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Early intersubjective skills and the understanding of intentionality in young children with Down syndrome

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ABSTRACT

This study examined the relationship between early intersubjective skills (joint attention and affect sharing) and the development of the understanding of intentionality in 16 young children with Down syndrome (DS) and 16 developmentally matched children with other developmental disabilities (DD). The study of intentionality focuses on how children come to understand the goal-directed actions of others and is an important precursor to the development of more complex social cognitive skills, such as theory of mind. Joint attention and affect sharing were examined using the Early Social Communication Scales (Mundy, Sigman, & Kasari, 1990; Seibert, Hogan, & Mundy, 1982). Meltzoff's (1995) behavioral reenactment paradigm was used to examine the understanding of intentionality. For children with DS, higher rates of affect sharing were associated with poorer intention reading abilities. This pattern was not observed in children with other DD. These results suggest that the intersubjective strengths associated with DS may not support the development of intentionality-interpretation skills. Future research is needed to explore if children with DS have the joint attention behaviors needed to be intentional.

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1. Introduction

Social cognition encompasses numerous skills (i.e., intersubjectivity, social referencing, social attribution, interpretation of cues, face recognition, and theory of mind) that allow children to think and reason about the social world (Cebula & Wishart, 2008; Tager-Flusberg, Plesa Skwerer, & Joseph, 2006; Trevarthen & Aitken, 2001). The study of intentionality focuses on if and when children are able to understand the intentions of others (Meltzoff, 1995). Understanding intentionality is a key component of social cognitive development, and is critical for navigating complex social dynamics and interactions (Cebula & Wishart, 2008; Kunda, 1999; Tager-Flusberg et al., 2006; Trevarthen & Aitken, 2001; Zinck, 2008). To investigate when young children begin to understand the intentions of others, Meltzoff (1995) developed a research paradigm called the 'behavioral reenactment' procedure.

The behavioral reenactment procedure is a nonverbal task designed to examine whether children will interpret an individual's behavior literally or if they can read through their behavior and identify the intended goal of the individual's

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actions. In Meltzoff's (1995) original study, he concluded that at 18 months, infants could infer intentionality in others. The ability to understand intentionality suggests that infants have begun to differentiate surface behavior (what an individual does) from what an individual is trying to do (Meltzoff, 1995). Subsequent studies using the behavior reenactment procedure have examined whether these skills emerge earlier in development. Together these studies suggest that the ability to interpret an unsuccessful goal-directed action as intentional is still emerging between 12 and 15 months and that the understanding of intentionality improves with age (Bellagamba & Tomasello, 1999; Bellagamba, Camaioni, & Colonnese, 2006). Because of the complex demands of social-cognitive processing, children with neurogenetic disorders, such as Down syndrome (DS), may be at risk for atypical development in this area.

Based on existing work, it is unclear whether the understanding of intentionality is compromised in children with DS beyond the level of delay that would be anticipated based on their overall developmental level. It has been noted that during cognitively challenging tasks, children with DS have the tendency to overuse their social relatedness skills to compensate for weaknesses in other domains (Cebula & Wishart, 2008; Fidler, 2006; Kasari & Freeman, 2001; Wishart, 1996). It is possible that the combination of early social strengths and the tendency to overuse social relatedness skills are interfering with the development of more complex social cognitive skills, including the understanding of intentionality (Cebula & Wishart, 2008; Fidler, 2006). On the other hand, these early social strengths (Fidler, Most, Booth-LaForce, & Kelly, 2008; Gilmore, Campbell, & Cuskelly, 2003) and the strengths that have been observed in intersubjectivity (i.e., joint attention and affect sharing; Adamson & Bakeman, 1985; Kasari, Freeman, Mundy, & Sigman, 1995; Mundy, Sigman, Kasari, & Yirmiya, 1988; Mundy et al., 1990; Sigman & Ruskin, 1999) may provide young children with DS with the necessary foundational knowledge to be more skilled at more complex social cognitive tasks (Cebula, Moore, & Wishart, 2010), like the understanding of intentionality. To date, intentionality has yet to be examined in children with DS.

