wider ASD population.

In chapter 1, it was argued that 'broad level' diagnostic descriptions can often mask important qualitative differences that exist between genetic syndromes and idiopathic ASD. Findings from chapter 2 provide further evidence that this is the case, and thus emphasise the importance of conducting fine-grained analysis of ASD in genetic syndromes.

The fact that RTS showed a dissociation across the triad of impairments (a fractionated social profile) adds to literature that points towards a fractionation in the triad of impairments and so has implications for the debate regarding how ASD is studied and conceptualised. Happé and Ronald (2008) propose that perhaps it would be more helpful if individuals were mapped separately "...along three orthogonal, dimensions: social interaction, communication, and restricted and repetitive behaviours." (p. 299). When taken together with the previous literature that outlines evidence for the fractionation in the ASD triad of impairments (e.g. Happé & Ronald, 2008; Happé, Ronald, & Plomin, 2006), the findings of the current thesis challenge the assumption that all aspects of the ASD triad can be, or should be explained together. Instead, the current evidence would suggest that

research examining these three core impairments, and the pathways underpinning them, would be better understood if studied separately.

The finding that individuals with RTS show social cognitive impairments has important implications for theories of ASD. As discussed throughout this thesis, there is a wide body of evidence linking the characteristic social interaction and communicative impairments in ASD to deficits in ToM (e.g. Baron-Cohen, 2000). In this account, social impairments are explained by the fact that individuals with ASD struggle to understand their social world. However, the fact that ToM impairments *also* exist in groups that show fractionated social profiles (i.e. WS and now RTS) suggests that the ToM hypothesis alone cannot fully account for the specific presentation of social deficits seen in ASD. More recently, an alternative 'social motivation theory' of ASD has been suggested (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Chevallier and colleagues present evidence to propose that social motivation is subserved by dedicated biological mechanisms including the ventral striatum, amygdala, and orbital and ventromedial regions of the prefrontal cortex (e.g. Adolphs & Spezio, 2006; Ghashghaei, Hilgetag, & Barbas, 2007; Klein, Shepherd, & Platt, 2009; Lin,Adolphs, & Rangel, 2011; Tabibnia & Lieberman, 2007). They argue that for individuals with ASD, social motivation may be diminished as a result of disruptions to the orbitofrontal-striatum-amygdala circuitry and disregulation of neuropeptide signalling (e.g. Bachevalier & Loveland, 2006; Modi & Young, 2012). Based on this framework, the authors propose that social cognitive deficits are a downstream *consequence* of social motivational deficits *rather than the cause*. It is hypothesised that reduced social motivation deprives the individual of the necessary social learning opportunities to develop their expertise in social cognition.

As the authors themselves admit, many questions remain regarding this theory. However, the model provides one possible explanation for the findings in the current

thesis; that it is other mechanisms, rather than simply ToM, that determine relative 'sociability'. Perhaps it is the case that although the social cognitive 'end result' may be similar in ASD and RTS (i.e. impaired ToM), the *cause* of these impairments may actually be quite different. For ASD, it could well be the downstream affect of diminished social interaction; but for 'sociable' RTS, the impairments may be more attributable to memory difficulties. Although more research is necessary to examine these potential theories, the findings presented in this thesis provide new insights and a new methodology that can be used to further our understanding of the aetiological pathways underpinning ASD.

6.3.3. Implications for theoretical models of ToM

The findings of the current research have implications for models of early social cognition and ToM. Firstly, the findings add support to the literature that implicates the importance of executive functions in the development and acquisition in ToM (Moses, 2005; Russell, 1996). Secondly, the findings provide new insights into the possible cause-effect sequence of early social cognitive understanding. As discussed in section 5.5, Baron – Cohen's (1994, 1995) neuro-cognitive model of infant social cognition makes the claim that eye gaze detection and understanding is a necessary prerequisite for the acquisition of joint attention behaviours. However, findings from this thesis demonstrate that individuals with RTS were able to demonstrate joint attention behaviours (i.e. cooperation), despite their gaze understanding being impaired. Consequently, these findings potentially undermine Baron-Cohen's sequential pathway and suggest that there may be alternative pathways implicated in early social cognitive development.

The development of the ESCS in chapters 3 and 4 has more general implications for models of ToM due to its potential application in future research. Wellman and Liu (2004) argued that their ToMS allowed for the examination and exploration of the

development of ToM in a way that had not previously been possible. They discussed how it enabled a more comprehensive assessment of the potential interplay between ToM understanding and other relevant factors such as family conversations, language, and executive function in individual difference research. However, the ToMS is centrally concerned with preschool developmental accomplishments and so cannot offer insight into the earlier developments that occur in infancy. The development of the ESCS means that it will now be possible to assess a much wider range of ages and abilities, capture a much broader array of social cognitive skills, and may provide a more continuous means to assess the relationship between early social cognitive skills in infants and preschool ToM.

6.4. Future Research

As the chapters in this thesis have progressed, more specific questions and further ideas for future research have emerged as a result. For example, future research should be conducted to examine the nature of the gaze deficit in RTS. Simple eye tracking methodologies could be utilised to disentangle whether deficits exist because individuals with RTS are simply gaze avoidant or whether they do look at others' eyes but subsequently fail to interpret the communicative intention of a person's gaze.

One of the main limiting factors in this research is the lack of a syndrome or idiopathic ASD comparison group in chapter 5. Consequently, future research should examine the specificity of findings to RTS by mapping the developmental trajectories of other syndrome groups and idiopathic ASD. Given reports that individuals with CdLS show prolonged eye gaze (Collis, Oliver & Moss, 2006), and individuals with FXS show gaze avoidance (Turk & Graham, 1997; Udwin & Dennis, 1995), it would be of interest to map the developmental trajectory of these groups using the ESCS and examine if the developmental positioning of the gaze task varies across the groups. Furthermore, as

outlined in chapter 3, given that some of the tasks in the ESCS vary with regard to the level of social motivation that they require (i.e. the 'helping' and 'cooperation' tasks, see sections 3.4.1.1 and 3.4.5.1), it would be of interest to examine whether the position of these tasks vary across groups that show differing levels of social motivation, such as a 'socially withdrawn' idiopathic ASD group, and a 'hyper sociable' WS group.

Although the current thesis refers to anecdotal descriptions of RTS as 'sociable' and 'overfriendly', and cites evidence to suggest that individuals with RTS were more sociable than a number of other syndrome groups (see section 2.2) it is of note that there has yet to be a study that specifically aims to characterise the social phenotype of RTS more systematically. Future work should be conducted that utilises observational assessments and group comparison designs to more accurately describe the social behaviour of the group.

6.5. Research Strengths

One of the main strengths of the current research is the unique use of such a broad range of experimental methods to investigate behaviour in a rare genetic syndrome group. In the first instance, the use of standardised measures together with the matched and total group comparison designs used in chapter 2 enabled the consideration of the specificity of findings to RTS, while controlling for the influence of ID. The subsequent use of a developmental scaling methodology in chapter 5 allowed the examination of the cognitive underpinnings of a behaviour of interest to be considered in much more comprehensive way than has previously been attempted.

Another main strength of this research is that it demonstrates a 'proof of principle'. It shows how it is possible to draw from the developmental literature to overcome

methodological constraints, and subsequently how this can then generate findings that may have otherwise been missed, or may have taken longer to reveal.

6.6. Research Limitations

The findings of the current thesis need to be considered alongside methodological limitations. Although certain methodological considerations have been mentioned above, and more generally throughout the thesis, a number of limitations require further attention and discussion.

Firstly, although is it the case that the ESCS and ToMS capture a much broader array of social cognitive skills over a much wider age range than has previously been possible, it is important to highlight that the tasks still only capture a *subset* of social cognitive skills. The tasks selected for the ESCS were required to fit inclusion criteria to enable them to be suitable for administering in participants' homes over the course of one day, meaning that it was not possible to include large numbers of tasks or tasks that required more complex apparatus. Similarly, the items in the ToMS were selected by Wellman and Liu (2004) specifically because they were comparable in testing format, few in number, and easily understood by young children. Therefore, not only does the ToMS not encompass *all* preschool ToM insights but there is a 'ceiling' effect for the use with older children who show more sophisticated ToM understanding. It is possible that there may be other social cognitive skills that are relatively 'advanced', 'spared' or 'impaired' in RTS but the current scales were unable to identify these. However, it is felt that limitations such as these should be expected given the novel and exploratory nature of the empirical work and the constraints of examining an area as complex as social cognition. As outlined by Wellman, Fang, and Peterson (2011) adding additional items, batteries and approaches

such as Pons, Harris, and de Rosnay's (2003) battery assessing children's understanding of emotional states, into future research would be informative.

There are limitations relating to the samples used in this thesis. Firstly, the generalisabilty of the current findings to all individuals with RTS should be considered as participants with RTS were recruited via a syndrome support group. It could be suggested that families and carers may be more likely to access support groups if the person they care displays greater difficulties. Therefore, it is possible that the findings reported may not be representative of the wider population of individuals with RTS. Secondly, it is of note that the sample sizes used in the thesis were relatively small. It is possible that some results may not have reached statistical significance because power was affected by a small N. This problem was illustrated in chapter 2, where even though the RTS group evidenced a much higher proportion of individuals meeting the ASD cut off than the DS group, this difference only approached significance. It is possible that additional results may have been uncovered in chapter 5, if a larger group of individuals with RTS, with a wider range of abilities was sampled. More specifically, if a greater number of younger or less able individuals with RTS were recruited, who were not at 'ceiling' on the ESCS, then it may have been possible to determine a more 'general developmental progression' of early social cognitive skills in RTS. However, difficulties with recruitment and sample size are a common and often unavoidable problem in research focusing on individuals with rare genetic syndromes. It is important to consider that despite these difficulties, the current thesis has highlighted that it is possible to obtain meaningful and clinically important findings from relatively small samples.

Limitations regarding the measures used in the studies should also be considered. In chapter 2, informant based questionnaire assessments were used to measure characteristics of ASD phenomenology, affect, and over activity. Although these measures

have been found to demonstrate good levels of reliability and have been developed for use with individuals with ID specifically, findings are still dependant on subjective ratings which may threaten the construct validity of conclusions drawn. Further support gathered through observational data would strengthen the validity of these findings. It is also important to consider the sole reliance upon a single screening tool to evaluate ASD phenomenology and subsequently highlight RTS as a group of interest. The Social Communication Questionnaire (SCQ; Berument, Rutter, Lord, Pickles & Bailey, 1999) is considered to be a robust measure of ASD symptomatology; however the validity of the measure in individuals with rare genetic syndromes such as RTS is not well understood. Consequently, although confidence in the findings is warranted from the convergent reports noted in the literature, further 'gold standard' ASD diagnostic assessments should be conducted to more fully understand ASD phenomenology in the sample.

6.7. Concluding Remarks.

At the beginning of this thesis, a question was posed: *How does the development of ToM relate to the social behaviour of syndrome groups that show a high prevalence of 'ASD' but fractionated social profiles?* The research presented in this thesis attempted to overcome methodological constraints and move closer to answering this question.

The thesis illustrated the benefits of using a broad range of methodological approaches to examine behaviour and cognition. In an initial study, both total and matched group approaches were utilised to highlight RTS as a syndrome of interest. The thesis then outlined the development of an early social cognition scale that would enable a developmental approach to be applied to the assessment of social cognition in individuals with ID. The scale was later examined and validated with typically developing infants. In a final study, the scale was applied to individuals with RTS.

As well as having important theoretical and clinical implications, the findings of thesis have produced a validated scale that will facilitate future research in this area. It is hoped that further research will be conducted to explore the questions and possibilities that have emerged as a result of this research and consequently may enable us to move closer towards understanding the link between social behaviour and social cognition.

References

Abu-Amero, K.K., Hellani, A.M., Salih, M.A., Seidahmed, M.Z., Elmalik, T.S., Zidan, G. & Bosley, T.M. (2010). A de novo marker chromosome derived from 9p in a patient with 9p partial duplication syndrome and autism features: genotype-phenotype correlation. *BMC Medical Genetics*, 11, 135.

Adolphs, R., & Spezio, M. (2006). Role of the amygdala in processing visual social stimuli. *Progress in brain research*, 156, 363-378.

Alvarez, J. A., & Emory, E. (2006). Executive function and the frontal lobes: a meta-analytic review. *Neuropsychology Review*, 16(1), 17-42.

Aman, M. G. (2004). Management of hyperactivity and other acting-out problems in patients with autism spectrum disorder. *Seminars in Pediatric Neurology* 11 (3), 225-228.

American Psychiatric Association (Ed.). (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-TR®*. American Psychiatric Association: Washington DC.

Amodio, D. M., & Frith, C. D. (2006). Meeting of minds: the medial frontal cortex and social cognition. *Nature Reviews Neuroscience*, 7(4), 268-277.

Argyle, M., & Cook, M. (1976). *Gaze and mutual gaze*. Cambridge, England: Cambridge University Press.

Arron, K., Oliver, C., Moss, J., Berg, K., & Burbidge, C. (2011). The prevalence and phenomenology of self-injurious and aggressive behaviour in genetic syndromes. *Journal of Intellectual Disability Research*, 55(2), 109-120.

