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A comparative study of sociability in autism spectrum disorder, Angelman, Cornelia de Lange, Fragile X, Down and Rubinstein-Taybi syndromes.

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Abstract

Few comparative studies have evaluated the heterogeneity of sociability across a range of neurodevelopmental disorders. The Sociability Questionnaire for People with Intellectual Disabilities (SQID) was completed by caregivers of individuals with Cornelia de Lange (CdLS; n=98), Angelman (AS; n=66), Fragile X (FXS; n=142), Down (DS; n=117) and Rubinstein Taybi (RTS; n=88) syndromes and autism spectrum disorder (ASD; n=107). Between groups and age-band (<12yrs; 12-18yrs; >18yrs) comparisons of SQID scores were conducted. Rates of behaviors indicative of selective mutism were also examined. FXS achieved the lowest SQID scores. CdLS, ASD and FXS groups scored significantly lower than AS, DS and RTS groups. **S**elective mutism characteristics were highest in CdLS (40%) followed by FXS (17.8%) and ASD (18.2%). Age-band differences were identified in CdLS and DS.

Key words: Sociability, behavioral phenotypes, social anxiety, autism spectrum disorder, genetic syndromes

The term 'sociability' is an umbrella term encompassing various aspects of social functioning (Cook and Oliver, 2011). In the current study we define sociability in terms of observable, behavioral responses in specific social contexts which encompass motivation for and enjoyment of social interaction.

The literature on behavioral phenotypes has expanded significantly over the past twenty years, with growing interest in the prevalence and presentation of autism spectrum disorder (ASD) in genetic syndromes (Moss & Howlin, 2009). This literature has synthesized research describing the phenomenology of behavioral and cognitive phenotypes of genetic syndromes with basic cognitive research on ASD and literature on typical development. Research undertaken on theory of mind and executive function in genetic syndromes has directly contributed to the understanding of typical and atypical development of these domains and their role in social functioning (e.g., Grant, Apperly & Oliver, 2007; Santos & Deruelle, 2009). However, alongside this growing interest in social cognition, relatively little attention has been paid to describing observable, behavioral presentation of sociability in this population beyond the descriptions of characteristics of ASD, with the exception of Williams, Down and Angelman syndromes.

Although sociability is a relatively under-researched area, there are detailed descriptions of several genetic syndromes which have striking social profiles which might be considered to fall along a continuum of sociability. At one end are genetic syndromes such as Angelman and Rubinstein Taybi, associated with heightened levels of sociability. Individuals with Angelman syndrome for example, are considered to show comparatively high levels of both social approach behaviors and laughing and smiling during social interactions relative to a matched contrast group of individuals with intellectual disability of heterogeneous cause (Horsler & Oliver, 2006; Oliver et al., 2007; Strachan et al., 2009). This heightened sociability appears independent of degree of intellectual disability, given that

most individuals with Angelman syndrome have a severe or profound degree of cognitive impairment. A similar profile is also described in case reports and single group design studies of individuals with Rubinstein-Taybi syndrome, with social competencies reported at a level that is considered to be higher than expected, given the level of associated intellectual ability (Gotts & Liemohn, 1977; Hennekam et al., 1992). The findings from Galera et al. (2009), in which individuals with Rubinstein-Taybi syndrome were found to score significantly lower than matched controls on the 'reduced contact or social interest' subscale of the Children's Social Behaviour Questionnaire (CSBQ; Luteijn et al., 1998, 2000), also provides support for heightened social tendencies in this group.

Sociability has long been considered a relative strength of individuals with Down syndrome (Fidler & Nadel, 2007). Although not all individuals fit this stereotype (a proportion of individuals with Down syndrome meet criteria for autism spectrum disorder; ASD; Warner et al., 2014), evidence suggests that children with Down syndrome have higher levels of prosocial behaviour than children with other forms of developmental delay (Fidler, Barrett, & Most, 2005).

At the other end of the continuum are (amongst others) Fragile X and Cornelia de Lange syndromes in which clinically significant levels of shyness and social anxiety are evident (Hall et al., 2006; Hessl et al., 2006; Lesniak-Karpiak, Mazzocco & Ross, 2003; Richards et al., 2009). These syndromes are both strongly associated with ASD characteristics (see Moss et al., 2012 & Zafeiriou et al., 2013 for reviews). Social anxiety is common in individuals with Fragile X syndrome and rates of selective mutism, considered to be an extreme manifestation of social anxiety, are high in this group (Hagerman, Hills, Scharfenaker & Lewis, 1999). Extreme shyness, social anxiety and selective mutism are also prominent in individuals with Cornelia de Lange syndrome (Goodban, 1993; Kline et al., 2007; Moss et al., 2012; Richards et al., 2009) and are reported to become more severe with

age (Basile et al., 2007; Sarimski, 1997; Collis, Oliver, & Moss, 2006) alongside declines in mood and behavior (Nelson et al., 2014; Kline et al., 2007; Oliver et al., 2011). While individuals with ASD do show a greater degree of social anxiety compared to the typically developing population, it is not considered diagnostic of the disorder (Bellini, 2004; Gillott et al., 2001).

One of the difficulties of conducting research in genetic syndromes is the selection of an appropriate contrast group. The use of a contrast group is important in helping us to understand whether a particular syndrome is associated with an excess or a deficit within a particular domain, which is over and above what would be expected given the degree of associated intellectual disability. Identifying who should comprise this contrast group is ever challenging and often circulatory. Cross syndrome comparisons across multiple contrast groups can be more informative and enable positioning of syndrome groups across a continuum of skills and impairments. This approach has been used to effectively evaluate a range of behavioral constructs (e.g. Arron et al., 2011, Eden et al., 2013, Moss et al., 2009, Waite et al., 2014). In the current study we will use this approach to assess levels of sociability in children and adults with six neurodevelopmental disorders: Cornelia de Lange, Angelman, Fragile X, Down and Rubinstein Taybi syndromes and individuals with idiopathic ASD. Angelman, Rubinstein Taybi and Down syndromes have been selected because they represent groups with reportedly typical or enhanced levels of sociability (Gotts & Liemohn, 1977; Hennekam et al., 1992), whereas Cornelia de Lange syndrome, Fragile X syndrome and ASD are described as showing significant social impairments (Bellini, 2004; Hall et al., 2006). The well established profiles of sociability in ASD and DS, palce these two contrast groups as anchor points along the spectrum of sociability, around which the other syndrome groups can be positioned, thus providing greater context to the broader study findings

In study one, we outline the rationale for and development of a novel measure of sociability; the Sociability Questionnaire for people with Intellectual Disability (SQID). The SQID was developed in order to evaluate motivation for and enjoyment of social engagement, using observable indicators of sociability that are defined based on previous literature. These behaviors are examined in four social contexts (initiation of interaction, ongoing interaction, being the recipient of initiated interaction and interaction in a group). This is so that sociability can be described objectively during commonly occurring social situations. The inter-rater reliability and validity of the SQID will be assessed.

In study two, we will use the newly developed SQID to examine the nature and developmental trajectory of sociability with both familiar and unfamiliar people in individuals with neurodevelopmental disorders including; Angelman, Cornelia de Lange, Down, Fragile X and Rubinstein-Taybi syndromes and individuals with idiopathic Autism Spectrum Disorder. This will enable relative positioning of these disorders on a continuum of sociability. We will also establish the prevalence of characteristics that are indicative of selective mutism across these participant groups.

Study One: development of the Sociability Questionnaire for People with Intellectual Disabilities

The Sociability Questionnaire for People with Intellectual Disabilities (SQID) was developed for the current study and examines sociability in children and adults with a range of intellectual and verbal abilities. The informant-based questionnaire consists of 25 items which comprise thirteen categories and is completed by the main caregiver based on typical behavior in defined social situations with familiar and unfamiliar people over the preceding two months. The questionnaire also screens for characteristics indicative of selective mutism.

Rationale for developing the SQID. The SQID was developed in response to a lack of appropriate measures to evaluate sociability and social anxiety (beyond the assessment of ASD related symptomatology) in individuals with a broad range of intellectual disabilities and verbal abilities, that includes severe and profound levels of intellectual disability. The majority of measures of sociability and social anxiety that are available have been devised with typically developing children in mind and items refer to behaviours and responses which require a certain capacity for verbal language (self report measures), positioning in mainstream classroom settings or assume a level of responsibility and insight that may not be appropriate in those with a more severe degree of disability or those with more limited communication skills. The SQID uses operationalized definitions of observable behaviours that can be easily rated by parents and carers in a range of everyday social contexts. This enables the measure to be used in individuals with a broad range of abilities and circumstances.