Social cognition in DS has not received a large amount of research attention when compared to other areas of the DS behavioral phenotype. This may be because individuals with DS are characterized as demonstrating relative strengths in some aspects of social development, especially social relatedness (Fidler et al., 2008; Gilmore et al., 2003), leading researchers to conclude that social understanding is also relatively intact (Cebula & Wishart, 2008; Cebula et al., 2010; Wishart, 2007). However, research specifically focused on the social cognitive profile associated with DS suggests that social cognition does not seem to be "playing the same supporting role" (Cebula & Wishart, 2008, p. 45) in the overall development of children with DS as it does in typically developing children, and it has been suggested that these skills may actually be compromised in this population (Wishart, 2007). Examining the understanding of intentionality in children with DS may help to bridge the gap between the strengths that have been observed in intersubjectivity (Adamson & Bakeman, 1985; Fidler, 2006; Kasari et al., 1995; Mundy et al., 1988, 1990; Sigman & Ruskin, 1999) and the weaknesses observed on theory of mind tasks in children with DS (Abbeduto et al., 2001; Binnie & Williams, 2002; Yirmiya, Solomonica-Levi, Shulman, & Pilowsky, 1996; Zelazo, Burack, Benedetto, & Frye, 1996).

From a developmental perspective, social cognition depends on interactions between the self and others, and begins in infancy with primary and secondary intersubjectivity (Meltzoff, Gopnik, & Repacholi, 1999). Intersubjectivity is the intuitive recognition and understanding of the impulses and desires of another's mind (Trevvarthen, 1978). These early intersubjective skills serve as a foundation for more advanced social cognitive skills (i.e., understanding of intentions, theory of mind, social decision making; Cebula & Wishart, 2008; Meltzoff, 2007; Tager-Flusberg et al., 2006; Trevvarthen & Aitken, 2001). The majority of infants with DS achieve the developmental milestones associated with primary intersubjectivity (Fidler, 2006), but with noticeable deviations from the typical trajectory. For example, infants with DS show increased looking behavior at the faces of their social partner in the middle of the first year (Crown, Feldstein, Jasnow, & Beebe, 1992; Gunn, Berry, & Andrews, 1982), a time when typically developing infants are beginning to shift their focus to the world around them as they develop secondary intersubjectivity (i.e., joint attention; Berger & Cunningham, 1981; Carvajal & Iglesias, 2000). Joint attention occurs when individuals engage in a shared interaction around an object or event (Mundy & Newell, 2007). It has been suggested that this longer looking time may lead to difficulties in joint attention because instead of sharing attention between an object or event and a social partner infants with DS are still focused solely on their social partner (Cebula & Wishart, 2008; Legerstee & Weintraub, 1997). However, the majority of research on joint attention suggests relative strengths in this area (Fidler, Philofsky, Hepburn, & Rogers, 2005; Kasari, Mundy, Yirmiya, & Sigman, 1990; Kasari, Sigman, Mundy, & Yirmiya, 1990; Kasari et al., 1995; Mundy et al., 1988; Sigman & Ruskin, 1999). To date, only one study of joint attention in DS suggests it to be an area of relative weakness (Legerstee & Weintraub, 1997). Although there are more studies supporting the notion of relative strengths in joint attention, if joint attention is compromised, then it is possible that the development of the understanding of intentionality will also be compromised in children with DS (Trevvarthen, 1978; Trevvarthen & Aitken, 2001).

Another intersubjective skill that may influence joint attention in children with DS and the development of intentionality is affect sharing (Adamson & Bakeman, 1982; Kasari, Mundy et al., 1990; Kasari, Sigman, et al., 1990). Affect sharing has been conceptualized as the combination of joint attention behaviors and positive emotional signals (Kasari, Sigman, et al., 1990; Mundy et al., 1990; Seibert et al., 1982). The purpose of affect sharing behavior is to share a positive emotional reaction to an event or object with a social partner (Kasari, Sigman, et al., 1990; Mundy et al., 1990; Seibert et al., 1982). Affect sharing is an important precursor to the understanding of others' intentions because through affect sharing infants and young children begin to represent the desires, motivations, and intentions of others (Meltzoff & Moore, 1994, 1998; Trevvarthen, 1978, 1979; Trevvarthen & Aitken, 2001). During joint attention, affect sharing supports joint attention behavior by helping to indicate the child's interest or the desire to share the experience of an object or event with a social partner (Adamson & Bakeman, 1985;

Bruner, 1983; Campos, 1983; Feinman, 1982; Kasari, Sigman, et al., 1990; Rheingold, Hay, & West, 1976), which in turn helps to instigate more successful communicative interactions with a social partner (Adamson & Bakeman, 1982, 1985; Hornik & Gunnar, 1988; Kasari, Sigman, et al., 1990; Mundy & Sigman, 1989; Rheingold et al., 1976).