Bachevalier, J., & Loveland, K. A. (2006). The orbitofrontal–amygdala circuit and self-regulation of social–emotional behavior in autism. *Neuroscience & Biobehavioral Reviews*, 30(1), 97-117.

Backes, M., Genc, B., Schreck, J., Doerfler, W., Lehmkuhl, G., & Von Gontard, A. (2000). Cognitive and behavioral profile of fragile X boys: correlations to molecular data. *American Journal of Medical Genetics*, 95(2), 150-156.

Baird, G., Simonoff, E., Pickles, A., Chandler, S., Loucas, T., Meldrum, D., & Charman, T. (2006). Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: the Special Needs and Autism Project (SNAP). *The Lancet*, 368(9531), 210-215.

Baron-Cohen, S. (1989). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, 30, 285- 289.

Baron-Cohen, S. (1994). How to build a baby that can read minds; Cognitive mechanisms in mindreading. *Cahiers de Psychologie Cognitive*, 13, 513 – 552.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Oxford: MIT Press.

Baron-Cohen, S. (2000). Theory of mind and autism: A fifteen year review. In S. Baron-Cohen, H. Tager-Flusberg, & D.J. Cohen (Eds.), *Understanding other minds: Perspectives from developmental cognitive neuroscience* (pp. 3-20). Oxford: Oxford University Press.

Baron-Cohen, S. (2002). The extreme male brain theory of autism. *TRENDS in Cognitive Sciences*. 6 (6), 248-254.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition*, 21(1), 37-46.

Bartsch, D., Ghirardi, M., Skehel, P.A., Karl, K.A., Herder, S.P., Chen, M.,...Kandel, E.R. (1995). Aplysia CREB2 represses long term facilitation: relief of repression converts transient facilitation into long-term functional and structural change. *Cellular and Molecular Life Sciences*, 83, 979-992.

Baxter, G. & Beer, J. (1992). 'Rubinstein Taybi syndrome'. *Psychological Reports*, 70, 451-456.

Behne, T., Carpenter, M., & Tomasello, M. (2005). One-year-olds comprehend the communicative intentions behind gestures in a hiding game. *Developmental Science*, 8(6), 492-499.

Behne, T., Carpenter, M., Call, J., & Tomasello, M. (2005). Unwilling versus unable: infants' understanding of intentional action. *Developmental Psychology*, 41(2), 328.

Bellagamba, F., & Tomasello, M. (1999). Re-enacting intended acts: comparing 12-and 18-month-olds. *Infant Behavior and Development*, 22(2), 277-282.

Berument, S. K., Rutter, M., Lord, C., Pickles, A., & Bailey, A. (1999). Autism screening questionnaire: diagnostic validity. *The British Journal of Psychiatry*, 175(5), 444-451.

Bolton, P., Macdonald, H., Pickles, A., Rios, P., Goode, S., Crowson, M., ... & Rutter, M. (1994). A case-control family history study of autism. *Journal of Child Psychology and Psychiatry*, 35(5), 877-900.

Bonati, M. T., Russo, S., Finelli, P., Valsecchi, M. R., Cogliati, F., Cavalleri, F., ... & Larizza, L. (2007). Evaluation of autism traits in Angelman syndrome: a resource to unfold autism genes. *Neurogenetics*, 8(3), 169-178.

Bourtchuladze, R., Frenguelli, B., Blendy, J., Cioffi, D., Schutz, G, & Silva, A.J. (1994). Deficient long-term memory in mice with a targeted mutation of the cAMP-responsive element-binding protein. *Cellular and Molecular Life Sciences*, 79, 59-68.

Broadley, I., & MacDonald, J. (1993). Teaching short term memory skills to children with Down syndrome. *Down Syndrome Research and Practice*, 1(2), 56-62.

Brock, J., Einav, S., & Riby, D. M. (2008). The other end of the spectrum. Social cognition in Williams syndrome. In: Reid, V., Striano, T., editors. *Social Cognition: Development, Neuroscience, and Autism*. Oxford: Blackwell, 281-300.

Burbidge, C. & Oliver, C. (2008). *The Activity Questionnaire. Manual for administration and score interpretation*. University of Birmingham.

Burbidge, C., Oliver, C., Moss, J., Arron, K., Berg, K., Furniss, F., ... & Woodcock, K. (2010). The association between repetitive behaviours, impulsivity and hyperactivity in people with intellectual disability. *Journal of Intellectual Disability Research*, 54(12), 1078-1092.

Campbell, L. E., Stevens, A. F., McCabe, K., Cruickshank, L., Morris, R. G., Murphy, D. G., & Murphy, K. C. (2011). Is theory of mind related to social dysfunction and emotional problems in 22q11. 2 deletion syndrome (velo-cardio-facial syndrome)? *Journal of Neurodevelopmental Disorders*, 3(2), 152-161.

Cebula, K. R., Moore, D. G., & Wishart, J. G. (2010). Social cognition in children with Down's syndrome: challenges to research and theory building. *Journal of Intellectual Disability Research*, 54(2), 113-134.

Chapman, R.S., & Hesketh, L.J. (2000). Behavioural phenotype of individuals with Down syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, 6, 84-95.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A., & Drew, A. (2000). Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development*, 15(4), 481-498.

Chein, J. M., & Morrison, A. B. (2010). Expanding the mind's workspace: Training and transfer effects with a complex working memory span task. *Psychonomic Bulletin & Review*, 17(2), 193-199.

Chevallier, C., Kohls, G., Troiani, V., Brodkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in cognitive sciences*, 16(4), 231-239.

Clark, P., & Rutter, M. (1981). Autistic children's responses to structure and to interpersonal demands. *Journal of Autism and Developmental Disorders*, 11(2), 201-217.

Clifford, S., Dissanayake, C., Bui, Q. M., Huggins, R., Taylor, A. K., & Loesch, D. Z. (2007). Autism spectrum phenotype in males and females with Fragile X full mutation and premutation. *Journal of Autism and Developmental Disorders*, 37(4), 738-747.

Collis, L., Oliver, C., & Moss, J. (2006). Low mood and anxiety in Cornelia de Lange syndrome. *Journal of Intellectual Disability Research*, 50, 791-800.

Colonnesi, C., Rieffe, C., Koops, W., & Perucchini, P. (2008). Precursors of a theory of mind: A longitudinal study. *British Journal of Developmental Psychology*, 26(4), 561-577.

Comblain, A. (1994). Working memory in Down syndrome: Training the rehearsal strategy. *Down Syndrome Research and Practice*, 2(3), 123-126.

Connor, J. M., & Ferguson-Smith, M. A. (1997). Chromosomal disorders. *Essential Medical Genetics*, ed, 5, 118-119.

Cornish, K., Burack, J. A., Rahman, A., Munir, F., Russo, N., & Grant, C. (2005). Theory of mind deficits in children with fragile X syndrome. *Journal of Intellectual Disability Research*, 49(5), 372-378.

Cornish, K., Turk, J., & Levitas, A. (2007). Fragile X syndrome and autism: common developmental pathways? *Current Pediatric Reviews*, 3(1), 61-68.

D'Archangelo, G., & Curran, T. (1995). Smart transcription factors. *Nature*, 376, 292-293.

Doherty, M. J. (2008). *Theory of mind: How children understand others' thoughts and feelings*. Psychology Press.

Donnellan, A. M., Anderson, J. L., & Mesaros, R. A. (1984). An observational study of stereotypic behavior and proximity related to the occurrence of autistic child-family member interactions. *Journal of Autism and Developmental Disorders*, 14(2), 205-210.

Dykens, E. M., Hodapp, R. M., & Finucane, B. M. (2000). *Genetics and mental retardation syndromes: A new look at behavior and interventions*. Paul H Brookes Publishing.

Dykens, E. M., & Volkmar, F. R. (1997). Medical conditions associated with autism. *Handbook of Autism and Pervasive Developmental Disorders*, 2, 388-407.

Fidler, D. J., Most, D. E., Booth-LaForce, C., & Kelly, J. F. (2008). Emerging social strengths in young children with Down syndrome. *Infants & Young Children*, 21(3), 207-220.

Fisch, G., Grossfeld, P.D., Youngblom, J., Simensen, R. & Battaglia, A. (2010). Autism, intellectual disability and molecular-genetic aspects associated with subtelomeric rearrangements. *Journal of Intellectual Disability Research*, 54, 886.

Flavell, J. H. (1972). An analysis of cognitive-developmental sequences. *Genetic Psychology Monographs*, 86, 279 - 350.

Flavell, J.H., & Miller, P.H. (1998). Social cognition. In D. Kuhn & R. Siegler (Eds.), *Handbook of child psychology: Vol 2: Cognition, perception and language* (pp. 851-898). New York: Wiley.

Flint, J. (1996). Annotation: behaviour phenotypes: a window on to the biology of behavior. *Journal of Child Psychology and Psychiatry*, 37(4), 355-367.

Fombonne, E. (1999). The epidemiology of autism: a review. *Psychological medicine*, 29(4), 769-786.

Fombonne, E. (2003). The prevalence of autism. *JAMA: The Journal of the American Medical Association*, 289 (1), 87-89.

Frith, U. (1989). *Autism: Explaining the enigma*. (1st ed.) Oxford: Blackwell.

Frith, C. D., & Corcoran, R. (1996). Exploring 'theory of mind' in people with schizophrenia. *Psychological Medicine*, 26(3), 521-530.

Frith, U., & Happé, F. (1994). Autism: Beyond “theory of mind”. *Cognition*, 50(1), 115-132.

Galéra, C., Taupiac, E., Fraisse, S., Naudion, S., Toussaint, E., Rooryck-Thambo, C., ... & Bouvard, M. P. (2009). Socio-behavioral characteristics of children with Rubinstein-Taybi syndrome. *Journal of Autism and Developmental Disorders*, 39(9), 1252-1260.

Garber, K. B., Visootsak, J., & Warren, S. T. (2008). Fragile X syndrome. *European Journal of Human Genetics*, 16(6), 666-672.

Garner, C., Callias, M., & Turk, J. (1999). Executive function and theory of mind performance of boys with fragile-X syndrome. *Journal of Intellectual Disability Research*, 43(6), 466-474.

Ghashghaei, H. T., Hilgetag, C. C., & Barbas, H. (2007). Sequence of information processing for emotions based on the anatomic dialogue between prefrontal cortex and amygdala. *Neuroimage*, 34(3), 905-923

Goodban, M. T. (1993). Survey of speech and language skills with prognostic indicators in 116 patients with Cornelia de Lange syndrome. *American Journal of Medical Genetics*, 47(7), 1059-1063.

Goots, E.E., & Liemohn, W.P. (1977). Behavioral characteristics of three children with the broad thrumb-hallux (Rubinstein-Taybi) syndrome. *Biological Psychiatry*, 12, 413-423.

Gopnik, A., & Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child Development*, 26-37.

Gopnik, A., Slaughter, V., & Meltzoff, A. (1994). Changing your views: How understanding visual perception can lead to a new theory of the mind. In C. Lewis & P. Mitchell (Eds.), *Children's early understanding of mind: Origins and development* (pp.157-181). Hove, UK: Lawrence Erlbaum Associates Ltd.

Gopnik, A., & Wellman, H. M. (1992). Why the child's theory of mind really is a theory. *Mind & Language*, 7, 145-171.

Gosch, A., & Pankau, R. (1997). Personality characteristics and behaviour problems in individuals of different ages with Williams syndrome. *Developmental Medicine & Child Neurology*, 39(8), 527-533.

Grant, C. M., Apperly, I., & Oliver, C. (2007). Is theory of mind understanding impaired in males with Fragile X syndrome? *Journal of Abnormal Child Psychology*, 35(1), 17-28.

Green, B. F. (1956). A method of scalogram analysis using summary statistics. *Psychometrika*, 21(1), 79-88.

Gregory, C., Lough, S., Stone, V., Erzinclioglu, S., Martin, L., Baron-Cohen, S., & Hodges, J. R. (2002). Theory of mind in patients with frontal variant frontotemporal dementia and Alzheimer's disease: theoretical and practical implications. *Brain*, 125(4), 752-764.

Guttman, L. (1944). A basis for scaling qualitative data. *American Sociological Review*, 139-150.

Guttman, L. (1950). The basis of scalogram analysis. In S. A. Stouffer, L. Guttman, E.A. Suchman, P.A. Lazarfeld, S.A. Star, & J.A. Clausen (Eds.), *Measurement and prediction* (pp.60 -90). Princetown, NJ: Princetown University Press.

Hagerman, R.J. & Lampe, M.E. (1999). Fragile X syndrome. In S. Goldstein & C.R. Reynolds (Eds.), *Handbook of Neurodevelopmental and Genetic Disorders in Children*. New York: Guildford Press.

Hall, S., DeBernardis, M., & Reiss, A. (2006). Social escape behaviors in children with Fragile X syndrome. *Journal of Autism and Developmental Disorders*, 36(7), 935-947.

Hall, S. S., Lightbody, A. A., Hirt, M., Rezvani, A., & Reiss, A. L. (2010). Autism in fragile X syndrome: a category mistake? *Journal of the American Academy of Child & Adolescent Psychiatry*, 49(9), 921-933.

