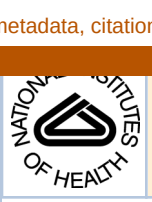

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The Social Orienting Continuum and Response Scale (SOC-RS): A dimensional measure for preschool-aged children

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Abstract

Children with autism show deficits in social orienting, joint attention, orienting to their names, and social smiling as early as the first year of life. The present study describes the development of the Social Orienting Continuum and Response Scale (SOC-RS), a quantitative scale that is designed to be used in the context of video-recorded Autism Diagnostic Observation Schedule (ADOS) sessions. The SOC-RS was shown to be reliable and valid, and when applied to a longitudinal sample of children with autism studied at 2 and 4 years of age, was shown to be sensitive to decreased levels of social referencing, joint attention, orientating to name, and social smiling in autism. The implications of these findings and potential applications of the SOC-RS are discussed.

Introduction

Understanding the development of early emerging deficits in autism is of great importance. Impairments that present within the first 3 to 4 years of life are associated with problems experienced by individuals with autism throughout development. For example, initial failures in joint attention predict subsequent social difficulties and increased language problems (Mundy et al. 1990). Efforts aimed at identifying and treating initial symptoms limit later developing manifestations.

Despite research indicating that core features of autism often are present within the first years of life, the mean age of diagnosis for autism remains 4–5 years (Wiggins et al. 2006). Progress has been made in identifying core impairments, and findings suggest that impairment in social orienting may be particularly critical to understanding early development in autism (Dawson et al. 2004). Social orienting behaviors involve attention to and processing of facial information with the goal of coordinating social interaction. Reduced rates of social orienting behaviors distinguish children with autism from non-autistic children in areas such as looking at faces (i.e., social referencing), sharing attention with another person towards an object (i.e., joint attention), orienting to name, and sharing enjoyment with others (i.e., social smiling), (e.g., Dawson et al. 1998; Mundy & Willoughby, 1996; Stone et al. 1997). Early deficits in social orienting behaviors are also predictive of social and communication impairment later in development (Nadig et al. 2007).

Social Orienting Behaviors

A variety of research methods document that children with autism have reduced rates of social orienting behaviors in the first years of life. Retrospective studies of home videotapes of infants diagnosed with autism have suggested that these infants could be identified reliably at 1 year on the basis of abnormal patterns of face processing (Klin & Jones, 2008; Osterling & Dawson, 1994). These infants also showed reduced rates of joint attention and orienting to name. Retrospective videotape analyses have found that infants later diagnosed with autism required a greater number of prompts to respond to their name compared with

infants with nonspecific developmental delays (Baranek, 1999; Osterling et al. 2002). Additionally, research investigating infant siblings of children with autism has documented that siblings later diagnosed as having autism showed less attention to faces, eye contact, and social smiling relative to siblings who were not diagnosed as having autism as early as 12 months of age (Landa & Garrett-Mayer, 2006; Zwaigenbaum et al. 2005). Nadig et al. (2007) reported that the rate at which infants oriented to their name was a sensitive and specific predictor of whether they were diagnosed with autism at 24 months. Finally, a recent validation study of an early screening measure for autism suggested that items related to social orienting (i.e., attention to faces, social smiling) were particularly useful for retrospectively identifying 12-month-old infants later diagnosed as having autism (Watson et al. 2007). These findings highlight the importance of social orienting deficits in differentiating young children with autism.

Measurement Limitations

Current methods used to measure social orienting have several limitations. Many of these approaches are intended for diagnostic purposes and thus yield qualitative ratings and categorical outcomes. These measures are minimally sensitive to subtle individual differences between affected children and between different points in development. Some methods that do measure the dimensional qualities of social orienting (e.g., retrospective videotape analysis) are based on behaviors observed in different contexts and environments, and thus lack standardization. A third limitation is that methods in which data on orienting behaviors is recorded in a laboratory (e.g., eye-tracking studies) fail to capture social behavior within a natural context. Finally, most current methods for measuring social orienting are not suitable for longitudinal designs. For example, it is difficult to acquire home videotapes for specified time points and therefore match children on age.