The only relevant measure known to the authors, is the Salk Institute Sociability Questionnaire (SISQ; Jones et al., 2000), developed to assess aspects of sociability commonly reported in Williams syndrome, a genetic syndrome associated with a mild to moderate intellectual disability. The relevance of the SISQ for those with more severe intellectual disability and those with other genetic syndromes is unknown. Measures of psychopathology are available, but none examine social anxiety in individuals with intellectual disabilities specifically. The Glasgow Anxiety Scale (Mindham & Espie, 2003) measures anxiety globally in individuals with a mild intellectual disability, rather than specific forms of anxiety, such as social anxiety. Furthermore, the self-report nature of the questionnaire limits its applicability in the study population.

The assessments available to evaluate sociability and social anxiety in individuals with intellectual disabilities contrasts significantly with the plethora of reliable and valid

scales focusing on sociability or social anxiety in the typically developing population (both children and adults) which are not suitable for nonverbal individuals or those with intellectual disability. Examples include the Social Anxiety Scale for Children-Revised (SASC-R; La Greca & Stone, 1993), the Social Phobia and Anxiety Inventory for Children (SPAI-C; Beidel, Turner & Morris, 1995) and the Social Phobia and Anxiety Inventory (SPAI; Turner, Biedel & Dancu, 1995).

Development of the SQID. Table 1 describes the items that comprise the SQID. Social contexts were identified in which an individual's sociability/social anxiety could be examined. According to the DSM-IV-TR criteria, individuals with social anxiety may show anxiety in either performance or interaction situations (American Psychiatric Association, 2000). Performance situations are those in which the person is exposed to possible scrutiny by others, such as speaking in front of groups, eating or writing with other people watching and performing activities (e.g., music or sport), in front of other people. Interaction situations typically involve social interactions with unfamiliar people (Antony, 1997).

(Insert Table 1 about here)

The categorization employed in the DSM-IV-TR criteria for social anxiety was used to develop the questionnaire (American Psychiatric Association, 2000). Existing questionnaires were examined to identify performance and interaction situations relevant to individuals with a range of intellectual disabilities. Existing questionnaires were examined to identify any performance and interaction situations that might be relevant to individuals with a range of intellectual disabilities. The existing questionnaires selected for examination were those which evaluated: 1) a range of psychopathology in individuals with intellectual disabilities, 2) social anxiety in typically developing children or, 3) sociability in typically

developing children and included the following: Strengths and Difficulties Questionnaire (Goodman, 1997), Spence Children's Anxiety Scale (Spence, 1998), Social Anxiety Scale for Children-Revised (SASC-R; La Greca & Stone, 1993), Infant Characteristics Questionnaire (Bates, Freeland & Lounsbury, 1979), Matson Evaluation of Social Skills for Individuals with Severe Retardation (MESSIER; Matson, 1995a), Diagnostic Assessment for the Severely Handicapped Revised (DASH-II, Matson, 1995b), Anxiety, Depression and Mood Scale (ADAMS; Esbensen, Rojahn, Aman, & Ruedrich, 2003), Child Behaviour Checklist (CBCL; 1991) and the Developmental Behavior Checklist (DBC, Einfeld, & Tonge, 1992).

General social situations, e.g. an ongoing social interaction, rather than specific examples of social situations, e.g. attending a party, were identified for inclusion to increase applicability across ages and abilities. Through inspection of existing measures, the social interaction situations deemed relevant included when an individual: 1) is approached by another person, 2) is in an ongoing interaction and 3) initiates an interaction. The only performance situation deemed relevant to individuals with a broad range of intellectual disability was a group situation because caregivers could refer to any group situation that they may have observed. Operationalized definitions of sociability and shyness, based on observable behaviors and corresponding to each of these situations, were devised from definitions of sociability and shyness/social anxiety from the literature (Conger & Farrell, 1981; Fydrich et al., 1998; Glass & Arnkoff, 1989; Glennon & Weisz, 1978; Hall et al., 2006; Hessl et al., 2006; Lesniak-Karpiak et al., 2003; Millbrook et al., 1986; Monti et al., 1984; Trower et al., 1978).

When examining sociability and social anxiety within social situations, familiarity of the other person(s) is pertinent. In typically developing children, the diagnostic criteria for social anxiety stipulate that the individual must show a greater capacity for social

relationships with familiar people (American Psychiatric Association, 2000). Therefore, corresponding familiar and unfamiliar items for each social situation identified, were used.

Two further aspects of sociability and social anxiety; the interaction between sociability with the person's main caregiver and the presence of an unfamiliar person and behaviors indicative of selective mutism were also incorporated into this measure. Examining the interaction between sociability with the person's main caregiver and an unfamiliar person was pertinent because typically developing children with social anxiety are often reported to stay close to a familiar person or show inhibited interactions in the presence of an unfamiliar person even when a familiar adult is also present (American Psychiatric Association, 2000). Three further categories were developed to evaluate this. These categories examined the person's interaction with their main caregiver (Main caregiver interaction), the effect of their main caregiver on an interaction with an unfamiliar person (presence of main caregiver on interaction with unfamiliar person) and also the separation from their main caregiver to interact with an unfamiliar person (separation anxiety).

Given the evidence that selective mutism is an extreme form of social anxiety (Black & Uhde, 1992), the questionnaire screened for the presence of selective mutism. Two items were developed for this purpose. Finally, diagnostic criteria for social anxiety in typically developing children stipulate that the child must demonstrate anxiety in peer settings, not just during interaction with adults (American Psychiatric Association, 2000). Thus, seven of the thirteen categories were devised to consist of two items; one examining sociability with someone their own age, and one examining sociability with an adult.

Scoring the SQID. The SQID consists of twenty-five items. Twenty-one are answered on a seven-point Likert scale and four on a yes/no basis. Items one to seventeen ask the respondent to rate how sociable the person they care for appears across a range of

different social situations, rating them from very shy to very sociable. Items eighteen to twenty-one ask the respondent to rate how frequently the person initiates social interaction (using verbal and nonverbal strategies) in a range of different contexts, rating from rarely/never to nearly always. Items twenty-two to twenty-five ask about use of language and require a yes/no response. Sixteen items contribute to scores which evaluate the effect of social context on an individual's sociability with a familiar or an unfamiliar person: receive interaction, ongoing interaction, initiate interaction, group interaction. A total Familiar score is calculated by aggregating the items pertaining to familiar adults (Q4 + Q5 + Q7 + Q11 + Q12 + Q14 + Q18 + Q20), and a total Unfamiliar score is calculated by aggregating the items pertaining to unfamiliar adults (Q2 + Q3 + Q6 + Q9 + Q10 + Q17+ Q19 + Q21). Four items contribute to scores examining the interaction between the main caregiver and an unfamiliar person on an individual's sociability. Two items are combined to indicate the presence of behaviors indicative of selective mutism. Separation anxiety and change in speech over time are each evaluated in a single item. One item is a screening question for verbal ability. Scores pertaining to behaviors indicative of selective mutism and change in speech over time are only applicable for verbal individuals. Item 22 screens for whether an individual is verbal and if so items 23 to 25 are completed. To receive a positive screening of selective mutism characteristics, the caregiver must answer 'yes' to both items 24 and 25. The questionnaire can be pro-rated at the category level, which enables missing item responses to be estimated based on existing scores where sufficient information is available. The selective mutism subscale cannot be pro-rated.

For the purpose of this study only scores from categories pertinent to the aims and hypotheses of the study were examined. These were: Receive Interaction, Ongoing Interaction, Initiate

Interaction, Performance, each for familiar and unfamiliar people, and behaviors indicative of selective mutism.

Method

Recruitment:

Participants with a broad range of intellectual ability were recruited at syndrome support group conferences or during research visits conducted as part of other research projects. The participants included in the inter-rater reliability and validity studies outlined below are not the same individuals that are reported on in study two.

Procedure:

For inter-rater reliability, two parents and/or carers were asked to complete the SQID independently on the same day (at family support group conferences or during research visits). Researchers were present while the questionnaire was completed in order to ensure independent ratings between reporters.

Concurrent validity was established between the SQID and real time observations of social interaction with familiar and unfamiliar adults using the Child Sociability Rating Scale (CSRS; Moss et al., 2013) and the frequency of participant verbalizations. The CSRS data and data regarding the frequency of verbalizations were collected as part of two, separate research studies in which experimental social conditions were presented to participants. These social conditions provided standardized social settings that enabled observation of social interaction behaviors and indicators of social enjoyment and motivation. The level of social demand, adult availability for social attention, and familiarity of the adult was systematically varied in each of the social conditions. Behavioral responses across these social conditions was observed (see Moss et al., 2013 and Nelson, 2010 for further details).