Happé, F (2001). Social and non-social development in Autism: Where are the links? In J.A. Burack, T.Charman, N. Yirmiya, & P.R. Zelazo (Eds.). *Perspectives on Development in Autism*. NJ: Lawrence Erlbaum Associates.

Happé, F., & Ronald, A. (2008). The 'fractionable autism triad': a review of evidence from behavioural, genetic, cognitive and neural research. *Neuropsychology review*, 18(4), 287-304.

Happé, F., Ronald, A., & Plomin, R. (2006). Time to give up on a single explanation for autism. *Nature Neuroscience*, 9(10), 1218-1220.

Harpin, V.A. (2005). The effect of ADHD on the life of an individual, their family, and the community from preschool to adult life. *Archives of disease in childhood*, 90. 2-7.

Harris, P. L., Donnelly, K., Guz, G. R., & Pitt-Watson, R. (1986). Children's understanding of the distinction between real and apparent emotion. *Child Development*, 57(4), 895-909.

Hennekam, R.M. (2006) Rubinstein-Taybi syndrome. *European Journal of Human Genetics*, 14, 981-985.

Hennekam, R.M., Baselier, A.C., Beyaert, E., Bos, A., Blok, J.B., Jansma, H.B.,...& Veerman, H. (1992). Psychological and speech studies in Rubinstein-Taybi syndrome. *American Journal of Mental Retardation*, 66, 645-660.

Hennekam, R., Stevens, C. A., & Van de Kamp, J. J. P. (1990). Etiology and recurrence risk in Rubinstein-Taybi syndrome. *American Journal of Medical Genetics*, 37(S6), 56-64.

Hennekam, R.M., Van Den Boogaard, M., Sibbles, B.J., & Van Spijker, H.G. (1990). Rubinstein-Taybi Syndrome in The Netherlands. *American Journal of Medical Genetics*. Supplement, 6, 17-29.

Hennekam, R.M., & Van Doorne, J.M. (1990). Oral aspects of Rubinstein Taybi syndrome. *American Journal of Medical Genetics*. Supplement, 6, 42-47.

Hepburn, S. L., & MacLean, W. E. (2009). Maladaptive and repetitive behaviors in children with Down syndrome and autism spectrum disorders: implications for screening. *Journal of Mental Health Research in Intellectual Disabilities*, 2(2), 67-88.

Hill, J., & Furniss, F. (2006). Patterns of emotional and behavioural disturbance associated with autistic traits in young people with severe intellectual disabilities and challenging behaviours. *Research in Developmental Disabilities*, 27(5), 517-528.

Hodapp, R. M., Burack, J. A., & Zigler, E. (1990). The developmental perspective in the field of mental retardation. *Issues in the Developmental Approach to Mental Retardation*, 3-26.

Horsler, K., & Oliver, C. (2006). Environmental influences on the behavioral phenotype of Angelman syndrome. *American Journal on Mental Retardation*, 111(5), 311-321.

Horsler, K., & Oliver, C. (2006). The behavioural phenotype of Angelman syndrome. *Journal of Intellectual Disability Research*, 50(1), 33-53.

Howlin, P., & Karpf, J. (2004). Using the social communication questionnaire to identify autistic spectrum disorders associated with other genetic conditions: findings from a study of individuals with cohen Syndrome. *Autism: the International Journal of Research and Practice*, 8(2), 175-182.

Hughes, C., Jaffee, S. R., Happé, F., Taylor, A., Caspi, A., & Moffitt, T. E. (2005). Origins of individual differences in theory of mind: From nature to nurture?. *Child Development*, 76(2), 356-370.

Hughes, C., Russell, J., & Robbins, T. W. (1994). Evidence for executive dysfunction in autism. *Neuropsychologia*, 32(4), 477-492.

Jawaid, A., Riby, D. M., Owens, J., White, S. W., Tarar, T., & Schulz, P. E. (2012). 'Too withdrawn'or 'too friendly': considering social vulnerability in two neuro-developmental disorders. *Journal of Intellectual Disability Research*, 56(4), 335-350.

Joliffe, T. Lansdown, R., & Robinson, C. (1992). Autism: A personal account. *Communication*, 26, 12-19.

Jones, W., Bellugi, U., Lai, Z., Chiles, M., Reilly, J., Lincoln, A., & Adolphs, R. (2000). II. Hypersociability in Williams syndrome. *Journal of Cognitive Neuroscience*, 12 (1) 30-46.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous child*, 2(3), 217-250.

Karmiloff-Smith, A., Klima, E., Bellugi, U., Grant, J., & Baron-Cohen, S. (1995). Is there a social module? Language, face processing, and theory of mind in individuals with Williams Syndrome. *Journal of cognitive Neuroscience*, 7(2), 196-208.

Klein, J. T., Shepherd, S. V., & Platt, M. L. (2009). Social attention and the brain. *Current Biology*, 19(20), R958-R962.

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlström, K., ... & Westerberg, H. (2005). Computerized training of working memory in children with ADHD-a randomized, controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, 44(2), 177-186.

Kushlick, A., Blunden, R., & Cox, G. (1973). A method of rating behavior characteristics for use in large scale surveys of mental handicap. *Psychological Medicine*, 3, 466-478.

La Malfa, G., Lassi, S., Bertelli, M., Salvini, R., & Placidi, G. F. (2004). Autism and intellectual disability: a study of prevalence on a sample of the Italian population. *Journal of Intellectual Disability Research*, 48(3), 262-267.

Lacombe, D., Saura, R., Taine, L., & Battin, J (1992). Confirmation of assignment of a locus for Rubinstein- Taybi syndrome gene to 16p13.3. *American Journal of Medical Genetics*, 44, 126-128.

Leekam, S. R., & Ramsden, C. A. (2006). Dyadic orienting and joint attention in preschool children with autism. *Journal of Autism and Developmental Disorders*, 36(2), 185-197.

Leyfer, O. T., Woodruff-Borden, J., Klein-Tasman, B. P., Fricke, J. S., & Mervis, C. B. (2006). Prevalence of psychiatric disorders in 4 to 16-year-olds with Williams

syndrome. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics*, 141(6), 615-622.

Liebal, K., Colombi, C., Rogers, S. J., Warneken, F., & Tomasello, M. (2008). Helping and cooperation in children with autism. *Journal of Autism and Developmental Disorders,* 38(2), 224-238.

Lin, A., Adolphs, R., & Rangel, A. (2012). Social and monetary reward learning engage overlapping neural substrates. *Social Cognitive and Affective Neuroscience*, 7(3), 274-281.

Loomes, C., Rasmussen, C., Pei, J., Manji, S., & Andrew, G. (2008). The effect of rehearsal training on working memory span of children with fetal alcohol spectrum disorder. *Research in Developmental Disabilities,* 29(2), 113-124.

Lord, C., Rutter, M., DiLavore, P.C., & Risi, S. (2000). *The Autism Diagnostic Observation Schedule (ADOS)*. Los Angeles: Western Psychological Services.

Losh, M., Martin, G. E., Klusek, J., Hogan-Brown, A. L., & Sideris, J. (2012). Social communication and theory of mind in boys with autism and Fragile X syndrome. *Frontiers in Psychology*, 3, 266.

Macrae, C. N., Hood, B. M., Milne, A. B., Rowe, A. C., & Mason, M. F. (2002). Are you looking at me? Eye gaze and person perception. *Psychological Science,* 13(5), 460-464.

Mazzocco, M.M., Pulsifer, M., Fiumara, A., Cocuzza, M., Nigro, E., Incorpora, G., & Barone, R. (1998). Brief Report: Autistic behaviours among children with Fragile X or Rett syndrome: Implications for the classification of Persuasive Developmental Disorder. *Journal of Autism and Developmental Disorders*, 28, 321-328.

Meltzoff, A. N. (1988). Infant imitation and memory: Nine-month-olds in immediate and deferred tests. *Child Development,* 59(1), 217.

Meltzoff, A. N. (1995). What infant memory tells us about infantile amnesia: Long-term recall and deferred imitation. *Journal of Experimental Child Psychology*, 59(3), 497-515.

Meltzoff, A. N., & Keith Moore, M. (1992). Early imitation within a functional framework: The importance of person identity, movement, and development. *Infant Behavior and Development*, 15(4), 479-505.

Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198(4312), 75-78.

Meltzoff, A. N., & Moore, M. K. (1983). Newborn infants imitate adult facial gestures. *Child Development*, 702-709.

Modi, M. E., & Young, L. J. (2012). The oxytocin system in drug discovery for autism: animal models and novel therapeutic strategies. *Hormones and Behavior*, 61(3), 340-350.

Moll, H., & Tomasello, M. (2007). How 14-and 18-month-olds know what others have experienced. *Developmental Psychology*, 43(2), 309.

Moses, L.J. (2005). Executive functioning and children's theories of mind. In B.F. Malle & S.D. Hodges (Eds.), *Other minds: How humans bridge the divide between self and others* (pp. 11-25). New York: Guildford Press.

Moss, J., & Howlin, P. (2009). Autism spectrum disorders in genetic syndromes: implications for diagnosis, intervention and understanding the wider autism spectrum disorder population. *Journal of Intellectual Disability Research*, 53(10), 852-873.

Moss, J., Howlin, P., Hastings, R. P., Beaumont, S., Griffith, G. M., Petty, J., ... & Oliver, C. (2013). Social behavior and characteristics of autism spectrum disorder in Angelman, Cornelia de Lange, and Cri du Chat syndromes. *American Journal on Intellectual and Developmental Disabilities*, 118(4), 262-283.

Moss, J., Howlin, P., Magiati, I., & Oliver, C. (2012). Characteristics of autism spectrum disorder in Cornelia de Lange syndrome. *Journal of Child Psychology and Psychiatry*, 53(8), 883-891.

Moss, J., Oliver, C., Nelson, L., Richards, C., & Hall, S. (2013). Delineating the profile of Autism Spectrum Disorder Characteristics in Cornelia de Lange and Fragile X syndromes. *American Journal on Intellectual and Developmental Disabilities*, 118(1), 55-73.

Mullen, E. M. (1995). *Mullen scales of early learning* (pp. 58-64). Circle Pines, MN: AGS.

Nelson, L. (Unpublished Thesis). Social anxiety and changes with age in Cornelia de Lange syndrome.

Nelson, L., Moss, J., Powis, L., Waite, J. & Oliver, C (in review). A comparative study of sociability and selective mutism in autism spectrum disorder, Angelman, Cri du Chat, Cornelia de Lange, Fragile X and Rubinstein Taybi syndromes. *American Journal on Intellectual and Developmental Disabilities*.

O'Brien, G & Yule, W. (1995). *Behavioural Phenotypes*. Mac Keith Press: London

Oliver, C., Arron, K., Sloneem, J., & Hall, S. (2008). Behavioural phenotype of Cornelia de Lange syndrome: case–control study. *The British Journal of Psychiatry*, 193(6), 466-470.

Oliver, C., Berg, K., Burbidge, C., Arron, K., & Moss, J. (2011). Delineation of behavioral phenotypes in genetic syndromes. Comparison of autism spectrum disorder, affect and hyperactivity. *Journal of Autism and Developmental Disorder*, 41, 1019 – 1032.

Oliver, C., Berg, K., Moss, J., Arron, K., & Burbidge, C. (2011). Delineation of behavioral phenotypes in genetic syndromes: Characteristics of autism spectrum disorder, affect and hyperactivity. *Journal of Autism and Developmental Disorders*, 41(8), 1019-1032.

Oliver, C., Demetriades, L., & Hall, S. (2002). Effects of environmental events on smiling and laughing behavior in Angelman syndrome. *American Journal on Mental Retardation*, 107(3), 194-200.

Ozonoff, S., & Jensen, J. (1999). Brief report: Specific executive function profiles in three neurodevelopmental disorders. *Journal of Autism and Developmental Disorders*, 29(2), 171-177.

Ozonoff, S., & Miller, J. N. (1995). Teaching theory of mind: A new approach to social skills training for individuals with autism. *Journal of Autism and Developmental Disorders*, 25(4), 415-433.

Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1991). Executive function deficits in high-functioning autistic individuals: relationship to theory of mind. *Journal of Child Psychology and Psychiatry*, 32(7), 1081-1105.

Padfield, C.J., Partington, M.W., Simpson, N.E. (1968). The Rubinstein-Taybi Syndrome. *Archives of Disease in Childhood*. 43, 94-101.

Paris, J., Mattick, R. P., McLaren, J., Degenhardt, L., Hall, W., Voruganti, L. N., ... & Seeman, M. V. (2006). Inattention, hyperactivity, and impulsivity in teenagers with intellectual disabilities, with and without autism. *Canadian Journal of Psychiatry*, 51, 598-606.

Partington, M.W. (1990). Rubinstein Taybi Syndrome: A Follow-Up Study. *American Journal of Medical Genetics*. Supplement, 6, 65-68.

Perner, J., Leekam, S. R., & Wimmer, H. (1987). Three-year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology*, 5(2), 125-137.

Perner, J., Ruffman, T., & Leekam, S. R. (1994). Theory of mind is contagious: You catch it from your sibs. *Child Development*, 65(4), 1228-1238.