The Social Orienting Continuum and Response Scale (SOC-RS)

The SOC-RS is an observational coding system for measuring social orienting behaviors in young children that minimizes the methodological limitations described above. Specifically, the SOC-RS provides dimensional ratings of multiple aspects of social orienting, is applied to a standardized setting, and can be prospectively applied to study specific and various points in development (as opposed to home videos that are specific only to the point in time at which they happened to be recorded).

The SOC-RS focuses on four social orienting behaviors: social referencing, joint attention, orienting to name, and social smiling. Previous research has identified each of these behaviors as being highly relevant in early diagnoses of autism (Baird et al. 2000; Baranek 1999; Dawson et al. 1998; Lord et al. 2000; Zwaigenbaum et al. 2005). The SOC-RS is designed to be used in the observational context of videotaped ADOS sessions. The ADOS, which is a structured play session designed to elicit social interaction and communication behaviors in young children, is an important tool for reliable diagnosis of autism. Examiners engage children in a broad array of interactions aimed at eliciting social and communicative behaviors, including joint attention, responding to his/her name being called, and social smiling. There are four modules of the ADOS, and the appropriate module is chosen based on the child's language level. Algorithm scores are computed for communication, reciprocal social interaction, play, and stereotyped behaviors and restricted interests. The present study describes the development, evaluation, and application of the SOC-RS to a longitudinal sample of 2–5 year-old children with autism who were administered the ADOS.

Given that the SOC-RS is a new measure, our primary goal was to assess reliability and validity. First, agreement between raters over time on SOC-RS items was examined. Then, the reliability of the SOC-RS was evaluated by analyzing the coherence of a broad social

orienting construct comprised of four individual items. Next, the validity of the SOC–RS was assessed by comparing SOC-RS items to a previously validated measure of social behavior [i.e., the Socialization subscale of the Vineland Adaptive Behavior Scales (VABS)]. Because social orienting is hypothesized to be a core aspect of overall social behavior, SOC-RS items should be correlated with VABS Socialization scores but not with other, non-social subscales of the VABS.

Once initial reliability and validity were established, we used the SOC-RS to examine social orienting behaviors in a longitudinal sample of children with autism aged 2–5 years. Given the clinical definition of autism, the SOCRS should reveal lower rates of social orienting in children with autism, above and beyond differences accounted for by cognitive impairments, relative to age-matched typically developing (TD) peers. The Mullen Scales of Early Learning were used to assess and control for cognitive differences between groups. Based on previous findings that children with autism exhibit decelerated growth rates in social behavior throughout childhood, deficits in social orienting for children with autism compared to TD children should become more robust over time.

Method

Participants

Children with autism were recruited as part of a longitudinal study using magnetic resonance imaging (MRI) to investigate early brain development in autism. Fifty-three children who enrolled between 18 and 35 months of age (i.e., 2 years; Time 1) participated in the present investigation. Table 1 provides chronological age and Mullen age equivalence for groups at each time point. As part of the longitudinal MRI study, children with autism were invited to participate in a 24 month follow-up assessment (i.e., 4 years of age; Time 2). Twenty-seven of the initial fifty three children participated at time 2. As will be reported below, there were no time 1 differences in age, IQ, or social orienting rates for the children with autism who dropped out after time 1 and those who participated at time 2. Thus, despite the high dropout rate, our longitudinal sample is representative of the initial cohort.

Thirty-five typically-developing (TD) children were recruited separately for the present study (i.e., they did not participate in the longitudinal MRI study). These children served as cross-sectional controls (15 TD children participated at time 1; 20 different TD children participated at time 2); no longitudinal control data was available. TD children were matched to participants with autism on age and gender.