Measures:

The Child Sociability Rating Scale (CSRS; Moss et al., 2013) is an observational rating scale with good inter-rater reliability and validity with real time observations of social behaviour. The CSRS rates the nature and quality of social interaction skills, social enjoyment and social motivation in individuals with a range of intellectual abilities. The absolute frequency of verbalizations was recorded during social interaction with familiar and unfamiliar adults. Verbalizations were defined as 'utterances (e.g. 'erm'), words, phrases or sentences used for the purpose of communication with someone else, e.g., asking a question, making a comment, answering a question or speech used when the person is talking to themselves. The participant's speech may be intelligible or unintelligible'. Frequency of verbalizations was considered to be a behavioral indicator of social anxiety during social interactions.

Participants:

Inter-rater reliability sample:

Participants were 50 individuals with intellectual disability and their parents/carers. Participants included individuals with Cornelia de Lange (N=32), Angelman (N =7), Cri du Chat (N=7) and Prader-Willi (N=9) syndromes. Participants were aged between 4 and 30 years (mean = 12.7; SD = 5.9).

Validity samples:

Validity between the SQID and the CSRS was conducted for a group of 47 participants with intellectual disability. The sample included individuals with Angelman (N=16; M_{age} = 10.90, SD = 4.86), Cornelia de Lange (N=18; M_{age} = 12.56, SD = 3.59) and Cri du Chat syndromes

(N=13; M_{age} = 8.35, SD = 4.51). Fourteen participants (29.8%) were reported to have 30 or more words or signs in their vocabulary and 28 (59.6%) were reported to be able to walk, including up and down stairs.

Validity between the SQID and the frequency of verbalizations was conducted in a separate sample of individuals with intellectual disability, which included 40 participants with Cornelia de Lange syndrome (N = 18; M_{age} = 21.68, SD = 8.27) and Down syndrome (N = 22; M_{age} = 24.44, SD = 5.94). All participants were reported to have 30 or more words or signs in their vocabulary and were reported to be mobile (able to walk, including up and down stairs).

Results

Inter-rater reliability:

Nonparametric analyses were employed because data were not normally distributed. Spearman correlations between independent rater scores ranged from .43 to .80 at item level for Q1 to Q21. Spearman coefficients for 81% of these items were above .60, which was deemed to be satisfactory. Kappa values for categorical items (Q22, Q24 and Q25) were .96, .44 and .51 respectively. Inter-rater reliability was not obtained for Q23 because this item was added after data on inter-rater reliability had been collected. Pearson partial correlations between the SQID and the Wessex questionnaire (controlling for chronological age) ranged from -.02 to -.17, indicating that scores on the SQID are not strongly associated with self-help skills.

Validity:

Scores on the CSRS subscales (social enjoyment, motivation for social interaction and social skills) and the CSRS total score correlated positively and significantly with the total score of the SQID (r_s = .36 to.52; all $p \leq .01$). The frequency of verbalizations was significantly, positively correlated with the total SQID score (r_s = .31 to .66; all $p < .05$) and significantly negatively correlated with scores indicative of selective mutism on the SQID (r_s = - .47 and -.52 for familiar and unfamiliar interactions respectively; $p < .001$).

Study two: Sociability in neurodevelopmental disorders

Method

Recruitment

Participants were recruited as part of a larger longitudinal study (anonymized for blind review et al., 2011; anonymized for blind review et al., 2010; anonymized for blind review et al., 2009; anonymized for blind review et al., 2011). In total, 180 individuals with Cornelia de Lange syndrome, 117 with Angelman syndrome and 208 with Fragile X syndrome who had participated in previous research studies conducted by the research team and provided consent to be contacted for future research were invited to take part. These individuals had originally been recruited via UK based syndrome support groups including the Cornelia de Lange Syndrome Foundation UK and Ireland, Angelman Syndrome Support Education and Research Trust and The Fragile X Society, UK. Individuals with Down syndrome, Rubinstein Taybi syndrome and ASD were recruited for the current study through family support groups. Five hundred families were approached through the Down Syndrome Association, 202 families through the Rubinstein-Taybi Syndrome support group and 1467 families through eight branches of the National Autistic Society around (anonymized for blind review) and (anonymized for blind review).

Procedure

Parents and caregivers of participants received a letter of invitation for the study, an information sheet and a questionnaire pack. Caregivers were asked to complete the questionnaire pack and a consent form. Reminders were sent, for those who had not responded, four to six weeks after the first contact.

Measures

Measures included: the Demographic questionnaire, the Sociability Questionnaire for People with Intellectual Disabilities (SQID), the Wessex Scale (Kushlick, Blunden & Cox, 1973) and the Social Communication Questionnaire (SCQ, Rutter, Bailey, Berument, Lord & Pickles, 2003)[1].

The Demographic Questionnaire was used to obtain background information about each participant. For the current study, only information regarding age, gender, verbal ability (whether the person had three or more words/signs) and diagnostic status (whether, when and by whom a diagnosis had been made) was used.

The Wessex Scale (Kushlick, Blunden & Cox, 1973) is an informant based questionnaire designed to examine social and physical abilities of children and adults with intellectual disability. Subscales include continence, mobility, self-help skills (categories include able, partly able or not able) speech and literacy. Additional questions regarding vision and hearing are also included. Informants complete ratings based on a three point scale for each question (apart from a question regarding speech comprehensibility). The Wessex scale has good inter-rater reliability at subscale level for both children and adult with intellectual disabilities (Kushlick et al., 1973; Palmer & Jenkins, 1982). The Wessex was selected because it evaluates self-help skills in a very concise way, is appropriate for a range

of ages and abilities and has been used effectively in our previous studies of genetic syndromes (anonymized for blind review et al., 2011; anonymized for blind review et al., 2010; anonymized for blind review et al., 2009; anonymized for blind review et al., 2011; anonymized for blind review 2014).

The Social Communication Questionnaire (SCQ; Rutter et al., 2003; also known as the Autism Screening Questionnaire) is a 40-item questionnaire that screens for characteristics associated with Autism and Autism Spectrum Disorder. All items are scored on a yes/no basis and a score of one is given for the presence of abnormal behavior and zero for absence. A total score is obtained by summing across items. Three subscales, representing the triad of impairments, can be calculated: Social Interaction, Communication and Repetitive Behavior. A cut-off of 15 is used to screen for the presence of Autism Spectrum Disorder and 22 for Autism. The questionnaire demonstrates good psychometric properties, with good sensitivity and specificity, internal consistency and concurrent validity with the Autism Diagnostic Observation Schedule and the Autism Diagnostic Interview (Berument et al., 1999; Howlin & Karpf, 2004).

Participants

In total 862 questionnaire packs were completed and returned. The overall percentage return rate was 32.24% (ranging from 20% to 63%). Participants who returned questionnaires were selected for data analysis if they met the following inclusion criteria: confirmed diagnosis from an appropriate professional according to responses on the demographic questionnaire (see measures section below; relevant professionals for a diagnosis of Cornelia de Lange, Fragile X, Angelman and Rubinstein Taybi syndromes included: Pediatrician and/or Clinical Geneticist. In the ASD participant group, relevant professionals for ASD diagnosis included: Psychologist, Psychiatrist, Pediatrician); no additional chromosomal

abnormalities (other than those due to the syndrome); completion of information regarding age or date of birth; aged four years or over. Individuals had to be at least four years old because the Social Communication Questionnaire (Rutter et al., 2003), which was included in the questionnaire pack, contains items regarding the participant's behavior when aged between four and five years. Participants in the ASD group were also required to meet criteria for ASD on the Social Communication Questionnaire (Rutter et al., 2003). In total, 701 respondents met the inclusion criteria outlined above. Although meeting inclusion criteria, a further fifteen participants from the Down syndrome group and 68 individuals from the ASD group were randomly excluded because the proportion of individuals with Down syndrome who were aged *19 years and over* and the proportion of individuals with ASD who were *under 12 years* of age (age groupings required for later analysis) was much larger in these groups than the comparison syndrome groups. As a result, a total of 618 participants met the inclusion criteria *and* were included in the data analysis. Table 2 shows the participant characteristics across the six groups.