Persico, A. M., & Bourgeron, T. (2006). Searching for ways out of the autism maze: genetic, epigenetic and environmental clues. *TRENDS in Neurosciences*, 29(7), 349-358.

Peterson, C. C., Wellman, H. M., & Liu, D. (2005). Steps in theory-of-mind development for children with deafness or autism. *Child Development*, 76(2), 502-517.

Petrij, F., Giles, R.H., Dauwerse, H.G., Saris, J.J., Hennekam, R.C., Masuno, M.,...Breuning, M.H.(2002). Rubinstein Taybi syndrome caused by mutations in the transcriptional co-activator CBP. *Nature*, 376, 348-351.

Phillips, A. T., Wellman, H. M., & Spelke, E. S. (2002). Infants' ability to connect gaze and emotional expression to intentional action. *Cognition*, 85(1), 53-78.

Pickles, A., Starr, E., Kazak, S., Bolton, P., Papanikolaou, K., Bailey, A., ... & Rutter, M. (2000). Variable expression of the autism broader phenotype: findings from extended pedigrees. *Journal of Child Psychology and Psychiatry*, 41(4), 491-502.

Pillow, B. H. (1989). Early understanding of perception as a source of knowledge. *Journal of Experimental Child Psychology*, 47(1), 116-129.

Piven, J., Palmer, P., Jacobi, D., Childress, D., & Arndt, S. (1997). Broader autism phenotype: evidence from a family history study of multiple-incidence autism families. *American Journal of Psychiatry*, 154(2), 185-190.

Pons, F., Harris, P. L., & de Rosnay, M. (2004). Emotion comprehension between 3 and 11 years: Developmental periods and hierarchical organization. *European Journal of Developmental Psychology*, 1(2), 127-152.

Pratt, C., & Bryant, P. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). *Child Development*, 61(4), 973-982.

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind?. *Behavioral and Brain Sciences*, 1(04), 515-526.

Quintero-Rivera, F., Sharifi-Hannauer, P., & Martinez-Agosto, J. A. (2010). Autistic and psychiatric findings associated with the 3q29 microdeletion syndrome: case report and review. *American Journal of Medical Genetics Part A*, 152(10), 2459-2467.

Repacholi, B. M., & Gopnik, A. (1997). Early reasoning about desires: evidence from 14- and 18-month-olds. *Developmental Psychology*, 33(1), 12.

Riby, D. M., Kirk, H., Hanley, M., & Riby, L. M. (2013). Stranger danger awareness in Williams syndrome. *Journal of Intellectual Disability Research*.

Richler, J., Bishop, S. L., Kleinke, J. R., & Lord, C. (2007). Restricted and repetitive behaviors in young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 37(1), 73-85.

Roelfsema, J.H., White, S.J., Ariyurek, Y., Bartholdi, D., Niedrist, D., Papadia, F.,...Peters, D.J., (2005). Genetic heterogeneity in Rubinstein Taybi syndrome: mutations in both the CBP and EP300 genes cause disease. *American Journal of Human Genetics*, 76, 572-580.

Ronald, A., Happe, F., Bolton, P., Butcher, L. M., Price, T. S., Wheelwright, S., ... & Plomin, R. (2006). Genetic heterogeneity between the three components of the autism spectrum: a twin study. *Journal of the American Academy of Child & Adolescent Psychiatry*, 45(6), 691-699.

Ronald, A., Happé, F., & Plomin, R. (2005). The genetic relationship between individual differences in social and nonsocial behaviours characteristic of autism. *Developmental Science*, 8(5), 444-458.

Rosner, B. A., Hodapp, R. M., Fidler, D. J., Sagun, J. N., & Dykens, E. M. (2004). Social Competence in Persons with Prader-Willi, Williams and Down's Syndromes. *Journal of Applied Research in Intellectual Disabilities*, 17(3), 209-217.

Ross, E., Arron, K., & Oliver, C. (2008). *The mood interest and pleasure questionnaire: manual for administration and scoring*. University of Birmingham.

Rubinstein, J.H. (1990). Broad Thumb-Hallux (Rubinstein- Taybi) Syndrome 1957- 1988. *American Journal of Medical Genetics*. Supplement, 6, 3-16.

Rubinstein, J.H., & Taybi, H. (1963). Broad thumbs and toes and facial abnormalities: A possible mental retardation syndrome. *American Journal of Diseases of Children*, 105, 588-608.

Runco, M. A., Charlop, M. H., & Schreibman, L. (1986). The occurrence of autistic children's self-stimulation as a function of familiar versus unfamiliar stimulus conditions. *Journal of Autism and Developmental Disorders*, 16(1), 31-44.

Russell, J. (1996). *Agency: It's role in mental development*. Hove, UK: Psychology Press.

Russell, J. E. (1997). *Autism as an executive disorder*. Oxford University Press.

Russell, T. A., Schmidt, U., Doherty, L., Young, V., & Tchanturia, K. (2009). Aspects of social cognition in anorexia nervosa: Affective and cognitive theory of mind. *Psychiatry Research*, 168(3), 181-185.

Rutter, M., Bailey, A., & Lord, C. (2003). *The social communication questionnaire: Manual*. Western Psychological Services.

Scott, F. J., Baron-Cohen, S., Bolton, P., & Brayne, C. (2002). The CAST (Childhood Asperger Syndrome Test) Preliminary development of a UK screen for mainstream primary-school-age children. *Autism*, 6(1), 9-31.

Sears, L. L., Vest, C., Mohamed, S., Bailey, J., Ranson, B. J., & Piven, J. (1999). An MRI study of the basal ganglia in autism. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 23(4), 613-624.

Senju, A., Southgate, V., White, S., & Frith, U. (2009). Mindblind eyes: an absence of spontaneous theory of mind in Asperger syndrome. *Science*, 325(5942), 883-885.

Skuse, D. H. (2007). Rethinking the nature of genetic vulnerability to autistic spectrum disorders. *Trends in Genetics*, 23(8), 387-395.

Stevens, C.A. (2007). GeneReviews: Rubinstein Taybi syndrome. Seattle: University of Washington. www.genetests.org.

Stevens, C.A., Carey, J.C., & Blackburn, B.L. (1990a) Rubinstein-Taybi Syndrome: A Natural History Study. *American Journal of Medical Genetics*. Supplement, 6, 30-37.

Stevens, C.A., Hennekam, R.M, & Blackburn, B.L. (1990b). Growth in the Rubinstein-Taybi syndrome. *American Journal of Medical Genetics*. Supplement, 6, 51-55.

Stevens, C. A., Pouncey, J., & Knowles, D. (2011). Adults with Rubinstein–Taybi syndrome. *American Journal of Medical Genetics Part A*, 155(7), 1680-1684.

Tabibnia, G., & Lieberman, M. D. (2007). Fairness and cooperation are rewarding. *Annals of the New York Academy of Sciences*, 1118(1), 90-101.

Tager-Flusberg, H., & Sullivan, K. (2000). A componential view of theory of mind: Evidence from Williams syndrome. *Cognition*, 76(1), 59-90.

Tager-Flusberg, H., Sullivan, K., & Boshart, J. (1997). Executive functions and performance on false belief tasks. *Developmental Neuropsychology*, 13(4), 487-493.

Tomasello, M. (1995). Joint attention as social cognition. In. C. Moore, P.J. Dunham (Eds.) *Joint attention: It's origin and role in development* (pp.103 – 130). Erlbaum.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences*, 28(05), 675-691.

Trillingsgaard, A., & Østergaard, J. R. (2004). Autism in Angelman Syndrome: An exploration of comorbidity. *Autism*, 8(2), 163-174.

Turk, J. (1992). The Fragile-X syndrome: On the way to a behavioural phenotype. *The British Journal of Psychiatry*, 160(1), 24-35.

Turk, J., & Graham, P. (1997). Fragile X syndrome, autism and autistic features. *Autism*, 1(2), 175-197.

Turner, M. (1997) Towards an executive dysfunction account of repetitive behaviour in autism. In J Russell (Eds.). *Autism as an executive disorder*. Oxford: Oxford University Press

Udwin, O., & Dennis, J. (1995). Psychological and behavioural phenotypes in genetically determined syndromes: A review of research findings. *Clinics in Developmental Medicine*, (138), 90-208.

Udwin, O., & Yule, W. (1991). A cognitive and behavioural phenotype in Williams syndrome. *Journal of Clinical and Experimental Neuropsychology*, 13(2), 232-244.

Van der Molen, M., Van Luit, J. E. H., Van der Molen, M. W., Klugkist, I., & Jongmans, M. J. (2010). Effectiveness of a computerised working memory training in adolescents with mild to borderline intellectual disabilities. *Journal of Intellectual Disability Research*, 54(5), 433-447.

Warneken, F., Chen, F., & Tomasello, M. (2006). Cooperative activities in young children and chimpanzees. *Child Development*, 77(3), 640-663.

Warneken, F., & Tomasello, M. (2006). Altruistic helping in human infants and young chimpanzees. *Science*, 311(5765), 1301-1303.

Warneken, F., & Tomasello, M. (2007). Helping and cooperation at 14 months of age. *Infancy*, 11(3), 271-294.

Wechsler, D. (1999). *Wechsler abbreviated scale of intelligence*. Psychological Corporation.

Weeber, E.J. & Sweatt, J.D. (2002). Molecular neurobiology of human cognition. *Neuron*, 33, 845-848.

Wellman, H. M., Baron-Cohen, S., Caswell, R., Gomez, J. C., Swettenham, J., Toye, E., & Lagattuta, K. (2002). Thought-bubbles help children with autism acquire an alternative to a theory of mind. *Autism*, 6(4), 343-363.

Wellman, H.M., & Bartsch, K. (1989). 3-year-olds understand belief. *Cognition*, 30, 231-236.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: the truth about false belief. *Child Development*, 72(3), 655-684.

Wellman, H. M., Fang, F., & Peterson, C. C. (2011). Sequential Progressions in a Theory-of-Mind Scale: Longitudinal Perspectives. *Child development*, 82(3), 780-792.

Wellman, H. M., Hollander, M., & Schult, C. A. (1996). Young children's understanding of thought bubbles and of thoughts. *Child Development*, 67(3), 768-788.

Wellman, H. M., & Liu, D. (2004). Scaling of Theory-of-Mind Tasks. *Child Development*, 75(2), 523-541.

Wellman, H. M., Phillips, A. T., Dunphy-Lelii, S., & LaLonde, N. (2004). Infant social attention predicts preschool social cognition. *Developmental Science*, 7(3), 283-288.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13(1), 103-128.

Wong, P. M., & Leung, S. O. (2010). The development of theory of mind ability in autistic children. *Psychologia*, 53(3), 151-162.

World Health Organization. (1992). *The ICD-10 Classification of Mental and Behavioral Disorders: Clinical Descriptions and Diagnostic Guidelines* (Vol. 1). World Health Organization, Geneva.

Yin, J.C., Wallach, J.S., Del Vecchio, M., Wilder, E.L., Zhou, H., Quinn, W.G., & Tully, T. (1994). Induction of a dominant negative CREB transgene specifically blocks long term memory in Drosphilia. *Cellular and Molecular Life Sciences*, 79, 49-58.

Yirmiya, N., Solomonica-Levi, D., Shulman, C., & Pilowsky, T. (1996). Theory of mind abilities in individuals with autism, Down syndrome, and mental retardation of unknown etiology: The role of age and intelligence. *Journal of Child Psychology and Psychiatry*, 37(8), 1003-1014.

APPENDICES

The Cerebra Centre for Neurodevelopmental Disorders

UNIVERSITY OF BIRMINGHAM

Dear Parent,

We are writing to inform you of a new research project that is being carried out at the Cerebra Centre for Neurodevelopmental Disorders at the University of Birmingham. We would like to invite you and the person you care for to take part in this new research project. Briefly, the research is a questionnaire study looking at different behaviours in children and adults with Rubinstein Taybi syndrome that have received minimal attention within the literature.

We have contacted you through the Rubinstein Taybi syndrome support group. Your personal details will not be known to us unless you decide to take part in the study. There is an information sheet enclosed that gives you more details about why the research is being carried out and what participation will involve. If you feel it is appropriate you may wish to discuss the research with the person you care for before a decision is made about taking part.

There is an information sheet enclosed that gives you more details about why the research is being carried out and what it will involve. If you and your child/person you care for would like to take part in the study then please complete the enclosed consent form and questionnaire pack and return them in the pre-paid envelope provided.

Please read the information sheets before completing the questionnaires and if you are unclear about any aspect of the study or have any questions then contact Professor Chris Oliver at the address below or on 0121 414 7206.

Thank you for your time and we look forward to hearing from you.

Yours sincerely

Chris Oliver
Professor of Neurodevelopmental Disorders

The Cerebra Centre for Neurodevelopmental Disorders

UNIVERSITY OF BIRMINGHAM

Understanding behaviour in Neurodevelopmental Disorders: Information Sheet

Please read this information carefully before deciding whether you wish to take part in the study. If you have any further questions please contact Professor Chris Oliver on (0121) 414 7206 or at cndd-enquiries@contacts.bham.ac.uk. If you have any medical/ other problems which make it difficult for you to read this information, please contact Professor Chris Oliver for a verbal explanation of the research.