Children with autism were referred to the longitudinal MRI study from nine specialty clinics for pervasive developmental disorders. Children were included in the study if they met Autism Diagnostic Interview-Revised (ADI-R) algorithm criteria for autism, obtained ADOS scores consistent with autism, and met DSM-IV criteria for Autistic Disorder. As part of the MRI study, children were administered the Mullen Scales of Early Learning and a standardized neurodevelopmental examination. They were excluded from the study if they had evidence of a medical condition thought to be associated with autism (including fragile X syndrome and tuberous sclerosis), gross central nervous system injury (e.g., cerebral palsy, significant perinatal or postnatal complications or trauma, drug exposure), seizures, or significant motor or sensory impairments. Because 18–35 months is younger than the usual age of a diagnosis of autism, many of the children recruited for the present study may have been more severely affected than the general population of children with autism.

TD children were recruited from a mailing sent to local families of newborns. Families were contacted if they returned a postcard indicating that they wished to participate in future research projects and had a child of appropriate age. Parents were interviewed informally to

determine if they had any indication that their child was developmentally delayed or had a history of neurological injury or disorder. Parents who had concerns about their children, whose children currently were receiving developmental evaluations, or whose children had been identified as developmentally delayed were excluded from the study. Children with a history of neurological injury or disorder (e.g., cerebral palsy, significant obstetric complications or perinatal or postnatal trauma, drug exposure, seizures, or significant motor or sensory impairments) also were excluded.

As part of the protocol for the longitudinal MRI study, children with autism were administered the ADOS and Mullen Scales of Early Learning. Additionally, one of their parents or caregivers participated in the VABS interview. TD children were recruited for the present study and then administered the ADOS and Mullen Scales of Early Learning in a single laboratory or in-home session. Parents of TD children did not complete the VABS.

Measures

The Mullen Scales of Early Learning. (Mullen, 1995)—The Mullen Scales of Early Learning assess language, motor, and visual perception abilities for children from birth to age 5 years, 8 months. The Mullen was used in the present investigation to obtain a single, reliable, and valid estimate of IQ for participants at both time 1 and time 2. A limitation of the Mullen is that it has a restricted distribution of standardized scores for lower functioning individuals (i.e., subscales only provide a < 50 Standard Score). Several of the lower functioning participants in the present investigation failed to reach a basal on the Mullen. As a result, mental age equivalents were used for all participants. In order to provide a greater range of IQ scores in the present sample, an average mental age equivalent across four subscales (Visual Perception, Fine Motor, Receptive Language, and Expressive Language) was used as an overall IQ measure.

Behavioral measures

Vineland Adaptive Behavior Scales (Vineland; Sparrow, Balla, & Cichetti, 1984)—The VABS is a standardized caregiver interview that yields information on several domains of adaptive functioning. These domains include: Communication, Daily Living Skills, Socialization, Motor Skills, and Problem Behaviors. Ratings for VABS items are categorical: DK = don't know, N = No opportunity, 0 = no never, 1 = sometimes or partially, and 2 = yes, usually.

Social Orienting Continuum and Response Scale (SOC-RS)—The SOC-RS is an observational coding system applied in this study to previously recorded ADOS sessions. In the present study, all time 1 children with autism and 23 of the children with autism studied at time 2 were examined with module 1 of the ADOS (the most basic module). Module 2 of the ADOS is intended for children with phrase speech; four children with autism and 4 TD children were administered Module 2 at time 2. ADOS sessions were included only if children were observable on camera for more than 10 minutes. ADOS sessions were converted to CD and then coded with the SOC-RS using NOLDUS Observer 5.0 Video Pro software (International Headquarters 2003). The Observer Video analysis program allowed for on-line continuous coding of each event or trial.

The SOC-RS provides ratings for 4 social orienting behaviors (i.e., social referencing, joint attention, orienting to name, social smiling) elicited during ADOS sessions. Each variable of the SOC-RS will be described in general here, and Appendix A contains detailed coding guidelines.