(Insert Table 2 about here)

All participants were aged between 4 and 62 years, 65.7 % of the sample was male. As expected there were significantly more males with Fragile X syndrome (only males were recruited due to variability in phenotypic characteristics between males and females) and ASD than other comparison groups. The Fragile X, Down and Rubinstein Taybi syndrome groups and the ASD group were significantly more likely to be classified by the Wessex Scale (Kushlick et al., 1973) as being 'able' than the Angelman and Cornelia de Lange syndrome groups. The Fragile X and Down syndrome groups had the highest proportion of individuals who were classified by the Wessex Scale as being 'able'. Significantly more

vision and hearing impairments were reported in the Cornelia de Lange and Down syndrome groups than the Angelman, Fragile X and Rubinstein Taybi syndrome ASD groups.

Data Analysis

Distribution of SQID data, examined via Q-Q plots and the Kolmogrov-Smirnov test, was not normal at subscale or total score level ($p < .05$). Attempts to transform the data were unsuccessful. Consequently, Kruskal-Wallis tests, with pair-wise Mann-Whitney post hocs, were employed for between group comparisons. To examine the developmental trajectory across groups, participants were divided into three age bands: under 12 yrs; 12-18yrs; and over 18yrs. These age bands were chosen because it allowed for the most equal distribution of participants in the smaller groups (Angelman, Rubinstein Taybi and Cornelia de Lange syndromes). Analyses were conducted at the total group level and across age groups, including within group, age band comparisons and between group comparisons within specific age bands. Chi Squared tests (or Fisher's exact where appropriate) were used to evaluate group differences in selective mutism. The proportion of individuals who obtained the maximum score possible on a subscale (score = 14; classified as 'extremely sociable') and those who obtained the lowest score possible on a subscale (score = 2; classified as 'extremely shy') were calculated. A conservative alpha level ($p < .005$) was used throughout the between group comparisons. Effect sizes were calculated for any significant difference identified post hoc. Pearson's correlation coefficient, *r*, was calculated as an estimation of effect size (Field, 2005; $r = .1$ is a *small* effect size; $r = .3$ is a *medium* effect size and $r = .5$ is a *large* effect size; Cohen, 1992).

Results

Group differences in sociability

SQID total scores were compared across groups (see Table 3). The Angelman, Down and Rubinstein Taybi syndrome groups scored significantly higher on both Familiar and Unfamiliar total scores compared to the Cornelia de Lange and Fragile X syndromes and ASD groups. The Fragile X syndrome group obtained the lowest Unfamiliar total score, while the ASD group obtained the lowest Familiar total score, with all other groups obtaining significantly higher scores on these variables. All six groups scored significantly higher on scores referring to interaction with familiar compared to unfamiliar adults ($p < .001$ for all groups), indicating that individuals in all syndrome groups were significantly more sociable in familiar social interactions than unfamiliar social interactions.

(Insert table 3 about here)

The Familiar total and Unfamiliar total SQID scores were compared across three age bands (*under 12 yrs*; *12-18yrs*; and *over 18yrs*), within each syndrome group using Kruskal-Wallis tests, with pair-wise Mann-Whitney post hocs (see Figure 1). There were no significant age band differences in any of the syndrome groups on either the Familiar or Unfamiliar total scores. The age band differences on the Familiar total score in the Down syndrome group ($\chi^2(2) = 9.68$, $p = .008$; *under 12 yrs > over 18yrs*) and the Unfamiliar total score in the Cornelia de Lange syndrome group ($\chi^2(2) = 8.51$, $p = .01$; *12-18yrs < over 18yrs < 12-18yrs*) approached significance.

(Insert Figure 1 about here)

Sociability in different social contexts with familiar and unfamiliar adults

Table 3 shows median scores and the results of statistical group comparisons of sociability in different social contexts. The Angelman, Down and Rubinstein Taybi syndrome groups were reported to be significantly more sociable than the Fragile X syndrome and ASD groups in all social contexts evaluated with familiar and unfamiliar adults (group, receiving interaction, initiating interaction, ongoing interaction) and more sociable than the Cornelia de Lange syndrome group in seven of eight contexts, indicating that individuals with Angelman, Down and Rubinstein Taybi syndromes are more sociable across various types of social situations.

The Angelman, Down and Rubinstein Taybi syndrome groups shared a similar level of sociability (evidenced by no significant group differences), with the exception of initiating interaction, for which the Angelman syndrome group scored significantly higher with both familiar and unfamiliar people than all other groups. In turn, the Cornelia de Lange syndrome group shared a similar level of sociability to the ASD and Fragile X syndrome groups (also evidenced by no significant group differences) in a number of the social contexts evaluated, while showing elevated scores relative to these groups in initiating social interaction with familiar and unfamiliar adults (CdLS>ASD, FXS), receiving interaction from an unfamiliar adult (CdLS>FXS) and in a group context with both familiar and unfamiliar adults (CdLS>FXS) .

(Insert Figure 2 about here)

Figure 2 shows syndrome group median scores across the different social contexts according to three age bands (*under 12yrs, 12-18yrs, above 18yrs*). A significant age band difference was identified in the Cornelia de Lange syndrome group with regard to initiation of interaction with unfamiliar adults (χ^2 = 11.05, p < .005), with the *under 12yrs* group

scoring significantly higher than the *12-18yrs* age group (U = 148.5, p = .001, r = -.48; medium to large effect size).

A significant age band difference was also identified in the Down syndrome group with regard to initiation of interaction with familiar adults (χ^2 = 14.93, p =.001) with the *under 12yrs* group significantly higher than o*ver 18yrs* group (U = 518.5, p < .001, r = -.39; medium effect size).

Prevalence of extreme sociability and extreme shyness

Table 4 shows the percentage of individuals from each group that met the cut-off for 'extreme sociability' and 'extreme shyness' on each social situation subscale of the SQID (ongoing interaction, receive interaction, group interaction, initiate interaction). The Fragile X syndrome group showed the highest rates of 'extreme shyness' in all unfamiliar social situations. Rates were generally low in the familiar social situations, with the exception of the group interaction with familiar adults. A similar pattern of results was identified in the Cornelia de Lange syndrome and ASD groups, demonstrating differences in sociability when interacting with familiar and unfamiliar individuals in these groups.

(Insert Table 4 about here)

The Down, Angelman and Rubinstein Taybi syndrome groups showed much higher levels of 'extreme sociability' during familiar and unfamiliar social situations. The profile of this extreme sociability differed across these groups. The Angelman syndrome group were more likely to meet the 'extreme sociability' cut off scores on initiating interaction with familiar and unfamiliar adults, while the Rubinstein Taybi syndrome group was reported to show the highest prevalence of 'extreme sociability' with unfamiliar people when receiving an interaction and also during an ongoing interaction. The Down syndrome group was

reported to show the highest prevalence of 'extreme sociability' in a group situation with unfamiliar people.

Prevalence of behaviors indicative of selective mutism

This analysis only included verbal individuals from each group. The approximate rates of behaviors indicative of selective mutism (i.e. the person is reported to speak to some individuals and not others *and* in some environments but not others) are shown in Table 5. Chi-square tests revealed that there was a significant group difference regarding the frequency of these selective mutism characteristics (χ^2 (4) = 22.67, $p < .001$). A significantly higher proportion of individuals with Cornelia de Lange syndrome were reported to show these characteristics compared to individuals in the Fragile X, Down and Rubinstein Taybi syndrome groups. Odds ratio analysis confirmed that the Cornelia de Lange syndrome group was 3.08, 8.22 and 4.35 times more likely to show behaviors indicative of selective mutism than the Fragile X, Down and Rubinstein Taybi syndrome groups, respectively.

(Insert Table 5 about here)

The association between selective mutism and sociability was also examined. Only the Cornelia de Lange syndrome, Fragile X syndrome and ASD groups were included in this analysis because only these groups included enough verbal individuals reported to show behaviors indicative of selective mutism. These three groups were combined and participants were divided into two sub-groups: those reported to show selective mutism characteristics and those who were not. The two groups were compared on sociability scores during the different social contexts with unfamiliar adults, with the prediction that those who showed behaviors indicative of selective mutism would obtain significantly lower scores, indicating reduced sociability. Mann-Whitney tests confirmed that individuals reported to show

selective mutism characteristics scored significantly lower during all of the social situations (receive interaction: $U = 3550.0$, $p = .001$; ongoing interaction: $U = 3419.0$, $p < .001$; initiate interaction: $U = 3211.0$; $p < .001$; group interaction: $U = 3204.5$, $p < .001$).