When you are happy that you have all of the information you need to be able to decide whether or not you and the person you care for would like to take part in the study, please complete the enclosed consent form and questionnaire pack return them to us in the prepaid envelope provided

Background

We would like to invite you to take part in a questionnaire study being conducted at the Centre for Neurodevelopmental Disorders, University of Birmingham. This research work, which is led by Professor Chris Oliver, looks at a range of behaviours, skills and impairments in individuals with Rubinstein Taybi syndrome including: Repetitive behaviour, Hyperactivity, Mood, Challenging behaviour, Social functioning and Health. We will also ask some questions that are related to family well-being and the impact that having a child with a disability has on the family.

We hope that this information will enable us to further understand the behaviours, skills and impairments associated with Rubinstein Taybi syndrome including challenging behaviour, social functioning, mood, hyperactivity and health and the impact that these behaviours have on the family. The more people that take part in this research, the more meaningful the results will be. A good response will provide new and valuable information about Rubinstein Taybi syndrome. In the future we hope to follow up the progress of the people who take part in this study. However, participation in this stage of the project will **not** mean that you are obliged to participate in further surveys in the future.

Aims of the study

1. To further our understanding of challenging behaviour, repetitive behaviour, hyperactivity, mood and social functioning in individuals with Rubinstein Taybi syndrome.
2. To understand what happens with regard to these behaviours as children and adults develop.
3. To understand what, if any, changes may occur with regard to these behaviours when the individuals reach a certain age.
4. To understand the impact of having a child with a disability has on the family.

What will happen if you and your child/the person you care for decide(s) to participate?

Where will the research take place?

The research will involve completing the enclosed questionnaire pack. This can be completed by you in your own time.

Who will be involved in collecting the data?

Members of the research team at the Cerebra Centre for Neurodevelopmental disorders including Professor Chris Oliver and Dr. Joanna Moss.

How long will participation in the study take?

The questionnaire pack will take approximately 45 minutes to complete.

In the future you may be asked if you would like to complete the questionnaire again so that we can start to understand what happens to people with Rubinstein Taybi syndrome across their lifetime. We will only contact you with this invitation if you have previously agreed to be contacted by the research team at the University of Birmingham with information about research studies conducted by the team.

Sometimes after you have completed the questionnaire, we may need to contact you again in order to clarify any information that you have provided or to ask you for further information regarding the diagnosis of the person you care for. This helps us to ensure that our data is as useful and as accurate as possible. If this happens then we would contact you again within 6 months of receiving your questionnaire pack to ask whether or not you would be willing to provide us with the extra information.

What will participants be required to do during the study?

We will ask parents and caregivers to complete the enclosed questionnaire pack and return it to us alongside the consent form in the pre-paid envelope provided.

Are there any risks that individuals taking part in the study might face?

There will not be any risks associated with participation in this study.

What are the potential benefits for participants from taking part?

You will receive a personalised feedback regarding your child/ the person you care for. This study will help us to find out more about the lives of people with Rubinstein Taybi syndrome and the difficulties that these people face. The results might help us to improve things for people with Rubinstein Taybi syndrome in the future.

Where will data be stored?

The data collected will be kept in locked or password protected storage at the University of Birmingham. Only members of the research team at the University of Birmingham will have access to information that we collect about you. Information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.

If you/ the person you care for decide(s) to participate, what will happen after that participation?

You and your child/ person you care for will receive an individual feedback report describing the results of all of the assessments that were carried out during the study. If requested, this feedback report will be circulated to other interested individuals. Descriptions of research findings will be published in newsletters of the relevant family support groups and educational institutions involved. Any request for advice concerning the person you care for will be referred to Professor Chris Oliver, Clinical Psychologist.

The researchers will publish the findings from the study in scientific journals and will present the results at relevant conferences.

What will happen to the data afterwards?

The information that you provide will be locked in a filing cabinet at the University of Birmingham or held on a password protected database. Participants will be identified by a unique number so that the information you provide us with cannot be traced to your personal details. You will be able to decide whether or not you want to make your research data available to any professionals or clinicians working with you and the person you care for should they wish to see it. This is optional and will not affect your participation in the current study. If you agree to this, then your research data will only be made available to relevant clinicians or professionals should they contact us directly and request to see it. If you do not agree to this then research data will not be made available to anyone other than the research team at the University of Birmingham.

After 6 months of receiving your questionnaire pack, your personal details will be ***destroyed unless you tell us otherwise.*** This means that we would no longer be able to trace the results of your assessments back to you. ***The section below on 'The Regular Participant Database Information'*** gives information about a database that we use to store the personal details of some participants. Please read this section in order to decide if you would like to join that database.

Regular Participant Database Information:

What is the regular participant database?

We have a database that we keep in the Cerebra Centre where we store the names and contact details of some previous participants. If you would like us to, we can add your details to this database. We would use this information for two things:

1) We will contact you with information about future research work to find out whether or not you would like to participate.
2) It is often important to find out how things change over time. By keeping your details we would be able to trace the results of the previous assessments that you have done with us back to you. This means that if you take part in other studies with us we would be able to look at how things have changed over time.

Who would have access to my details?

Only approved members of our research team would have access to your details. We would not share your details with anyone outside the research team.

When would I be contacted?

You would only be contacted by an approved member of the research team when we are starting another study or phase of a study that we think you might like to participate in or when we need to clarify some information that you have provided us with from participation in a research study.

What happens if I decide that I want my details to be added to the database but then I change my mind?

All you would need to do is contact Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk or at the School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT. Your details would be removed from the database immediately.

Consent

After having read all of the information and having received appropriate responses to any questions that you may have about the study you and the person you care for will be asked to give your and your child's/ person you care for's consent to participate in the study if you decide that you do wish to participate. The section below on ***'Giving consent'*** will explain this process. We need to receive consent from/ on behalf of potential participants in order for them to participate.

Withdrawal

Even after consent has been granted, participants can request to be withdrawn from the study at any time, without giving a reason. Even after participation has taken place, consent can be withdrawn and any data collected will be destroyed. This will not restrict the access of you/ the person you care for to other services and will not affect their right to treatment.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. Please contact Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk in the first instance. If you remain unhappy and wish to complain formally, you can contact: Professor Chris Miall; Head of School; School of Psychology, University of Birmingham, Birmingham, B15 2TT, by email: hos.psychology@contacts.bham.ac.uk or by phone on 0121 414 4931

Confidentiality

The confidentiality of participants will be ensured. If published, information on the participant will be presented without reference to their name or any other identifying information. All personal details will be kept separately from the information collected so that it will only be possible to connect results to individuals via a special code. This will ensure that results are kept anonymous. In the unlikely event of any evidence of abuse being identified, this information will be disclosed by the research workers.

Review

The study has been approved by Coventry NHS Research Ethics Committee. For any queries or concerns regarding the ethical approval of this study please contact Pauline Pittaway on 02476967529 quoting study reference number: 10/H1210/1.

Further information

If you would like any more information about the study please contact Professor Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk. Or write to Chris Oliver, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

Giving consent

Now it is up to you whether you decide that you and your child/the person you care for would like to participate. The decision about whether or not to take part in the study must be 'informed'. This means that anyone making the decision must understand exactly what is involved in the study, what will be required from participants and why.

IMPORTANT:

You need to decide whether your child/the person you care for is able to understand enough about the study to make an 'informed' decision independently about whether or not they would like to participate and to communicate this decision to you. If you are unsure whether or not your child/person you care for is able to understand enough to make a decision independently then we can provide you with some guidelines to help you to assess this A symbol information sheet can also be made available to you if this would be of help. Please contact Professor Chris Oliver 0121 414 7206 or cndd-enquiries@contacts.bham.ac.uk ***to request a copy of this.***

Please choose from one of the following options:

1. My child/ the person I care for is able to understand what is involved in the study and what will be required from them if they participate and has communicated their decision to me:

If you think that the person ***is* able** to understand enough about the study in order to make an 'informed'
decision and they decide that they would like to participate then please ensure that they complete **Section 1 of Consent Form A coloured YELLOW** enclosed, or that you complete it with them, on their behalf. A parent/carer will need to complete **Section 2 of Consent From A coloured YELLOW** in order to indicate that they also agree to participate in the study. *A symbol information sheet can be made available in order to support your child/person you care for in making this decision if it would be of help.*
Please contact the research team if you would like a copy of the symbol consent form or if you need us to adapt this information further, in order to suit your child's needs. Please return the consent form along with the questionnaire pack to us in the prepaid envelope provided.

2. My child/ the person I care for is <u>unable to understand</u> what is involved in the study and what will be required from them if they participate (either because they are too young to understand or because they are unable to understand) and cannot communicate their decision to me:

If you are reading this information on behalf of someone you care for who is under the age of 16 years and you decide that the person ***<u>is not</u>*** able to make an 'informed' and independent decision about whether or not they would like to participate, then we would like to ask you to decide whether or not you think that it is in your child's best interests for them to participate in the study and whether you would like to provide your consent to participation on their behalf. If you would like your child/person you care for to participate in this study, please complete **<u>Consent Form B coloured PURPLE</u>** enclosed. Please return the consent form along with the questionnaire pack to us in the prepaid envelope provided.

UNIVERSITY OF BIRMINGHAM

The Cerebra Centre for Neurodevelopmental Disorders

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Background

We would like to invite you to take part in a questionnaire study being conducted at the Centre for Neurodevelopmental Disorders, University of Birmingham. This research work, which is led by Professor Chris Oliver, looks at a range of behaviours, skills and impairments in individuals with Rubinstein Taybi syndrome including: Repetitive behaviour, Hyperactivity, Mood, Challenging behaviour, Social functioning and Health. We will also ask some questions that are related to family well-being and the impact that having a child with a disability has on the family.

We hope that this information will enable us to further understand the behaviours, skills and impairments associated with Rubinstein Taybi syndrome including challenging behaviour, social functioning, mood, hyperactivity and health and the impact that these behaviours have on the family. The more people that take part in this research, the more meaningful the results will be. A good response will provide new and valuable information about Rubinstein Taybi syndrome. In the future we hope to follow up the progress of the people who take part in this study. However, participation in this stage of the project will **not** mean that you are obliged to participate in further surveys in the future.

Aims of the study

1. To further our understanding of challenging behaviour, repetitive behaviour, hyperactivity, mood and social functioning in individuals with Rubinstein Taybi syndrome.
2. To understand what happens with regard to these behaviours as children and adults develop.
3. To understand what, if any, changes may occur with regard to these behaviours when the individuals reach a certain age.
4. To understand the impact of having a child with a disability has on the family.

What will happen if you and your child/the person you care for decide(s) to participate?

Where will the research take place?

The research will involve completing the enclosed questionnaire pack. This can be completed by you in your own time.

Who will be involved in collecting the data?

Members of the research team at the Cerebra Centre for Neurodevelopmental disorders including Professor Chris Oliver and Dr. Joanna Moss.

How long will participation in the study take?

The questionnaire pack will take approximately 45 minutes to complete.

In the future you may be asked if you would like to complete the questionnaire again so that we can start to understand what happens to people with Rubinstein Taybi syndrome across their lifetime. We will only contact you with this invitation if you have previously agreed to be contacted by the research team at the University of Birmingham with information about research studies conducted by the team.

Sometimes after you have completed the questionnaire, we may need to contact you again in order to clarify any information that you have provided or to ask you for further information regarding the diagnosis of the person you care for. This helps us to ensure that our data is as useful and as accurate as possible. If this happens then we would contact you again within 6 months of receiving your questionnaire pack to ask whether or not you would be willing to provide us with the extra information.

What will participants be required to do during the study?

We will ask parents and caregivers to complete the enclosed questionnaire pack and return it to us alongside the consent form in the pre-paid envelope provided.

Are there any risks that individuals taking part in the study might face?

There will not be any risks associated with participation in this study.

What are the potential benefits for participants from taking part?

You will receive a personalised feedback regarding your child/ the person you care for. This study will help us to find out more about the lives of people with Rubinstein Taybi syndrome and the difficulties that these people face. The results might help us to improve things for people with Rubinstein Taybi syndrome in the future.

Where will data be stored?

The data collected will be kept in locked or password protected storage at the University of Birmingham. Only members of the research team at the University of Birmingham will have access to information that we collect about you. Information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.

If you/ the person you care for decide(s) to participate, what will happen after that participation?

You and your child/ person you care for will receive an individual feedback report describing the results of all of the assessments that were carried out during the study. If requested, this feedback report will be circulated to other interested individuals. Descriptions of research findings will be published in newsletters of the relevant family support groups and educational institutions involved. Any request for advice concerning the person you care for will be referred to Professor Chris Oliver, Clinical Psychologist.

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After 6 months of receiving your questionnaire pack, your personal details will be ***destroyed unless you tell us otherwise.*** This means that we would no longer be able to trace the results of your assessments back to you. ***The section below on 'The Regular Participant Database Information'*** gives information about a database that we use to store the personal details of some participants. Please read this section in order to decide if you would like to join that database.

Regular Participant Database Information:

What is the regular participant database?

We have a database that we keep in the Centre where we store the names and contact details of some previous participants. If you would like then we can add your details to this database. We would use this information for two things:

3) We will contact you with information about future research work to find out whether or not you would like to participate.
4) It is often important to find out how things change over time. By keeping your details we would be able to trace the results of the previous assessments that you have done with us back to you. This means that if you take part in other studies with us we would be able to look at how things have changed over time.