Social referencing is defined as an event in which the target child fixates his or her attention on the face of another individual. Children must fixate for greater than 2 seconds in order to be coded. Referencing is necessary for all SOC-RS codes, although to avoid redundancy, events are categorized as referencing only if they do not meet criteria for joint attention, orienting to name, or social smiling. Social referencing was coded as rate per minute of observable time and then converted to z-scores.

Joint attention (JA) is coded when children either follow someone else's attention towards an object (responding) or evoke another person's attention and direct it towards an object (initiating). Children are scored as JA 'responders' only if they follow the examiner's shifts in eye-gaze during JA trials of the ADOS. Because the SOC-RS focuses on behaviors involving attention to faces, children are scored as 'non-responders' if they only follow bids using pointing or if they do not follow the examiner's JA bids. JA responding was included to increase variability in JA scores; few children with autism initiate JA, although a greater number will respond to a JA bid. JA initiation was coded as rate per minute of observable time. A 'JA total' (JAT) score is computed by standardizing JA responding and JA initiating scores separately and then averaging the two z-scores.

Orienting to name is scored only during the 'response to name' press of the ADOS. The ADOS response to name press includes 4 trials in which the examiner calls the child's name, and then 2 trials in which the parent attempts to acquire the child's attention by calling his/her name. Because the number of trials administered and the method for acquiring the child's attention are standardized within the ADOS, this press was examined. The press is discontinued as soon as the child orients to the examiner's or parent's voice. SOC-RS orienting to name scores reflect the trial on which children first respond to their name being called.

Social smiling events are recorded when a child references another person while smiling in order to share enjoyment. Children must fixate for greater than 2 seconds and the smiling must be judged by the rater to be appropriate to the context in order for social smiling to be coded (i.e., self-stimulatory laughing combined with social referencing was not scored). Social smiling was coded as rate per minute of observable time and then converted to z-scores.

A *social orienting composite* was calculated by averaging the standardized ratings of children's social referencing, JAT, name trial, and social smiling. This composite was examined along with the four constituent variables.

Reliability

To establish reliability of the SOC-RS, raters independently coded 15 videotaped ADOS sessions two times. Reliability was calculated using intra-class correlation coefficients (ICC's). After establishing an intra- and interrater reliability score of >0.8 across these 15 cases, each rater independently coded cases for final analysis. Reliability was calculated separately for each SOC-RS item. Agreements were scored if both raters identified the same behavior within a 3 s window. Then, raters met and discussed their ratings and coding decisions. If disagreements occurred, raters viewed the session together and discussed their ratings until a consensus was reached. Once raters were reliable, they independently coded the remainder of the videos.

ANCOVA models were used to test group differences in social behavior. Main effects of autism versus TD were examined with age, IQ, and gender entered as covariates. Age and IQ were centered for all analyses to control for multicollinearity. All 2-way interactions with group were included initially to check the assumption of parallelism, but non-significant

interactions were dropped. Univariate analysis was used as a first step to examine differences in the social orienting composite between groups. Multivariate analyses were used to compare group rates on the individual SOC-RS variables.

Because longitudinal data were not available for the TD group, within group differences between time 1 and time 2 were examined with separate ANCOVA models for each group. IQ and gender were entered as covariates and time (1 vs. 2) was entered as the predictor variable. The social orienting composite and the individual variables were entered as outcomes.

Results

Sample Characteristics

Sample characteristics for the autism and TD groups are shown in Table 1. The average length of time between time 1 and time 2 assessments was 2 years, 1 month, with a range of 1.2 to 3.4 years. The children with autism were significantly older than the TD children at time 1, t (65) = 4.97, p <0.01, and time 2, t (56) = 3.49, p = .01. The age distributions for the children with autism were skewed at both time points with more children at the upper end of the age range and fewer children at the lower end. The TD children had a more even distribution for age at both time points. Group comparisons were calculated while statistically controlling for age.