Discussion

This is the first study to examine sociability, defined as motivation for social contact in six neurodevelopmental disorders using a novel, reliable and valid measure of sociability for individuals with a range of intellectual disabilities. In addition to examining differences and similarities in sociability across groups, the study has also examined the proportion of individuals meeting cut offs for 'extreme sociability' and 'extreme shyness' in both familiar and unfamiliar situations. The study has also estimated the prevalence of behaviors indicative of selective mutism in each group. These findings will enhance knowledge of the profile of sociability in each of the neurodevelopmental disorders evaluated in this study, some of which have received limited attention within the literature, such as Rubinstein Taybi syndrome. Furthermore, the findings confirm theoretical positioning of the different groups along a spectrum of sociability.

Analysis of the psychometric properties of the SQID, outlined in study one, indicated good inter-rater reliability at item level and good validity with the CSRS (Moss et al., 2013) and with real time observations of verbalizations during social settings. Although not all of the groups reported on in study two were recruited into the reliability and validity studies, the findings from study two demonstrate the face validity of the SQID, confirming previous findings of higher levels of sociability in Down and Angelman syndromes relative to other syndrome groups and heightened social anxiety in ASD, Cornelia de Lange and Fragile X syndromes. Scores on the SQID do not correlate with self-help skills, indicating that the measure is unlikely to be strongly confounded by this factor.

In study two, analysis of SQID scores indicated that, the Angelman, Down and Rubinstein Taybi syndrome groups were reported to be significantly more sociable than the Cornelia de Lange syndrome, ASD and Fragile X syndrome groups. The Cornelia de Lange and ASD groups showed broadly similar levels of sociability, while the Fragile X group

scored significantly lower than all groups. A more fine-grained analysis evaluating sociability within different social contexts indicated that while the Cornelia de Lange syndrome group was comparable to the Fragile X syndrome and ASD groups with regard to sociability during some social situations, they were reported to be significantly more sociable in three out of four social contexts with unfamiliar adults. Furthermore, the Fragile X syndrome group were reported to be significantly less sociable than all other groups in a number of social contexts. These results indicate that the shyness/social anxiety reported in Cornelia de Lange syndrome may not be as extreme as that reported in Fragile X syndrome or ASD. This pattern of results was also reflected in the analysis of the extreme sociability and extreme shyness cut-off scores.

The findings provide further evidence of a heightened level of sociability in Rubinstein Taybi syndrome (Galéra et al, 2009; Hennekam et al., 1992) that is similar to that observed in individuals with Angelman and Down syndromes. Initiating behavior was reported to be significantly more frequent in the Angelman syndrome group than all other participant groups and this is consistent with previous reports of elevated social approach behaviors in Angelman syndrome (Horsler & Oliver, 2006; Strachan et al., 2009). The findings regarding Cornelia de Lange syndrome are consistent with previous observations of similarities with ASD with regard to overall severity of social impairment (Moss et al., 2008; Moss et al., 2012). However, the levels of social anxiety in this group, and indeed in the ASD group, appear to be less severe than that reported in individuals with Fragile X syndrome. With regard to positioning of these syndrome groups along a continuum of sociability, these findings confirm our predictions that the Angelman, Down and Rubinstein Taybi syndrome groups would fall at the upper end of this continuum, while the Cornelia de Lange syndrome, ASD and Fragile X syndrome cluster at the lower end. The findings further delineate this continuum, placing the Angelman and Fragile X syndrome groups at the extremes of

sociability, given the significantly higher rates of social initiation in Angelman syndrome relative to all other groups and the significantly lower scores in the Fragile X syndrome group in a range of social contexts, relative to all other groups.

The effect of age band on sociability in these syndrome groups highlighted two of the six groups as showing possible age related changes in initiation of social interaction. In Down syndrome, participants aged over 18 years scored significantly lower than those aged 12 years and under on initiating behavior with familiar people. Age related changes are well established within the Down syndrome literature (e.g. Holland, Hon, Huppert & Stevens, 1998) and this change in initiation of social interaction may reflect an early predictor of change as described by Holland et al. (2001). In Cornelia de Lange syndrome, participants aged 12-18 years scored significantly lower than those aged 12 years and under on initiating behavior with unfamiliar people. The findings suggest that a decline in sociability during adolescence, specifically in relation to interaction with unfamiliar adults, may be characteristic of this syndrome. Previous literature indicating greater social isolation in older children with Cornelia de Lange syndrome supports this conclusion (Sarimski, 1997). Changes in social interaction skills with age may be part of a more global change in the syndrome, as evidenced by increased behavioral problems, communication disturbances, impulsivity, anxiety, mood and executive function skills with age in this syndrome group (Basile et al., 2007; Nelson et al., 2014; Kline et al., 2007; Oliver et al., 2011; anonymized for blind review; in review). Preliminary studies have alluded to the role of genes within the cohesin pathway (relevant to the cause of Cornelia de Lange syndrome) and the high levels of oxidative stress in cell lines of individuals with Cornelia de Lange syndrome as having a mechanistic role in these reported changes (Gimigliano et al., 2012; Kline et al., 2007). Given the broad age range of the study samples and the cross-sectional nature of the data,

further, prospective, longitudinal studies are required to evaluate the developmental trajectory of these characteristics and its causes more closely.

The approximate prevalence of behaviors indicative of selective mutism was also examined. In Cornelia de Lange syndrome, 40% of verbal participants showed signs of selective mutism (i.e. were reported to speak with some individuals and not others *and* in some environments and not others). This was significantly higher than the rates reported for the Fragile X, Down and Rubinstein Taybi syndrome groups. These findings indicate that selective mutism may be characteristic of Cornelia de Lange syndrome and provides empirical support for anecdotal and case study descriptions of individuals with the syndrome who are able to speak but speak very little (Moss et al., 2008; Collis et al., 2006; Goodban, 1993). Further analysis indicated a strong association between selective mutism and low scores on the SQID, indicating lower levels of sociability and higher levels of shyness in those individuals (groups combined) who showed behaviors indicative of selective mutism. In the typically developing literature, selective mutism is considered an extreme form of social anxiety (Black & Uhde, 1995) and these findings reflect this position. However, if selective mutism was simply an extreme form of social anxiety, it would be expected that the Fragile X syndrome group (not the Cornelia de Lange syndrome group) should show the highest rate of selective mutism, given that the Fragile X syndrome group showed the highest rates of extreme shyness relative to the other groups and obtained the lowest total and subscale scores on the SQID. The pattern of findings suggests that there may be other factors contributing to selective mutism in Cornelia de Lange syndrome.

Recent research suggests that individuals with selective mutism have a phobia of their own speech (Omdal & Galloway, 2008). Omdal & Galloway (2008) also suggest that as a result of selective mutism, individuals may become socially isolated and then develop social anxiety as a secondary problem. This may be relevant to the difficulties observed in Cornelia

de Lange syndrome, particularly given the number of studies demonstrating expressive communication problems (Goodban, 1993; Oliver et al., 2008). In Cornelia de Lange syndrome selective mutism might develop as a result of expressive communication difficulties and social anxiety develops as a secondary problem to this. In Fragile X syndrome, however, social anxiety may be a primary difficulty with selective mutism becoming a manifestation of this anxiety. Therefore, different causal pathways may underlie social anxiety and selective mutism in these two syndromes.

There are several limitations to the study that need to be taken into consideration when interpreting the findings. The comparison groups were significantly different on a number of demographic variables including mobility, self-help skills, vision and hearing. Such differences are inherent when conducting large cross syndrome comparison studies such as this one. While, these differences between the groups are an important consideration in the study, the direction of the findings suggests that they did not impact on the pattern of results. For example, the Angelman syndrome group was one of the lowest functioning groups but scored highly on the sociability questionnaire and achieved similar (if not higher) scores than individuals with Rubinstein Taybi and Down syndrome (both relatively high functioning groups). Similarly, the Cornelia de Lange syndrome group (also a lower functioning group) achieved similar scores to the Fragile X and ASD groups, which were significantly higher functioning than the Cornelia de Lange syndrome group. Thus, the findings indicate that associated degree of intellectual disability did not play a significant role in the pattern of results from this study and was not a significant confounding variable. The informant-based nature of the assessment is a strength when evaluating individuals who have intellectual disabilities, although the lack of direct assessment limits the conclusions that can be drawn from the study. Furthermore, parental responses on the SQID may be influenced by knowledge of their child's syndrome more broadly, rather than solely their child's individual

behavioral responses. This study has been useful, however, in facilitating a large group comparison study of sociability across relatively rare neurodevelopmental disorders and provides important information about the developmental trajectory of sociability in each group. The cross-sectional nature of the study was also a limitation when trying to draw inferences about the developmental trajectory of sociability in the participant groups, due to potential cohort effects and longitudinal approaches are needed to further evaluate this. Finally, interpretation of the direction of the findings of the study raised an interesting challenge. If a significant difference was identified between two groups, it was difficult to determine whether this was indicative of a heightened level of sociability than expected in one group or whether the other group showed a lower level of sociability than expected. The use of cut-offs for examining extreme sociability and extreme shyness helped determine which groups showed a higher prevalence of extreme sociability and extreme shyness but the interpretation of results remains a challenge for this type of research. However, the direction of findings was consistent with previous reports of sociability/ social interaction skills in the five contrast groups.