Who would have access to my details?

Only approved members of out research team would have access to your details. We would not share your details with anyone outside the research team.

When would I be contacted?

You would only be contacted by an approved member of the research team when we are starting another study or phase of a study that we think you might like to participate in or when we need to clarify some information that you have provided us with from participation in a research study.

What happens if I decide that I want my details to be added to the database but then I change my mind?
All you would need to do is contact Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk or at the School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT. Your details would be removed from the database immediately.

Consent

After having read all of the information and having received appropriate responses to any questions that you may have about the study you and the person you care for will be asked to give your and your child's/ person you care for's consent to participate in the study if you decide that you do wish to participate. The section below on ***'Giving consent'*** will explain this process. We need to receive consent from/ on behalf of potential participants in order for them to participate.

Withdrawal

Even after consent has been granted, participants can request to be withdrawn from the study at any time, without giving a reason. Even after participation has taken place, consent can be withdrawn and any data collected will be destroyed. This will not restrict the access of you/ the person you care for to other services and will not affect their right to treatment.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. Please contact Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk in the first instance. If you remain unhappy and wish to complain formally, you can contact: Professor Chris Miall; Head of School; School of Psychology, University of Birmingham, Birmingham, B15 2TT, by email: hos.psychology@contacts.bham.ac.uk or by phone on 0121 414 4931

Confidentiality

The confidentiality of participants will be ensured. If published, information on the participant will be presented without reference to their name or any other identifying information. All personal details will be kept separately from the information collected so that it will only be possible to connect results to individuals via a special code. This will ensure that results are kept anonymous. In the unlikely event of any evidence of abuse being identified, this information will be disclosed by the research workers.

Review

The study has been approved by Coventry NHS Research Ethics Committee. Ref: 10/H1210/01. Tel: 01527 587688

Further information

If you would like any more information about the study please contact Professor Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk. Or write to Chris Oliver, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

Giving consent

Now it is up to you whether you decide that you and your child/the person you care for would like to participate. The decision about whether or not to take part in the study must be 'informed'. This means that anyone making the decision must understand exactly what is involved in the study, what will be required from participants and why.

IMPORTANT:

You need to decide whether your child/the person you care for is able to understand enough about the study to make an 'informed' decision independently about whether or not they would like to participate and to communicate this decision to you. If you are unsure whether or not your child/person you care for is able to understand enough to make a decision independently then we can provide you with some guidelines to help you to assess this A symbol information sheet can also be made available to you if this would be of help.

Please contact Professor Chris Oliver 0121 414 7206 or cndd-enquiries@contacts.bham.ac.uk ***to request a copy of this.***

Please choose from one of the following options:

3. My child/ the person I care for is able to understand what is involved in the study and what will be required from them if they participate and has communicated their decision to me:

If you think that the person ***is*** **able** to understand enough about the study in order to make an 'informed' decision and they decide that they would like to participate then please ensure that they complete **Section 1 of Consent Form A coloured YELLOW** enclosed, or that you complete it with them, on their behalf. A parent/carer will need to complete **Section 2 of Consent From A coloured YELLOW** in order to indicate that they also agree to participate in the study. A symbol information sheet can be made available in order to support your child/person you care for in making this decision if it would be of help. Please contact the research team if you would like a copy of the symbol consent form or if you need us to adapt this information further, in order to suit your child's needs. Please return the consent form along with the questionnaire pack to us in the prepaid envelope provided.

4. My child/ the person I care for is over the age of 16 and cannot understand what is involved in the study or cannot communicate their decision to me:

If you are reading this information on behalf of someone you care for who is **over the age of 16** and you decide that the person ***is not*** able to make an 'informed' decision about whether or not they would like to participate, then we would like to invite you to act as a 'personal consultee' (or 'nominated consultee' where an unpaid carer e.g. parent, legal guardian etc is not able to act as a 'personal consultee') for that person. Please read the enclosed 'Personal and Nominated Consultee Information Sheet' coloured **PINK**. Once

you have finished reading the 'Personal and Nominated Consultee Information Sheet' please decide whether or not you feel able to act as a personal or nominated consultee for the person you care for.

If you feel able to act as a personal or nominated consultee for the person you care for please think about whether the person would decide to participate if they were able to make an 'informed' decision themselves about whether or not to participate. If you decide that the person would decide to participate, please complete **Consent Form *C* coloured BLUE** enclosed and return it to us alongside the questionnaire pack in the prepaid envelope provided.

Consent Form A : For individuals who are able to provide consent to participate in the study

Understanding behaviour and family adjustment in individuals with neurodevelopmental disorders

Study Director: Professor Chris Oliver

SECTION 1: Please complete this section if you are a person with Rubinstein Taybi syndrome:

1. Has somebody else explained the project to you? YES/NO
2. Do you understand what the project is about? YES/NO
3. Have you asked all of the questions you want? YES/NO
4. Have you had your questions answered in a way you understand? YES/NO
5. Do you understand it is OK to stop taking part at any time? YES/NO
6. Are you happy to take part? YES/NO

If any answers are 'no' or you don't want to take part, don't sign your name!

If you do want to take part, you can write your name below

You can also choose if you want to say 'yes' to these questions:

7. If your Dr asks to see your results from this project is that OK? YES/NO
8. Are you happy for us to contact you again in the future? YES/NO

Your name:_____

Date:_____

The person who explained this project to you needs to sign too. If you are under the age of 16, this should be your parent/guardian.

Print name:_____ Sign:_____
Date:_____

<u>SECTION 2:</u> Please complete this section if you are a parent/carer/guardian of a person with PMS

who has provided their consent to participate in the study. Please initial box…

1. I confirm that I have read and understood the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation and that of my child/person I care for is voluntary and that I am free to withdraw at any time without giving any reason, without my or that of my child's/person I care for's medical care or legal rights being affected. ☐

3. I understand that relevant sections of my child's/person I care for's GP medical notes or records confirming genetic diagnosis and health status may be looked at by members of the Cerebra Centre for Neurodevelopmental Disorders research team at the University of Birmingham, where it is relevant to this research project. I give permission for these individuals to have access to these records. ☐

4. I agree to my child's/person I care for's GP being informed of my participation and that of my child/person I care for's in the study, where access to my child's/person I care for's medical records is required. ☐

5. I agree to take part in the above study. ☐

Optional clause: The statement below is <u>optional</u>:

1. I agree to the University of Birmingham research team sharing my research data with any professionals or clinicians working with me and the person I care for should they request to see them. ☐

Print Name: _____
Telephone number: _____

Address: _____
Email: _____

Relationship to participant: _____
Signature: _____
Date: _____

SECTION 3: This is optional and allows you to provide consent for us to keep your personal details on the Regular Participant Database. See section titled 'Regular Participant Database' in the information sheet.

Please initial box…

1. I have read and understood the section titled 'Regular Participant Database' and I would like my personal details to be added to the database. ☐

2. I understand that my name and contact details will be kept by the research team at the University of Birmingham in accordance with the provisions of the Data Protection Act 1998 and I will be contacted by an approved member of the team with information about future research that I and the person I care for may like to participate in. ☐

3. I understand that if my details are held on the database it will be possible for the research team to trace the results of the assessments that I complete in this project back to me and my child/person I care for so that they can look at changes over time if I take part in future projects. ☐

4. I understand that even after I have agreed for my details to be added to the database, I can request that they be removed by contacting Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk or by post at the School of Psychology, University of Birmingham, Edgbaston, B15 2TT. ☐

5. I understand the Professor Chris Oliver holds ultimate responsibility for the database. ☐

Print Name: _____Signature: _____Date: _____

<u>Consent Form B:</u> For Children under the age of 16 who are <u>not</u> able to provide consent.

<u>Understanding behaviour and family adjustment in individuals with neurodevelopmental disorders</u>

Study Director: Professor Chris Oliver

SECTION 1: Please complete this section if you are a parent/ guardian of a child (under 16 years) with Rubinstein Taybi syndrome who is not able to provide consent.
Please initial box…

1. I confirm that I have read and understood the information sheet dated 01.02.2007 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation and that of my child/person I care for is voluntary and that I am free to withdraw at any time without giving any reason, without my or that of my child's/person I care for's medical care or legal rights being affected. ☐

3. I understand that relevant sections of my child's/person I care for's GP medical notes or records confirming genetic diagnosis and health status may be looked at by members of the Cerebra Centre for Neurodevelopmental Disorders research team at the University of Birmingham, where it is relevant to this research project. I give permission for these individuals to have access to these records. ☐

4. I agree to my child's/person I care for's GP being informed of my participation and that of my child/person I care for's in the study, where access to my child's/person I care for's medical records is required. ☐

5. I agree to take part in the above study. ☐

Optional clause: The statement below is <u>optional</u>:

2. I agree to the University of Birmingham research team sharing my research data with any professionals or clinicians working with me and the person I care for should they request to see them. ☐

Print Name: _____Name of person you care for: _____

Address:_____Email: _____

Telephone number:_____Relationship to participant: _____

Signature: _____Date: _____

SECTION 2: This is optional and allows you to provide consent for us to keep your personal details on the Regular Participant Database. See section titled 'Regular Participant Database' in the information sheet.

Please initial box…

6. I have read and understood the section titled 'Regular Participant Database' and I would like my personal details to be added to the database. ☐

7. I understand that my name and contact details will be kept by the research team at the University of Birmingham in accordance with the provisions of the Data Protection Act 1998 and I will be contacted by an approved member of the team with information about future research that I and the person I care for may like to participate in. ☐

8. I understand that if my details are held on the database it will be possible for the research team to trace the results of the assessments that I complete in this project back to me and my child/person I care for so that they can look at changes over time if I take part in future projects. ☐

9. I understand that even after I have agreed for my details to be added to the database, I can request that they be removed by contacting Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk or by post at the School of Psychology, University of Birmingham, Edgbaston, B15 2TT. ☐

10. I understand the Professor Chris Oliver holds ultimate responsibility for the database. ☐

Print Name: _____Signature: _____Date: _____

<u>Consent Form C</u>: For individuals over the age of 16 who are not able to provide consent.

<u>Understanding behaviour and family adjustment in individuals with neurodevelopmental disorders</u>

Study Director: Professor Chris Oliver

SECTION 1: Please read the following statements:

Please initial box…

1. I (your name)_____have been consulted about (name of participant)_____'s participation in the above research project. I have had the opportunity to ask questions about the study and understand what is involved. ☐
2. In my opinion he/she would have no objection to taking part in the above study. ☐
3. I understand that I can request he/she is withdrawn from the study at any time without giving any reason and without his/her care or legal rights being affected. ☐
4. I understand that relevant sections of his/her GP medical notes or records confirming genetic diagnosis and health status may be looked at by members of the Cerebra Centre for Neurodevelopmental Disorders research team at the University of Birmingham, where it is relevant to this research project. I give permission for these individuals to have access to these records. ☐
5. I agree to his/her GP being informed of their participation in the study, where access to medical records is required. ☐
6. I agree to take part in the above study. ☐

Optional clause: The statement below is <u>optional</u>:

3. I agree to the University of Birmingham research team sharing his/her research data with any professionals or clinicians working with them should they request to see them. ☐

Print Name: _____Telephone number:_____

Address:_____Email: _____

Relationship to participant_____Signature: _____Date: _____

SECTION 3: This is optional and allows you to provide consent for us to keep your personal details on the Regular Participant Database. See section titled 'Regular Participant Database' in the information sheet.

Please initial box…

11. I have read and understood the section titled 'Regular Participant Database' and I would like my and the person I care for's personal details to be added to the database. ☐

12. I understand that my name and contact details will be kept by the research team at the University of Birmingham in accordance with the provisions of the Data Protection Act 1998 and I will be contacted by an approved member of the team with information about future research that I and the person I care for may like to participate in. ☐

13. I understand that if my details are held on the database it will be possible for the research team to trace the results of the assessments that I complete in this project back to me and the person I care for so that they can look at changes over time if we take part in future projects. ☐

14. I understand that even after I have agreed for my details to be added to the database, I can request that they be removed by contacting Chris Oliver on 0121 414 7206 or at cndd-enquiries@contacts.bham.ac.uk or by post at the School of Psychology, University of Birmingham, Edgbaston, B15 2TT. ☐

15. I understand the Professor Chris Oliver holds ultimate responsibility for the database. ☐

Print Name: _____Signature: _____
Date: _____

ID_____

BACKGROUND INFORMATION

Please tick or write your response to these questions concerning background details:
Please answer the following about the person you care for:

1. **Today's date:** _____

2. **Gender:** Male ☐ Female ☐

3. **Date of Birth**: ___/___/____ **Age:_____**

4. **Is the person you care for verbal?** (i.e. more than 30 signs/words in their vocabulary)

   Yes/No (delete as appropriate)

5. **Is the person you care for able to walk unaided?**

   Yes/No (delete as appropriate)

6. **Has the person you care for been diagnosed with a syndrome?** Yes/No (delete as appropriate)

If yes, please indicate which syndrome in 5a. and answer questions 6 to 8. If no, please move on to question 9

6.a

Cornelia de Lange syndrome	☐	Cri du Chat syndrome	☐
Prader-Willi syndrome	☐	Rubinstein Taybi syndrome	☐
Fragile X syndrome	☐	Down syndrome	☐
Lowe syndrome	☐	Soto Syndrome	☐
Rubinstein-Taybi syndrome	☐	9q34 deletion	☐
8p23deletion	☐	Tuberous Sclerosis	☐
Other _____	☐		

7. **What is the genetic mechanism causing the syndrome in the person you care for?**

Uni-parental disomy	☐	Sequence repetition	☐
Deletion	☐	Translocation	☐
Unknown	☐		

Other _____

8. **When was the person you care for diagnosed?** _____

9. **Who diagnosed the person you care for?**

Paediatrician	☐	Clinical Geneticist	☐
GP	☐		

Other _____

10. **Has the person you care for had any medical/health difficulties in the last six months? If yes, please give details:**

_____

_____

In the information sheet and consent form we informed you that we may need to contact your child's/person you care for's GP in order to clarify any information regarding your child's health and diagnostic status (see consent form and information sheet for more information). If you have already

indicated on the consent form that you are happy for us to do this, please complete the relevant details below:

11. Name of your child's/person you care for's

GP_____

GPAddress_____

_____

GP Telephone number_____

The following questions ask for background information about you and your family. Please tick the appropriate boxes or write in the spaces provided.