Mean IQ was significantly lower in the autism group than in the TD group at both time 1, t (60) = 11.37, p<.001 and time 2, t (54) = 9.71, p <.001. The distribution of IQ scores within the autism group was not normal. The majority of children with autism scored in the mentally retarded range (i.e., IQ<70: 93% at 2 years; 78% at 4 years). These rates of mental retardation exceed most current estimates (approximately 60–70%) and suggest that the present sample is more impaired than the broader population of individuals with autism. The mean IQ of the TD group was in the average range and the distribution approached normality. Group comparisons were calculated while statistically controlling for IQ.

Groups were comparable on gender ratios at time 1 (autism = 8% female; TD = 8% female) and time 2 (autism = 5% female; TD = 6% female).

No time 1 difference in age, IQ, or social orienting rates was found between the children with autism who dropped out after time 1 and those who participated at time 2.

Psychometric Properties of the SOC

Inter-rater Reliability—The average inter-rater ICC's across the four SOC-RS items was .85 (range .78–.91). Reliability indices for each of the two raters across individual SOC-RS items are displayed in Table 2.

SOC-RS items were significantly related to each other at both time 1 and time 2 (see Tables 3, 4). Cronbach's alpha scores were acceptable: .78 at time 1 and .72 at time 2. All 4 items contributed significantly to the reliability of this composite (alphas if item deleted <.58 at age 2 and .54 at age 4).

Validity—The convergent validity of the SOC-RS was examined using Pearson r correlations between the SOC-RS and the VABS-Socialization subscale and between the SOC-RS and the VABS-Motor subscale. As indicated in Table 5, the SOC-RS composite score and individual item scores each were significantly associated with VABS-Social scores at time 1, with the exception of social referencing. The composite score and each individual item score were significantly associated with VABS-Social scores at time 2.

Significant relationships were specific to the VABS Social domain. The only significant association between the SOC-RS variables and the VABS-Motor subscale was a single correlation for time 2 children between orienting to name and the Motor scores, r(27) = .57, $p<.01$.

Behavioral comparisons between children with autism and TD children

Time 1 (2 years of age)—Controlling for age, IQ, and gender, children with autism scored lower than TD children on the social orienting composite as well as social referencing, JAT, and orienting to name items (Table 6). Social Smiling rates were not significantly different between groups.

Time 2 (4 years of age)—Controlling for age, IQ and gender at time 2, children with autism again scored lower on the social orienting composite as well as social referencing, JAT, orienting to name, and social smiling (Table 7).

Change over time—Analyses indicated that children with autism did not show significant changes in their social orienting composite score over time, F (1,63) = 2.91, p = n.s., R2 = .06. Additionally, they did not show significant changes in rates of social referencing, orienting to name, or social smiling. However, they did have significant increases over time in JAT, F (1,63) = 6.72, p = .01, R2 = .18. This change was above and beyond that predicted by IQ. Analyses revealed that TD children showed higher rates of overall social orienting at age 4 than at age 2 years, F(1,33) = 6.72, p = .02, R2 = .18. Furthermore, this effect held for two individual items: social referencing, F (1, 33) = 4.34, p = .05, R2 = .24, and social smiling, F (1, 33) = 5.75, p = .03, R2 = .32. Rates of JAT, F (1, 17) = 2.99, p = n.s., R2 = .17, and orienting to name, F (1, 17) = 2.21, p = n.s., R2 = .13, were not significantly different between time 1 and time 2 TD children.