Footnotes

[1] All groups, apart from the ASD group received the Autism Screening Questionnaire (Berument et al., 1999), which is the unpublished version of the Social Communication Questionnaire (Rutter et al., 2003). The ASD group were sent the Social Communication Questionnaire (Rutter et al., 2003). One item (item 20; social chat) differed for nonverbal individuals between the ASQ and the SCQ. For consistency across the groups, this item was treated as missing data and was prorated for all nonverbal participants. The prorated score was calculated as the mean item score, based on other completed items within the communication domain. This approach has previously been used by Moss et al. (2013).

References

American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.). Washington, DC: Author.

Antony, M. M. (1997). Assessment and Treatment of Social Phobia. *Canadian Journal of Psychiatry, 42, 826-834.*

Arron, K., Oliver, C., Berg, K., Moss, J. and Burbidge, C. (2011). Delineation of behavioural phenotypes in genetic syndromes. Prevalence, phenomenology and correlates of self-injurious and aggressive behaviour. *Journal of Intellectual Disability Research, 55,* 109-120.

Arron, K., Oliver, C., Hall, S., Sloneem, J., Forman, D., & McClintock, K. (2006). Effects of Social Interaction on Pragmatic Communication and Self-Injurious Behavior in Cornelia de Lange syndrome. *American Journal on Mental Retardation, 111,* 184-192.

Basile, E., Villa, L., Selicorni, A., & Molteni, M. (2007). The behavioural phenotype of Cornelia de Lange syndrome: A study of 56 individuals. *Journal of Intellectual Disability Research, 51,* 671–681.

Bates, J. E., Freeland, C. A., & Lounsbury, M. L. (1979). Measurement of infant difficultness. *Child Development, 50,* 794-803.

Beidel, D. C, Turner, S. M., & Morris, T. L. (1995). A new inventory to assess childhood social anxiety and phobia: The Social Phobia and Anxiety Inventory for Children. *Psychological Assessment, 7,* 73-79.

Bellini, S. (2004). Social Skill Deficits and Anxiety in High-Functioning Adolescents with Autism Spectrum Disorders. *Focus on Autism and Other Developmental Disabilities, 19,* 78-86.

Berney, T. P., Ireland, M., & Burn, J. (1999). Behavioural phenotype of Cornelia de Lange syndrome. *Archives of Disease of Childhood, 81*, 333-336.

Berument, S. K., Rutter, M., Lord, C., Pickles, A., & Bailey, A. (1999). Autism Screening Questionnaire: Diagnostic validity. *British Journal of Psychiatry, 175*, 444-451.

Black, B., & Uhde, T. W. (1992). Elective mutism as a variant of social phobia. *Journal of the American Academy of Child & Adolescent Psychiatry, 31*, 1090−1094.

Bregman, J. D., Leckman, J. F., & Ort, S. I. (1988). Fragile X syndrome: Genetic predisposition to psychopathology. *Journal of Autism and Developmental Disorders, 18*, 343-534.

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

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*, 155-159.

Collis, L., Oliver, C., & Moss, J. (2006). Low mood and social anxiety in Cornelia de Lange syndrome. *Journal of Intellectual Disability Research, 55*, 792.

Conger, J. C., & Farrell, A. D. (1981). Behavioral components of heterosocial skills. *Behavior Therapy, 12*, 41-55.

Cook, F. And Oliver, C. (2011). A review of defining and measuring sociability in children with intellectual disabilities. *Research in Developmental Disabilities, **32***, 11-24.

Doyle, T. F., Bellugi, U., Korenberg, J. R., & Graham, J. (2004). "Everybody in the world is my friend": hypersociability in young children with Williams syndrome. *American Journal of Medical Genetics, 124A*, 263-273.

Einfeld, S. L., & Tonge, B. J. (1992). *Manual for the Developmental Behaviour Checklist. (Primary Carer Version: Developmental Behaviour Checklist-P).* Sydney / Melbourne, Australia: University of New South Wales/ Monash University.

Esbensen, A. J., Rojahn, J., Aman, M. G., & Ruedrich, S. (2003). Reliability and Validity of an Assessment Instrument for Anxiety, Depression, and Mood among Individuals with Mental Retardation. *Journal of Autism and Developmental Disorders*, *33*, 617-629.

Fidler D.J., Barrett, K.C. & Most, D.E. (2005). Age related differences in smiling and personality in Down syndrome. *Journal of Developmental and Physical Disability*, *33*, 263–280.

Fidler, D.J. & Nadel, L. (2007). Educating children with Down syndrome: Neuroscience, development, and intervention. *Mental Retardation and Developmental Disabilities Research Reviews, 13*¸ 262-277.

Field, A. P. (2005). *Discovering Statistics Using SPSS (Second Edition)*. London: Sage.

Fydrich, T., Chambless, D. L., Perry, K. J., Buergener, F., & Beazley, M. B. (1998). Behavioral assessment of social performance: a rating system for social phobia. *Behaviour Research and Therapy*, *36*, 995-1010.

Galéra, C., Taupiac, E., Fraisse, S., Naudion, S., Toussaint, E., Rooryck-Thambo, C., Delrue, M., Arveiler, B., Lacombe, D., & Bouvard, M. (2009). Socio-Behavioral Characteristics of Children with Rubinstein-Taybi Syndrome. *Journal of Autism and Developmental Disorders*, 39, 1252-1260.

Gillott, A., Furniss, F., & Walter, A. (2001). Anxiety in high-functioning children with autism. *Autism*, *5*, 277-286.

Glass, C. R., & Arnkoff, D. B. (1989). Behavioral Assessment of Social Anxiety and Social Phobia. *Clinical Psychology Review*, *9*, 75-90.

Glennon, B., & Weisz, J. R. (1978). An observational approach to the assessment of anxiety in young children. *Journal of Consulting and Clinical Psychology*, *46*, 1246-1257.

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*, 1059-1063.

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, *38*, 581-586.

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

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*, 17-28.

Hagerman, R, & Sobesky, W. E. (1989). Psychopathology in Fragile X syndrome. *American Journal of Orthopsychiatry*, *59*, 142-152.

Hagerman, R. J., Hills, J., Scharfenaker, S., & Lewis, H. (1999). Fragile X syndrome and selective mutism. *American Journal of Medical Genetics*, *83*, 313-317.

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

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

Hessl, D., Glaser, B., Dyer-Friedman, J., & Reiss, A. L., (2006). Social behavior and cortisol reactivity in children with Fragile X syndrome. *Journal of Child Psychology and Psychiatry*, *47*, 602-610.

Holland, A. J., Hon, J., Huppert, F. A., Stevens, F., & Watson, P. (1998). Population-based study of the prevalence and presentation of dementia in adults with Down's syndrome, *British Journal of Psychiatry, 172,* 493-498.

Holland, A. J., Hon, J., Huppert, F. A., Stevens, F., & Watson, P. (2001). Incidence and course of dementia in people with Down's syndrome: Findings from a population based study. *Journal of Intellectual Disability Research, 44,* 138-146.

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

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, 8,* 175-182.

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

Kline, A. D., Grados, M., Sponseller, P., Levy, H. P., Blagowidow, N., Schoedel, C., Rampolla, J., Clemens, D. K., Krantz, I., Kimball, A., Pichard, C., & Tuchman, D. (2007). Natural history of aging in Cornelia de Lange syndrome. *American Journal of Medical Genetics Part C, 145C,* 248-260.

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

La Greca, A. M., & Stone, W. L. (1993). Social anxiety scale for children-revised: factor structure and concurrent validity. *Journal of Clinical Child Psychology, 22,* 17-27.

Lachiewicz, A. M. (1992). Abnormal behaviors of young girls with Fragile X syndrome. *American Journal of Medical Genetics, 43,* 72-77.