1. Are you male or female? Male ☐ Female ☐

2. What was your age in years on your last birthday? _____years

3. Please tick the highest level of your educational qualifications.

No formal educational qualifications..... ☐
Fewer than 5 GCSE's or O Level's (grades A-C), NVQ 1, or BTEC First Diploma… ☐
5 or more GCSE's or O Level's (grades A-C), NVQ 2, or equivalent…….…….. ☐
3 or more 'A' Levels, NVQ 3, BTEC National, or equivalent..... ☐
Polytechnic/University degree, NVQ 4, or equivalent..... ☐
Masters/Doctoral degree, NVQ 5, or equivalent……..... ☐

4. What is your relationship to your child with a genetic syndrome (e.g. mother, father, stepmother, grandmother, adoptive parent)?

_____

5. In total how many people currently live in your home? _____ Adults _____ Children

6. Does your child with a genetic syndrome normally live with you? Yes ☐ No ☐

If no, then where do they live?_____

7. What is your current marital status?

Married, and living with spouse..... ☐

Living with partner..... ☐

Divorced/Separated/Widowed/Single and NOT living with a partner..... ☐

If living with partner/spouse, please answer the following questions, if not, please go to question 12.

8. Is your partner male or female? Male ☐ Female ☐

9. What was their age in years on their last birthday? _____ years

10. Please tick the highest level of your partner/spouse's educational qualifications.

No formal educational qualifications..... ☐

Fewer than 5 GCSE or O Level (grades A-C), NVQ 1, or BTEC First Diploma..... ☐

5 or more GCSE or O Level (grades A-C), NVQ 2, or equivalent……..… ☐

3 or more 'A' Levels, NVQ 3, BTEC National, or equivalent..... ☐

Polytechnic/University degree, NVQ 4, or equivalent..... ☐

Masters/Doctoral degree, NVQ 5, or equivalent……..... ☐

11. What is your partner/spouse's relationship to your child with a genetic syndrome (e.g., mother, father, stepmother, adoptive parent)?_____

12. Recent data from research with families of children with special needs has shown that a family's financial resources are important in understanding family member's views and experiences. With this in mind, we would be very grateful if you could answer the additional question below. We are not interested in exactly what your family income is, but we would like to be able to look at whether those with high versus lower levels of financial resources have different experiences.

What is your current total annual family income? Please include a rough estimate of total salaries and other income (including benefits) before tax and national insurance/pensions. Please tick one box only:

Less than £15,000……..……..… ☐

£15,001 to £25,000……...…….. ☐

£25,001 to £35,000……...……..……. ☐

£35,001 to £45,000……...……..…… ☐

£45,001 to £55,000……...……..…… ☐

£55,001 to £65,000……..……..... ☐

£65,001 or more……..……..… ☐

Please check your answers and go on to the next questionnaire.

WESSEX Questionnaire

These items refer to the person you care for. For each question (A, B, C, D etc …), please enter the appropriate code in each box.

(Frequently = more than once a week)

A) Wetting (nights) **1** = frequently **2** = occasionally **3** = never ☐

B) Soiling (nights) **1** = frequently **2** = occasionally **3** = never ☐

C) Wetting (days) **1** = frequently **2** = occasionally **3** = never ☐

D) Soiling (days) **1** = frequently **2** = occasionally **3** = never ☐

E) Walk with help **1** = not at all **2** = not up stairs **3** = up stairs and elsewhere ☐

(note: if this person walks *by himself* upstairs and elsewhere, please also code '3' for 'walk with help')

F) Walk by himself **1** = not at all **2** = not up stairs **3** = up stairs and elsewhere ☐

G) Feed himself **1** = not at all **2** = with help **3** = without help ☐

H) Wash himself **1** = not at all **2** = with help **3** = without help ☐

I) Dress himself **1** = not at all **2** = with help **3** = without help ☐

J) Vision **1** = blind or almost **2** = poor **3** = normal ☐

K) Hearing **1** = deaf or almost **2** = poor **3** = normal ☐

L) Speech **1** = never a word **2** = odd words only **3** = sentences and normal **4** = can talk but doesn't ☐

If this person talks in sentences, is his/her speech:

1 = Difficult to understand even by acquaintances, impossible for strangers?

2 = Easily understood for acquaintances, difficult for strangers?

3 = Clear enough to be understood by anyone? ☐

M) Reads **1** = nothing **2** = a little **3** = newspapers and/or books ☐

N) Writes **1** = nothing **2** = a little **3** = own correspondence ☐

O) Counts **1** = nothing **2** = a little **3** = understands money values ☐

Please check your answers and go on to the next questionnaire.

THE MOOD, INTEREST AND PLEASURE QUESTIONNAIRE –

SHORT FORM (MIPQ-S)

Instructions for completing the MIPQ-S

This questionnaire contains 12 questions – you should complete all 12 questions. Each question will ask for your opinion about particular behaviours, which you have observed in the last 2 weeks. For every question you should circle the most appropriate response e.g.

6) In the last two weeks, how interested did the person appear to be in his/her surroundings?

interested all of the time	*interested most of the time*	*interested about half of the time*	*interested some of the time*	*never interested*

The Mood, Interest and Pleasure Questionnaire - Short Form

1) In the last two weeks, did the person seem…

sad all of the time	sad most of the time	sad about half of the time	sad some of the time	never sad

Please comment if anything has happened in the last two weeks which you feel might explain sadness if it has been observed (e.g. a bereavement):

2) In the last two weeks, how often did you hear positive vocalizations* when the person was engaged in activities*?

all of the time	most of the the time	about half of the time	some of the time	never

*positive vocalizations: e.g. laughing, giggling, "excited sounds" etc.
*engaged in activities: i.e. when someone is actively involved in any activity such as a mealtime, a social interaction, a self-care task or social outing etc.

3) In the last two weeks, do you think the facial expression of the person looked "flat"*…

all of the time	most of the the time	about half of the time	some of the time	never

*flat expression: expression seems lifeless; lacks emotional expression; seems unresponsive.

4) In the last two weeks, would you say the person…

cried every day	cried nearly every day	cried 3-4 times each week	cried once or twice each week	cried less than once each week

5) In the last two weeks, how interested did the person appear to be in his/her surroundings?

interested all of the time	interested most of the time	interested about half of the time	interested some of the time	never interested

6) In the last two weeks, did the person seem to have been enjoying life…

all of the time	most of the the time	about half of the time	some of the time	never

Please comment if there are any reasons why this person might not have been enjoying him/herself e.g. illness, being in pain, experiencing a loss etc.:

7) In the last two weeks, would you say the person smiled…

at least once every day	at least once nearly every day	3-4 times each week	once or twice each week	less than once each week

8) In the last two weeks, how disinterested did the person seem to be in his/her surroundings?

disinterested all of the time	disinterested most of the time	disinterested about half of the time	disinterested some of the time	never disinterested

9) In the last two weeks, when the person was engaged in activities*, to what extent did his/her facial expressions* suggest that s/he was interested in the activity?

interested all of the time	interested most of the time	interested about half of the time	interested some of the time	never interested

*****engaged in activities: i.e. when someone is actively involved in any activity such as a mealtime, social interaction, self-care task or social outing etc.
*****facial expressions: interest might be indicated by the degree to which the person's gaze is being directed at the person/things involved in an activity.

10) In the last two weeks, would you say that the person…

laughed every day	laughed nearly every day	laughed 3-4 times each week	laughed once or twice each week	laughed less than once each week

11) In the last two weeks, how often did you see gestures which appeared to demonstrate enjoyment* when the person was engaged in activities*?

all of the time	most of the the time	about half of the time	some of the time	never

*gestures which appear to demonstrate enjoyment: e.g. clapping, waving hands in excitement etc.
*****engaged in activities: i.e. when someone is actively involved in any activity such as a meal time, social interaction, self-care task or social outing etc.

12) In the last two weeks, did the person's vocalizations* sound distressed…

all of the time	most of the the time	about half of the time	some of the time	never

*****vocalizations: any words, noises or utterances.

THE ACTIVITY QUESTIONNAIRE

Instructions:

- Please read each item carefully and circle the appropriate number on the scale, for the person you care for.
- Please ensure that you indicate a response for every item. If the particular behaviour does not apply,
  for example, if the person is not verbal or not mobile, please circle 0 on the scale.

	Never/ almost never	Some of the time	Half of the time	A lot of the time	Always/ almost all the time
1. Does the person wriggle or squirm about when seated or lying down?	**0**	**1**	**2**	**3**	**4**
2. Does the person fidget or play with their hands and/or feet when seated or lying down?	**0**	**1**	**2**	**3**	**4**
3. Does the person find it difficult holding still?	**0**	**1**	**2**	**3**	**4**
4. Does the person find it difficult to remain in their seat even when in situations where it would be expected?	**0**	**1**	**2**	**3**	**4**
5. Does the person prefer to be moving around or becomes	**0**	**1**	**2**	**3**	**4**
6. When the person is involved in a leisure activity (e.g. watching TV, playing a game etc.) do they make a lot of noise?	**0**	**1**	**2**	**3**	**4**
7. When the person is involved in an activity, are they boisterous and/or rough?	**0**	**1**	**2**	**3**	**4**
8. Does the person act as if they are "driven by a motor" (i.e. often very active)?	**0**	**1**	**2**	**3**	**4**
9. Does the person seem like they need very little rest to recharge their battery?	**0**	**1**	**2**	**3**	**4**
10. Does the person often talk excessively?	**0**	**1**	**2**	**3**	**4**
11. Does the person's behaviour seem difficult to manage/contain whilst out and about (e.g. in town, in supermarkets etc.)?	**0**	**1**	**2**	**3**	**4**
12. Do you feel that you need to "keep an eye" on the person at all times?	**0**	**1**	**2**	**3**	**4**
13. Does the person you care for seem to act/do things without stopping to think first?	**0**	**1**	**2**	**3**	**4**
14. Does the person blurt out answers before questions have been completed?	**0**	**1**	**2**	**3**	**4**
15. Does the person start to respond to instructions before they have been fully given or without seeming to	**0**	**1**	**2**	**3**	**4**
16. Does the person want things immediately?	**0**	**1**	**2**	**3**	**4**
17. Does the person find it difficult to wait?	**0**	**1**	**2**	**3**	**4**
18. Does the person disturb others because they have difficulty waiting for things or waiting their turn?	**0**	**1**	**2**	**3**	**4**

SOCIAL COMMUNICATION QUESTIONNAIRE © Rutter et al 2003

1. Is she/he now able to talk using short phrases or sentences? If no, skip to question 8.	**Yes** **No**
2. Can you have a to and fro "conversation" with her/him that involves taking turns or building on what you have said?	**Yes** **No**
3. Has she/he ever used odd phrases or said the same thing over and over in almost exactly the same way (either phrases that she/he has heard other people use or ones that she/he has made up?	**Yes** **No**
4. Has she/he ever used socially inappropriate questions or statements? For example, has she/he ever regularly asked personal questions or made personal comments at awkward times?	**Yes** **No**
5. Has she/he ever got her/his pronouns mixed up (e.g., saying you or she/he for I)?	**Yes** **No**
6. Has she/he ever used words that she/he seemed to have invented or made up her/himself; put things in odd, indirect ways; or used metaphorical ways of saying things (e.g., saying hot rain for steam)?	**Yes** **No**
7. Has she/he ever said the same thing over and over in exactly the same way or insisted that you say the same thing over and over again?	**Yes** **No**
8. Has she/he ever had things that she/he seemed to have to do in a very particular way or order or rituals that she/he insisted that you go through?	**Yes** **No**
9. Has her/his facial expression usually seemed appropriate to the particular situation, as far as you could tell?	**Yes** **No**
10. Has she/he ever used your hand like a tool or as if it were part of her/his own body (e.g., pointing with your finger, putting your hand on a doorknob to get you to open the door)?	**Yes** **No**
11. Has she/he ever had any interests that preoccupy her/him and might seem odd to other people (e.g., traffic lights, drainpipes, or timetables)?	**Yes** **No**
12. Has she/he ever seemed to be more interested in parts of a toy or an object (e.g., spinning the wheels of a car), rather than using the object as it was intended?	**Yes** **No**
13. Has she/he ever had any special interests that were unusual in their intensity but otherwise appropriate for her/his age and peer group (e.g., trains, dinosaurs)?	**Yes** **No**
14. Has she/he ever seemed to be unusually interested in the sight, feel, sound, taste, or smell of things or people?	**Yes** **No**
15. Has she/he ever had any mannerisms or odd ways of moving her/his hands or fingers, such as flapping or moving her/his fingers in front of her/his eyes?	**Yes** **No**
16. Has she/he ever had any complicated movements of her/his whole body, such as spinning or repeatedly bouncing up and down?	**Yes** **No**
17. Has she/he ever injured her/himself deliberately, such as by biting her/his arm or banging her/his head?	**Yes** **No**
18. Has she/he ever had any objects (other than a soft toy or comfort blanket) that she/he had to carry around?	**Yes** **No**