Discussion

The present findings support the psychometric properties of the SOC-RS and suggest that the SOC-RS is a reliable and valid measure of social orienting in preschool-aged children with and without autism. Social orienting behaviors represent a core set of early emerging impairments in autism; they are the most consistently identified features that separate infants and toddlers with autism from age matched developmentally delayed peers (Baranek 1999; Nadig et al. 2007). The SOC-RS provides a system for measuring these impairments and monitoring changes in them over time. Although the SOC-RS was applied to a longitudinal sample of young children in the present study, it provides coding guidelines and yields data that could be relevant to studies of autism throughout development. Associations between social orienting behavior and related behavioral, cognitive, and neurodevelopmental outcomes can be assessed with the SOC-RS.

Social orienting deficits in autism

Results from the present longitudinal sample of 18–35 month-old children with autism followed up 24 months later highlight robust impairments in social orienting. Deficits are evident at both time 1 (2 years of age) and time 2 (4 years of age) and are most profound when defined as a composite social orienting variable calculated by combining children's rates of social referencing, JA, orienting to name, and social smiling. The autism group also showed significant deficits in 3 out of 4 social orienting behaviors that were measured at age 2 years, and all behaviors at age 4 years. Moreover, these deficits were evident above and beyond differences accounted for by age or IQ.

Social smiling at age 2 years was the only behavior that was not significantly reduced in the autism group. Several factors could explain why social smiling is lower in the autism group than in the TD group only at age 4 years. Social smiling is a complex behavior that requires the organization of multiple cognitive and behavioral developments. Children not only are responding to emotional stimuli but also coordinating their emotional response with that of another individual. This coordination requires an understanding that the other individual has a unique perspective and may be interested in sharing enjoyment. Various studies suggest that perspective taking, or first order 'theory of mind' capacity, emerges at approximately 3–4 years of age in TD children (see Perner and Lang 1999 for a review). Data from the present investigation indicate that TD children who are 4 years of age show a stronger tendency to utilize this skill than 2 year-old TD children, suggesting they are developing over this period. The additional demands of social smiling relative to just smiling or the more basic social orienting behaviors studied here suggest that this phenomenon develops more rapidly after 2 years in TD children but does not improve in children with autism during this period.

Previous findings generally indicate that the deficits in social orienting shown by children with autism do not improve over time. With the exception of JA, children with autism did not show significant increases in social orienting behaviors between 2- and 4-years of age. TD children showed higher rates of overall social orienting associated with increased age. The lack of change for children with autism is particularly salient given the expected power of a longitudinal design to detect change. The lack of change, combined with differences observed between time points in the cross-sectional TD group, suggest that the preschool period may be a critical epoch in which children with autism fall further behind their TD peers.

Related research suggests that early deficits in social orienting likely disrupt multiple systems (e.g., social cognition, language) and may account for many of the difficulties faced later in life by individuals with autism. For example, Schultz (2005) and Dawson et al. (2002) each have suggested that failures to engage in social interactions among young children with autism contribute to a lack of social learning experiences that, in turn, precludes related social and cognitive growth. Early identification and measurement of social orienting deficits in autism, along with longitudinal follow-up of affected children, is important for examining this hypothesis. In contrast to overall social orienting, social referencing, and social smiling, TD rates of JA and orienting to name did not differ with age. Several explanations are possible. First, previous research suggests that TD children show joint attention skills and orient to their name within the first year of life (*9–12 months) (Carpenter et al. 1998; Mundy et al. 2007; Striano 2001). These skills, therefore, may plateau in their rate of development and show little change beyond the first year. Indeed, previous studies suggest that typically developing children show little improvement in joint attention between 3 and 4 years of age (MacDonald et al. 2006). Second, it is possible that the SOC-RS is not sensitive to higher levels of joint attention or orienting to name. The joint attention composite used in the present study includes a categorical joint attention response rating that has a ceiling attained by many TD children. The vast majority (13/15 or 87%) of 2 year-old TD children and all of the 4 year-old TD children responded to joint attention bids. Similarly, the orienting-to-name item has a ceiling that was attained by a large portion of TD children. The majority of both 2 year-old (12/15 or 80%) and 4 year-old (100%) TD children responded to their name in the first 2 trials. Ceiling effects for JA responding and orienting to name may limit the sensitivity of these items to change over time in TD children.