Lesniak-Karpiak, K., Mazzocco, M. M., & Ross, J. L. (2003). Behavioral assessment of social anxiety in females with Turner or Fragile X syndrome. *Journal of Autism and Developmental Disorders, 33,* 55-67.

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

Luteijn, E. F., Jackson, A. E., Volkmar, F. R., & Minderaa, R. B. (1998). The development of the Children's Social Behavior Questionnaire: Preliminary data. *Journal of Autism and Developmental Disorders, 28,* 559–565.

Luteijn, E. F., Luteijn, F., Jackson, A. E., Volkmar, F. R., & Minderaa, R. B. (2000). The Children's Social Behavior Questionnaire for milder variants of PDD problems: Evaluation of the psychometric characteristics.*Journal of Autism and Developmental Disorders, 30*, 317–330.

Matson, J. L. (1995a). *The Matson Evaluation of Social Skills for Individuals with Severe Retardation (MESSIER).* Baton Rouge, LA: Disability Consultants, LLC.

Matson, J. L. (1995b). *The Diagnostic Assessment for the Severely Handicapped-Revised (DASH-II).* Baton Rouge, LA: Scientific Publishers.

Matson, J. L., & Wilkins, J. (2007). A critical review of assessment targets and methods for social skills excesses and deficits for children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 1*, 28-37.

Millbrook, J. M., Farrell, A. D., Wallander, J. L., & Curran, J. P. (1986). Behavioral components of social skill: A look at subject and confederate behaviors. *Behavioral Assessment, 8,* 203-220.

Mindham, J., & Espie, C. A. (2003). Glasgow Anxiety Scale for people with an Intellectual Disability (GAS-ID): development and psychometric properties of a new measure for

use with people with mild intellectual disability. *Journal of Intellectual Disability Research, 47,* 22-30.

Monti, P. M., Boice, R., Fingeret, A. L., Zwick, W. R., Kolko, D., Munro, S., & Grunberger, A. (1984). Midi-level measurement of social anxiety in psychiatric and non-psychiatric samples. *Behaviour Research and Therapy*, *22*, 651-660.

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*, 852-873.

Moss, J., Howlin, P., Hastings, R., Beaumont, S., Griffith, G., Petty, J., Tunnicliffe, P., Yates, R., Villa, D. and Oliver, C. (2013). Social behavior and characteristics of Autism Spectrum Disorder in Angelman, Cornelia de Lange and Cri du Chat syndromes. *American Journal of Intellectual and Developmental Disabilities.* **118,** 262-283.

Moss, J., Howlin, P and Oliver, C. (2011). The assessment and presentation of Autism Spectrum Disorder and associated characteristics in individuals with severe intellectual disability and genetic syndromes. *The Oxford Handbook of Intellectual Disability and Development.* Editors: Jake Burack, Robert Hodapp, Grace Iarocci and Edward Zigler. New York: Oxford University Press

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

Moss, J., Oliver, C., Berg, K., Kaur, G., Jephcott, L., & Cornish, K. (2008). Prevalence of autism spectrum phenomenology in Cornelia de Lange and Cri du Chat syndromes. *American Journal on Mental Retardation, 113*, 278-291.

Nelson (2010). *Mood and sociability in Cornelia de Lange syndrome.* Unpublished Thesis: University of Birmingham.

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

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

Oliver, C., Horsler, K., Berg, K., Bellamy, G., Dick, K., & Griffiths, E. (2007). Genomic imprinting and the expression of affect in Angelman syndrome: what's in the smile? *Journal of Child Psychology and Psychiatry, 48*, 571-579.

Omdal, H., & Galloway, D. (2008). Could selective mutism be re-conceptualised as a specific phobia of expressive speech? An exploratory post-hoc study. *Child and Adolescent Mental Health, 13*, 74-81.

Richards, C., Moss, J., O'Farrell, L., Kaur, G., & Oliver, C. (2009). Social anxiety in Cornelia de Lange syndrome, *Journal of Autism and Developmental Disorders, 39*, 1155-1162.

Rutter, M., Bailey, A., Berument, S. K., Lord, C., & Pickles, A. (2003). *Social Communication Questionnaire* (SCQ). Los Angeles: Western Psychological Services.

Santos, A. & Deruelle, C. (2009). Verbal peaks and visual valleys in theory of mind ability in Williams syndrome. *Journal of Autism and Developmental Disorders, 39*, 651-659.

Sarimski, K. (1997). Communication, social-emotional development and parenting stress in Cornelia-de-Lange syndrome. *Journal of Intellectual Disability Research, 41*, 70-75.

Spence, S. H. (1998). A measure of anxiety symptoms among children. *Behaviour research and Therapy, 36*, 545-566.

Strachan, R., Shaw, R., Burrow, C., Horsler, K., Allen, D., & Oliver, C. (2009). Experimental functional analysis of aggression in children with Angelman syndrome. *Research in Developmental Disabilities*, *30*, 1095-1106.

Trower, P., Yardley, K., Bryant, B. M., & Shaw, P. (1978). The treatment of social failure: A comparison of anxiety-reduction and skills-acquisition procedures on two social problems. *Behavior Modification, 2*, 41-60.

Turner, S. M., Beidel, D. C., & Dancu, C. V. (1995). *Social Phobia and Anxiety Inventory Manual*. NY: MHS.

Warner, G., Moss, J., Smith, P and. Howlin, P. (2014). Autism characteristics and behaviour disturbances in 500 children with Down's syndrome in England and Wales. *Autism Research*, **7,** 433-441.

Zafeiriou DI, Ververi A, Dafoulis V, Kalyva E, Vargiami E. (2013). Autism spectrum disorders: the quest for genetic syndromes. *American Journal of Medical Genetics*; **162**:327–366.

Table 1: The SQID items and scoring profile.

Response to different social contexts

How would the person you care for appear if…	**Very shy**	**Moderately shy**	**A little shy**	**Neither**	**A little sociable**	**Moderately sociable**	**Very sociable**
1. Her / his main caregiver walks up to her / him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. (S)he is spending time with an adult (s)he does *not* know?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Someone (s)he does *not* know that is her / his own age walks up to her /him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. (S)he is spending time with a familiar adult?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. (S)he is the focus of attention in a group of adults (s)he knows?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. (S)he is spending time with someone (s)he does *not* know that her / his own age?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. Someone familiar that is her / his own age walks up to her /him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. (S)he has just been separated from her / his main caregiver to be with an adult (s)he does *not* know?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. An adult (s)he does *not* know walks up to her / him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. (S)he is the focus of attention in a group of people her / his own age that (s)he does *not* know?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. (S)he is spending time with someone familiar that is her / his own age?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. (S)he is the focus of attention in a group of people her / his own age that (s)he knows?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. (S)he is with her / his main caregiver and then someone her / his own age that (s)he does *not* know starts to talk to her / him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. A familiar adult walks up to her / him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. (S)he is with her / his main caregiver and then an adult (s)he does *not* know starts to talk to her / him?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. (S)he is spending time with her / his main caregiver?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. (S)he is the focus of attention in a group of adults (s)he does *not* know?	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Initiating interaction in different social contexts

	Never or very rarely	Rarely	Sometimes	About half the time	Often	Very often	Nearly Always
18. When there are only familiar people around, how often does (s)he try to make contact with them in any way (by talking, signing, vocalising, using gestures, moving towards them in any way etc.)?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19. When familiar people and people are around who (s)he does *not* know, how often does (s)he try to make contact with the people (s)he does *not* know in any way (by talking, signing, vocalising, using gestures, moving towards them in any way etc.)?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. When familiar people and people are around who (s)he does *not* know, how often does (s)he try to make contact with the familiar people in any way (by talking, signing, vocalising, using gestures, moving towards them in any way etc.)?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
21. When there are only people around who (s)he does *not* know, how often does (s)he try to make contact with them in any way (by talking, signing, vocalising, using gestures, moving towards them in any way etc.)?	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Characteristics of language

23. Does the person speak *less* than (s)he used to? YES/NO
24. Does the person *only* speak or sign in some settings and not others? YES/NO
25. Does the person *only* speak or sign to some people and not others? YES/NO