19. Does she/he have any particular friends or a best friend?	**Yes** **No**
20. When she/he was 4 to 5, did she/he ever talk with you just to be friendly (rather than to get something)?	**Yes** **No**
21. When she/he was 4 to 5, did she/he ever spontaneously copy you (or other people) or what you were doing (such as vacuuming, gardening, or mending things)?	**Yes** **No**
22. When she/he was 4 to 5, did she/he ever spontaneously point at things around her/him just to show you things (not because she/he wanted them)?	**Yes** **No**
23. When she/he was 4 to 5, did she/he ever use gestures, other than pointing or pulling your hand, to let you know what she/he wanted	**Yes** **No**
24. When she/he was 4 to 5, did she/he nod her/his head to mean yes?	**Yes** **No**
25. When she/he was 4 to 5, did she/he shake her/his head to mean no?	**Yes** **No**
26. When she/he was 4 to 5, did she/he usually look at you directly in the face when doing things with you or talking with you?	**Yes** **No**
27. When she/he was 4 to 5, did she/he smile back if someone smiled at her/him?	**Yes** **No**
28. When she/he was 4 to 5, did she/he ever show you things that interested her/him to engage your attention?	**Yes** **No**
29. When she/he was 4 to 5, did she/he ever offer to share things other than food with you?	**Yes** **No**
30. When she/he was 4 to 5, did she/he ever seem to want you to join in her/his enjoyment of something?	**Yes** **No**
31. When she/he was 4 to 5, did she/he ever try to comfort you if you were sad or hurt?	**Yes** **No**
32. When she/he was 4 to 5, when she/he wanted something or wanted help, did she/he look at you and use gestures with sounds or words to get your attention?	**Yes** **No**
33. When she/he was 4 to 5, did she/he show a normal range of facial expressions?	**Yes** **No**
34. When she/he was 4 to 5, did she/he ever spontaneously join in and try to copy the actions in social games, such as The Mulberry Bush or London Bridge Is Falling Down?	**Yes** **No**
35. When she/he was 4 to 5, did she/he play any pretend or make-believe games?	**Yes** **No**
36. When she/he was 4 to 5, did she/he seem interested in other children of approximately the same age whom she/he did not know?	**Yes** **No**
37. When she/he was 4 to 5, did she/he respond positively when another child approached her/him?	**Yes** **No**
38. When she/he was 4 to 5, if you came into a room and started talking to her/him without calling her/his name, did she/he usually look up and pay attention to you?	**Yes** **No**

39.	When she/he was 4 to 5, did she/he ever play imaginative games with another child in such a way that you could tell that they each understood what the other was pretending?	**Yes** **No**
40.	When she/he was 4 to 5, did she/he play cooperatively in games that required joining in with a group of other children, such as hide-and-seek or ball games?	**Yes** **No**

Please check your answers and go on to the next questionnaire.

UNIVERSITY OF BIRMINGHAM

1st December 2009

To whom it may concern,

We are writing to tell you about a research project we are currently conducting. Back in 2008 XXX Day Nursery in XXXX helped us gather pilot data for our study looking at the early development of social understanding in infancy. The pilot study was extremely successful and consequently we are hoping to run our full study across several nurseries in Birmingham.

To introduce ourselves – Sarah Beck and Ian Apperly are lecturers in developmental psychology and Laurie Powis is working with them as a PhD student. We wondered whether you would be happy for us to run some of our research with the 9 month – 3 year olds at your nursery.

The research we are currently running is concerned with children's early 'Theory of Mind' abilities. 'Theory of Mind' constitutes a high level social – cognitive component that involves inferring the mental states (beliefs, desires, feelings and intentions) of others. This ability has been implicated as essential for effective social understanding and is thought to develop progressively through childhood. We are interested in the social skills that young infants acquire as they develop this ability.

The testing we would like to carry out at your nursery would involve the children playing very simple games and tasks with the researchers. For example, in one task - looking at 'cooperation' skills - the infants will have to 'work together' with the researcher to get a toy out of a big tube.

To run the study we would test children individually for about 5-10 minutes. Laurie will contact you by phone to see if it would be possible for us to visit, and to answer any questions you may have. In the mean time thank you for your time in reading about our research.

Yours sincerely,

Laurie Powis, Dr Sarah Beck & Dr Ian Apperly
PhD Student & Lecturers in Developmental Psychology

UNIVERSITY OF BIRMINGHAM

2009

Dear Parent/Guardian,

My name is Laurie Powis and I am a PhD postgraduate researcher at the School of Psychology, University of Birmingham. I am writing to ask your permission for your child to participate in a study investigating children's thinking about social situations. The study is due to take place the week beginning the 25th February and will take place during the school day. I will briefly explain the purpose of the study below.

My research is looking at the extent in which both typically developing children and children with various genetic syndromes understand the behaviours and thoughts of others. The ability to relate to other people, understand their needs and feelings, empathize, and ability to express ones own thoughts/feelings are crucial developmental skills and I wish to investigate how individuals develop these important skills.

Your child may be invited to play some enjoyable games with myself, followed by a short story which involves answering several simple questions at the end. The stories and games are age appropriate and would take no more than 10 minutes to complete.

The results will contribute to the slowly-growing body of scientific research on children's psychological development and specifically our understanding of how children learn important skills for handling information in the world. No individual child will be identifiable in any report of the results.

If you prefer that your child does not participate, please return the form below and return it to the school.

Thank you,

Laurie Powis

I would prefer that my child _____ (name) of year ____ (class) does not participate in this study.

Signed _____ (parent/guardian)

UNIVERSITY OF BIRMINGHAM RESEARCH INTO CHARACTERISTICS OF INDIVIDUALS WITH RUBINSTEIN TAYBI SYNDROME

THE KEYSTONE PROJECT

This booklet should contain:

1. Letter of invitation
2. Professor Chris Oliver's contact details (See letter of invitation)
3. Information sheet
4. Background Questionnaire

Instructions for Completing Booklet:

1. Please read the booklet before deciding whether you want to take part in the study.

2. If you would like to take part in the study, please fill in the background questionnaire and return it to us in the *freepost* envelope provided.

Thank you for taking the time to read the information booklet.

Letter of Invitation

School of Psychology
Edgbaston
Birmingham
B15 2TT

Project Director: Professor Chris Oliver
Tel: 0121 414
E-mail: c.oliver@bham.ac.uk

Dear [name of caregiver],

Re: Thought and Interaction Study

You may remember that you have previously taken part in research with the University of Birmingham. Thank you for your participation in that research. We are now writing to inform you of a new research project that is being carried out by the research team at the University of Birmingham that you and [name of participant] are being invited to take part in. Before you decide whether to participate, you may want to know why the research is being carried out and what it will involve. Enclosed is an information sheet which describes the aim of the project and what will happen during the study.

Please take the time to read the information sheet before agreeing to take part in the study. If you are unclear about any aspect of the study or have any questions, feel free to contact Professor Chris Oliver at the above address or by phone on 0121 414 4909 or by e-mail on c.oliver@bham.ac.uk.

In brief, the research project is an experimental study that aims to investigate how people with Rubinstein Taybi think about and interact with their environment. We feel that [name of person] would be appropriate for the study and we are writing to ask you whether you would like [name of participant] to participate in the study. If you feel that it is appropriate, you may wish to discuss the nature of the research with [name of participant]. You will receive a personalised feedback report for your interest which will contain information about [name of participant] and the results of the study.

If you would like [name of participant] to participate in the study then please complete the enclosed background questionnaire and return it to us in the freepost envelope provided.

Thank you for your time. We look forward to hearing from you soon.

Yours sincerely,

Jane Waite	Laurie Powis	Chris Oliver	Dr. Sarah Beck	Dr. Ian Apperly
PhD student	PhD Student	Prof. of Clinical Psychology	Lecturer & Reader	Lecturer & Reader

INFORMATION SHEET

Background:
A team at the University of Birmingham is carrying out an experimental study to look at how people with Rubinstein Taybi syndrome think about and interact with their environment. The study aims to improve our understanding of these processes and how they may differ between individuals. The study will aim to examine individuals' short term memory, the way in which they generate novel ideas, plan, initiate and inhibit actions and shift from one idea to another. The study will also assess the way in which people with Rubinstein Taybi syndrome understand other people's thoughts and beliefs

What does it involve?

The following section has been included to give you an idea of the types of tasks we may ask the person you care for to complete. However, whether or not the person you care for will be asked to complete these two tasks will depend on their level of ability. If you feel that the person you care for would find these tasks too easy or too difficult do not worry. We have tests to suit <u>all abilities</u> and we also have tests that are suitable for <u>adults</u>.

The person will be assessed at the University or at home. Testing will take place over two days. The person will then be asked to complete several tasks that are used to examine people's general ability, short-term memory, the way in which people with RTS generate novel ideas, plan, initiate and inhibit an action, maintain attention on a task and shift from one idea to another. For example, in the bear/dragon task the person will be introduced to a 'nice' bear puppet and a 'naughty' dragon puppet and told that they should do what the 'nice' bear says but not what the 'naughty' dragon says (e.g. touch your nose). The purpose of this game is to test the person's ability to suppress an unwanted response (to avoid responding on dragon trials).

The person will also be asked to complete several tasks that are used to examine people's ability to understand other people's thoughts and beliefs. For example, in the Tubes with Handles task the person with RTS and the researcher must work together to retrieve a toy that is inside a tube. The tube has a handle on each end and can only be opened by two persons simultaneously pulling at each end. The length of the tube will make it impossible for person with RTS to grasp both handles at the same time, therefore, in order to succeed on the task the person with RTS must understand the intentions of the researcher and incorporate them into their own intention.

Withdrawal:
Should you or your child / the person you care for decide that you no longer wish to be involved in the study, the information that you have provided can be withdrawn at any time without you giving a reason. Even after your child / the person you care for has taken part in the study, consent can be withdrawn and any data collected will be destroyed. This will not restrict access to other services and will not affect the right to treatment.

Confidentiality:
All details collected during this study will be kept on a confidential database that is only accessible to those working on the project. Anonymity is ensured by storing the questionnaire data separately from any material that identifies the participant. If published, information will be presented without reference to any identifying information.

At the end of the study:
Each parent/ carer will receive a personalised feedback report on their child or the person they care for. A summary of the project's findings will be circulated to anyone involved who wishes to see a

copy and a report will be written for the RTS newsletter. Any requests for advice concerning your child/ the person you care for will be referred to Professor Chris Oliver, Clinical Psychologist. It is possible that you may be invited to participate in further research after the study however, consenting to participate in this study does not mean that you are obliged to do so.

Review:

This study has been reviewed by the University of Birmingham, School of Psychology Research Ethics Committee. If you have any concerns about the conduct of this study please contact Prof. Chris Oliver at the Centre for Neurodevelopmental Disorders, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

Thank you very much for taking the time to read this information

If you would like the person you care for to take part in the project then please complete the background questionnaire and return it in the envelope provided.

BACKGROUND DETAILS

1. **Today's date: _____**

2. **Parent / carer's name: _____**

3. **Name of person you care for: _____**

5. **Age of person you care for: _____**

6. **I would be interested in taking part in the current study** Yes ☐ No ☐

7. **The best times for me to be contacted about the current study are (dates / time etc.)**

_____

LEVEL OF ABILITY

Please complete the following items to assist us in choosing the most appropriate tests for the person you care for.

The person you care for:

1. **Points to at least three major body parts when asked (for example, nose, mouth, hands, etc.).**
   Usually ☐ Sometimes or partially ☐ Never ☐

2. **Points to common objects in a book or magazine as they are named (for example, dog, car, cup, key etc.)**
   Usually ☐ Sometimes or partially ☐ Never ☐

3. **Follows instructions with one action and one object (for example, "bring me the book"; "Close the door"; "Touch your head"; etc.**
   Usually ☐ Sometimes or partially ☐ Never ☐

4. **Takes turns when asked when playing simple games**
   Usually ☐ Sometimes or partially ☐ Never ☐

Has the person you care for had a formal IQ test? If yes, what was the score?

IQ Test Score _____

Thank you for completing these items.