Limitations and Future Directions

Several limitations within the present study suggest directions for future research. First, longitudinal data on TD children was not available. Comparing growth trajectories among children with autism with those of a control group would provide more power to detect differences. Second, despite the existence of group differences after accounting for IQ impairments in children with autism, it is possible that social orienting deficits are not unique to autism and may be present in non-autistic developmentally delayed children. Subsequent research should compare social orienting rates measured with the SOC-RS between children with autism and developmentally delayed children without autism. In order to address the possibility that the cognitive impairments evidenced by the children with autism in the present study accounted for their deficits in social orienting behaviors, IQ was covaried for all analyses. Results suggested that social orienting deficits in children with autism could not be accounted for by their overall cognitive impairments. Still, extant literature exists suggesting that ANCOVA is not always sufficient for addressing issues regarding the specificity of results (Adams et al. 1985, 1992; Berman and Greenhouse 1992). Comparisons of the SOC-RS with non-autistic developmentally delayed children are needed. Third, children in the present investigation were diagnosed earlier (*18–35 months) than is typical for children with autism, suggesting that this sample was more impaired and may not be representative. By including children diagnosed later than those in the present study, future research can explore the generalizability of these results. Fourth, it is possible that the relationship between social orienting variables and the VABS Socialization scale is better accounted for by the intercorrelations of IQ, social orienting variables, and the VABS-Socialization scale. Relationships between IQ and adaptive behavior are more robust for individuals with cognitive impairment (Bolte and Poustke 2002; Dykens et al. 1993; Kraijer 2000; Volkmar et al. 1987). However, if the relationship between social orienting variables and the VABS Socialization scale could be better accounted for by associations between IQ and adaptive behavior in our cognitively impaired sample of children with autism, we would expect the relationships to be evident across VABS subscales. This was not evident for Motor or other subscales. Still, the documented effects of IQ and adaptive behavior in cognitively impaired children should be accounted for in studies assessing relationships between specific symptoms of cognitively impaired children with autism and adaptive behavior. Finally, no information was available on the degree or type of intervention services utilized by children with autism during the course of the study. The SOC-RS has great potential value for evaluating early treatment efficacy, and particularly, for tracking domain-specific change over time. Social orienting deficits are profound and unique to young children with autism and should be a focus for future treatment research.

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Appendix A. Social Orienting Dimensional Scale Variable Definitions

Social referencing

Instances in which the child is observed looking directly at another person's face. It must be clear that the child is looking at the person's face and not another part of the body and not at a proximal object. Also, the child must fixate on the person's face, rather than glancing past him/her.

Joint Attention Responding

Events in which the examiner, parent, or other individual attempt to direct the child's attention to an object via establishing attention and shifting his or her gaze should be scored as *Joint Attention Responding* opportunity. If the child redirects his/her attention in the direction indicated by the person who initiated the bid, then they should be scored as having responded to joint attention.

Joint Attention Initiating

Events in which the child initiates a joint attention should be coded separately from *Joint Attention Responding.* In order for this behavior to be scored, the child must seek to get another individual to attend to an object or person of interest either by a shift in eye gaze or a distal point. The child must further reference the individual with whom they are interacting. Only responses that are "protodeclarative" in nature should be scored. "Protodeclarative" responses include those in which the primary goal of the interaction is to share attention or enjoyment or find out information about an object (e.g., pointing and asking, "What's that?"). In contrast, "protoimperative" episodes are those in which the child includes another individual solely as a means to obtain an object.

Orienting to name

Events in which the child's name is stated and at least a 1 second pause occurs in which the child's response is observed by the person who called his/her name.