Table 2: Participant group characteristics and results of group comparisons

		CdLS	AS	FXS	DS	RTS	ASD	F / χ^2	df	*P*	Post hoc analyses
N*		98	66	142	117	88	107				
Age (years)	Mean	18.8	15.1	19.8	22.6	19.2	13.8	11.9	5	<.001	CdLS, DS, FXS, RTS > ASD; DS>AS
	(SD)	8.7	8.7	8.6	13.0	10.6	6.3				
	Range	4-43	4-48	9-49	4-62	4-49	4-45				
Gender [a]	% Male	45.9	50	100	42.4	55.6	82.2	145.2	5+	<.001	FXS > ASD> CdLS, AS, DS, RTS
Self Help [b]	% Partly able / able [c]	48	45.5	95.1	92.3	76.7	88.8	138.0	5	<.001	FXS, DS, RTS, ASD > CdLS, AS; FXS, DS > RTS
Mobility [b]	% Fully Mobile [d]	66	52.3	97.8	91.5	78.4	95.3	106.0	5	<.001	FXS, DS, ASD > CdLS, AS; FXS, ASD > RTS > AS
Vision [b]	% Normal	66	87.9	92.9	63.2	52.9	92.5	67.8	5	<.001	AS, FXS, RTS, ASD > CdLS, DS
Hearing [b]	% Normal	58.2	100.0	96.5	66.1	84.4	94.4	108.0	5	<.001	AS, FXS, RTS, ASD > CdLS, DS; AS, FXS > RTS
Speech [e]	%Verbal	46.9	3.0	92.4	93.2	73.7	88.8	260.3	5	<.001	FXS, DS, RTS, ASD> CdLS > AS; FXS, DS > RTS
ASQ / SCQ	Mean score [f]	20.8	17.6	20.6	10.2	16.9	28.2				
	(SD)	6.8	5.0	6.0	7.1	5.9	3.9				

* N may vary due to missing data

[a] Females with FXS were excluded from the study because the syndrome characteristics vary between males and females in the syndrome (Dykens *et al*., 2000).

[b] Data derived from the Wessex Scale (Kushlick *et al.*, 1973).

[c] Partly able/able if obtain a score of six or above on the self-help subscale items.

[d] Fully mobile if obtain a score of three on item F.

[e] Information obtained from item three of the Demographic questionnaire. If this item had not been completed for participants, question one from the SCQ was used.

[f] The groups were not compared statistically on the measure of autism spectrum disorder because two different measures were used across the six groups.

Table 3: Median SQID total and subscale scores and results of between group analyses

	Group Median (Inter-quartile range)						**df**	**X^2**	***p* value**	**Post hoc***	**Large effect size**	**Medium effect size**	**Small effect size**
	A **CdLS** (n=98)	B **AS** (n=66)	C **FXS** (n=142)	D **DS** (n=117)	E **RTS** (n=88)	F **ASD** (n=107)							
Total Unfamiliar Subscale	26.00 (13.50-35.00)	41.00 (31.00-48.00)	15.00 (11.00-25.00)	36.00 (24.00-46.00)	31.50 (21.25-46.00)	21.00 (14.00-29.00)	5	153.65	<.001	B,D,E>A,F>C			
Unfamiliar Ongoing Interaction	7.00 (3.00-9.00)	11.00 (9.00-12.00)	4.00 (2.00-8.00)	10.00 (7.00-12.00)	9.00 (6.00-12.00)	5.50 (3.00-8.00)	5	139.12	<.001	B,D,E>A,C,F	B,D>C; B>F	B,D,E>A; D,E>F; E>C	N/A
Unfamiliar Receive Interaction	6.50 (3.00-8.00)	10.00 (8.00-12.00)	3.00 (2.00-6.00)	9.00 (6.00-11.00)	8.00 (5.00-12.00)	6.00 (3.00-8.00)	5	142.57	<.001	B,D,E>A,F >C	B,D>C; B>F	B,D>A; D,E>F; E>C	E>A; C>F
Unfamiliar Group situation	7.00 (2.75-9.00)	10.00 (7.00-13.00)	3.00 (2.00-6.00)	10.00 (5.00-12.00)	10.00 (4.00-12.00)	6.00 (2.00-8.00)	5	135.02	<.001	B,D,E>A,F >C	B,D>C; B>F	B,D>A; D,E>F; E>C	E>A; A,F>C
Unfamiliar Initiate Interaction	5.00 (4.00-7.50)	10.00 (6.75-12.00)	4.00 (2.00-6.00)	7.00 (4.00-11.00)	6.00 (4.00-10.75)	4.00 (3.00-6.00)	5	120.34	<.001	B>D,E>A,F; B,A,D,E>C	B>A,C,F	D,E>C,F	D,E>A; B>D,E; A>C
Total Familiar Subscale	41.50 (35.00-48.00)	53.00 (48.00-55.00)	39.00 (31.00-44.00)	51.00 (45.00-54.00)	50.50 (42.00-54.00)	37.50 (31.00-45.00)	5	179.65	<.001	B,D,E>A,C,F; A>F			
Familiar Ongoing Interaction	11.00 (10.00-13.00)	13.50 (12.00-14.00)	12.00 (9.00-13.00)	14.00 (12.00-14.00)	13.00 (12.00-14.00)	11.00 (9.00-12.00)	5	128.03	<.001	B,D,E>A,C,F	B,D>F; D>A	B,D,E>C; B,E>A; E>F	N/A
Familiar Receive Interaction	10.00 (8.75-12.00)	13.00 (12.00-14.00)	10.00 (7.00-12.00)	13.00 (12.00-14.00)	12.00 (10.00-14.00)	9.00 (8.00-12.00)	5	151.44	<.001	B,D,E>A,C,F	B,D>A,C,F	E> A,C,F	N/A
Familiar Group situation	11.00 (9.00-13.00)	14.00 (12.00-14.00)	9.00 (6.00-12.00)	14.00 (12.00-14.00)	13.00 (11.00-14.00)	10.00 (7.00-12.00)	5	159.77	<.001	B,D,E>A>C,F	B,D>F; D>C	B,D,E>A; B,E>C; E>F	A>C,F
Familiar Initiate Interaction	10.00 (7.00-12.00)	13.00 (10.00-14.00)	9.00 (6.00-11.00)	12.00 (8.00-13.00)	11.50 (8.00-13.00)	7.00 (6.00-10.00)	5	95.80	<.001	B>D,E,A>F; B,D,E>C	B>F	B>A,C; D,E>F	B>D,E; D,E>C; A>F

Table 4: The percentage of individuals in each group meeting the cut-off for extreme sociability and extreme shyness on each subscale

	Group					
	CdLS (n=98)	**AS (n=66)***	**FXS (n=142)**	**DS (n=117)***	**RTS (n=88)**	**ASD (n=107)***
Extreme Sociability (Score of 14)						
Unfamiliar Ongoing Interaction:	0	4.5	.7	6.8	8.0	1.9
Unfamiliar Receive Interaction	0	6.1	.7	8.5	9.1	.0
Unfamiliar Group situation	2.0	9.1	1.4	14.5	9.1	.9
Unfamiliar Initiate Interaction	3.1	13.6	1.4	11.3	5.7	1.9
Familiar Ongoing Interaction	11.2	50.0	21.1	53.0	40.9	9.3
Familiar Receive Interaction	6.1	43.9	10.6	45.3	34.8	8.4
Familiar Performance situation	14.3	53.0	14.8	58.1	42.0	7.5
Familiar Initiate Interaction	13.3	37.9	4.9	22.2	19.3	5.7
Extreme Shyness (Score of 2)						
Unfamiliar Ongoing Interaction	22.4	1.5	27.5	2.6	8.0	14.2
Unfamiliar Receive Interaction	21.4	1.5	35.9	7.7	10.2	20.8
Unfamiliar Group situation	24.5	4.5	47.2	11.1	10.2	25.5
Unfamiliar Initiate Interaction	14.4	0	28.9	10.4	9.1	21.7
Familiar Ongoing Interaction	1.0	0	0	0	0	0
Familiar Receive Interaction	1.0	0	3.5	0	0	.9
Familiar Performance situation	3.1	0	4.9	.9	1.1	2.8
Familiar Initiate Interaction	2.0	0	.7	.9	1.1	5.7

* n may vary between analyses due to missing data.

Table 5: Number of verbal individuals and approximate rates of selective mutism for each group

	CdLS	**AS**	**FXS**	**DS**	**RTS**	**ASD**
n (%) verbal[a]	42 (42.86)	5 (7.58)	125 (88.03)	107 (91.45)	61 (69.32)	93 (86.91)
n verbal with completed responses to SQID items referring to selective mutism characteristics	40	N/A[c]	118	106	59	88
Approximate rate of selective mutism characteristics[b]	**40%**	**N/A[c]**	**17.8%**	**7.5%**	**13.6%**	**18.2%**

[a] speaks or sign more than 30 words.
[b] Percentage of verbal participants who answered *yes* to both Q24a and Q25a.
[c] Group excluded from further analysis because n is too small.