Social smiling

Any event in which the child shows a clear and appropriate smile that involves attention to the face of a social partner should be scored. Pretend emotions, as in the course of playing, also may be scored if clearly indicated, and appropriate to the context (i.e., not stereotypic or inconsistent with the context).

Table 1

Sample data for autism and typically developing (TD) children

	Time 1		Time 2	
	Autism	**TD**	**Autism**	**TD**
Sample size (females)	53 (4)	15 (2)	27 (2)	20 (1)
Chronological age (yrs.)*	2.6 (.34)	2.3 (.43)	4.8 (.46)	4.5 (.48)
Mullen age equivalent (mos.)*	15.1 (5.1)	33 (9.9)	27.7 (15.2)	55 (6.4)

*Values represent means and standard deviations

Table 2

Reliability results for individual SOC items

	Rater 1 Mean (range)	Rater 2 Mean (range)	Inter-rater reliability Mean (range)
Social referencing	.94 (.76–1.00)	.88 (.60–1.00)	.91 (.83–1.00)
JAT	.86 (.70–1.00)	.80 (.76–1.00)	.80 (.70–1.00)
Orienting to name	.85 (.78–1.00)	.99 (.96–1.00)	.91 (.71–1.00)
Social smiling	.92 (.89–.95)	.77 (.70–1.00)	.78 (.70–.96)

JAT: joint attention total

Table 3

Relationships among time 1 variables

	1	2	3	4	5
1. Age	..				
2. IQ	−.06	..			
3. Referencing	−.17	.11	..		
4. JAT	.40**	.55***	.52***	..	
5. Smiling	−.18	.39**	.25*	.38**	..
6. Name	.28*	.33*	.35**	.35**	.26*

* p<.05,

** p<.01,

*** p<.001

JAT: joint attention total

Table 4

Relationships among time 2 variables

	1	2	3	4	5
1. Age	--				
2. IQ	−.22	--			
3. Referencing	−.15	.61***	--		
4. JAT	−.21	.82***	.63***	--	
5. Name	−.18	.76***	.52***	.74***	--
6. Smiling	−.35*	.50***	.69***	.46**	.41**

* p<.05,

** p<.01,

*** p<.001

JAT: joint attention total

Table 5

Relationships between SOC items and Vineland scores

	Socialization		Motor	
	Time 1	**Time 2**	**Time 1**	**Time 2**
Composite:				
Social orienting	.62***	.80***	−.09	.36
Individual items:				
Social referencing	.14	.68***	−.18	.00
JAT	.71***	.65***	.17	.03
Orienting to name	.39**	.64***	.18	.57**
Social smiling	.43**	.41*	.17	.08

* p<.05,

** p<.01,

*** p<.001

JAT = joint attention total

Table 6

Time 1 Social orienting group comparisons (controlling for age, gender, and IQ)

	Autism (N=53) Mean (sd)	TD (N=15) Mean (sd)	F	*p*
Composite:				
Social orienting	.09 (.22)	.60 (.23)	14.11	<.001
Individual items:				
Social referencing	1.27 (.55)	2.67 (1.37)	12.67	<.001
JAT	.18 (.19)	.53 (.06)	7.03	.01
Name trial	4.86 (2.05)	2.22 (1.03)	3.97	.02
Social smiling	.15(.20)	.43(.37)	1.67	n.s.

JAT: joint attention total

Table 7

Time 2 Social orienting group comparisons (controlling for age, gender, and IQ)

	Autism (N=27) Mean (sd)	**TD (N=20) Mean (sd)**	**F**	***p***
Composite:				
Social orienting	.04 (.32)	.81 (.30)	11.62	<.001
Individual items:				
Social referencing	1.41 (.84)	3.08 (.91)	11.49	.002
JAT	.28 (.19)	.57 (.08)	.25	n.s.
Name trial	5.04 (2.08)	1.56 (.73)	5.28	.03
Social smiling	.16 (.27)	.60 (.30)	5.88	.02

JAT: joint attention total