1.1. Present study

The present study examined whether early intersubjective skills (i.e., joint attention and affect sharing) are related to more complex social cognitive abilities in young children with DS. We investigated the relationship between joint attention and affect sharing abilities, as measured by the Early Social Communication Scales (Seibert et al., 1982 as described in Mundy et al., 1990), and performance on the behavioral reenactment procedure (Meltzoff, 1995). In addition, the performance of young children with DS was compared to MA-matched children with developmental disabilities (DD) in order to examine whether or not the patterns of performance on the behavioral reenactment procedure are specific to children with DS.

2. Materials and methods

2.1. Participants

Participants for this study were 16 children with a confirmed diagnosis of DS between 25 and 57 months and 16 children between 24 and 60 months with another developmental disability (Idiopathic DD = 3, questionable/unknown etiology = 3, Cochin syndrome = 2, Chromosome 18 = 2, Angelman's syndrome = 1, DD with sensory integration disorder = 1, Smith Magenis syndrome = 1, velocardiofacial syndrome = 1, Sturge-Webber with Psychosis = 1, speech language delays = 1). See Table 1 for developmental and demographic information. Children were individually matched on chronological age (CA), verbal mental age (VMA), and nonverbal mental age (NVMA). Matching procedures involved a four-step process. First, as many children as possible were matched within three months on all three matching variables ($N = 7$). Next, an additional child was matched within three months on CA and NVMA ($N = 1$). An additional subgroup of children was then matched within three months on NVMA ($N = 5$). Finally, in order to match the remaining three children with DS to children with DD, a group matching procedure was used in order to maintain the size of this sample. Independent Samples *t*-tests were performed to examine differences between the two groups on the matching variables. No statistically significant differences were observed (see Table 1 for *p*-values).

2.2. Procedure

Participants were recruited as part of larger study designed to longitudinally examine the developing behavioral phenotypes of children with Down syndrome, fragile X syndrome, and autism, and as part of a larger project within the Collaborative Program for Excellence in Autism (CPEA; see Luyster et al., 2005; Richler et al., 2006 for details on CPEA). Participants were recruited from the Autism and Developmental Disability Research Group at the JFK Partners University Center for Excellence in Developmental Disabilities at the University of Colorado School of Medicine, parent support groups (Mile High Down Syndrome Association, Wyoming Down Syndrome Association), and local agencies.

Before consent was obtained, consent forms were reviewed with each family and all parent questions regarding the study were answered. All of the examiners for these studies were Master's or doctoral level researchers who had several years of experience working with children with developmental disabilities. During administration of the test battery, two examiners were present: one to administer the test and one to videotape the administration. Assessments were counter-balanced and administered in at least two visits in order to reduce fatigue and maintain participant engagement and attention.

Table 1
Participant characteristics.

Characteristic	Down syndrome ($N = 16$)		Developmental disabilities ($N = 16$)		<i>t</i> -Test matching results <i>p</i> -Value
	M/%	SD	M/%	SD	
Child					
CA (in months)	40.38	10.60	39.69	11.79	.63
Verbal MA (in months)	23.28	7.38	27.59	12.20	.48
Nonverbal MA (in months)	25.38	7.34	28.07	8.73	.69
Child gender (% male)	64.7		43.8		
Child ethnicity (%)					
Caucasian	70.6		62.5		
Hispanic	5.9		12.5		
More than 1 race	11.8		6.3		
Unknown/Choose not to respond	11.7		18.7		

2.3. Measures

2.3.1. Child information sheet

Parents were asked to provide information about their age, education level, income, and the child's ethnicity (Wehner, 1996). This was used to collect descriptive information about the participants in this study.

2.3.2. Mullen Scales of Early Learning

The Mullen Scales of Early Learning (MSEL) is a standardized developmental test for children up to 68 months that assesses five domains of development: gross motor, fine motor, visual reception, expressive language, and receptive language (Mullen, 1995). The MSEL provides T scores as well as estimates of mental age equivalent scores for each domain. An overall standard score can be computed that reflects an estimate of overall developmental functioning (Mullen, 1995). Strong concurrent validity has been established with other well-known developmental tests (e.g., Bayley Scales of Infant Development [Bayley, 1993], Peabody Developmental Motor Scales [Folio & Fewell, 1983], Birth to Three Developmental Scale [Dodson & Bangs, 1979]). Also, content validity and construct validity has been established for this measure (Mullen, 1995). Internal consistency coefficients range from .83 to .95, test–retest reliability coefficients ranged from .82 to .85, and interrater reliability coefficients range from .91 to .99 (Mullen, 1995).

2.3.3. Early Social Communication Scale

The Early Social Communication Scale (ESCS; Seibert, Hogan & Mundy, 1982), as described in Mundy et al., 1990, was designed to elicit examples of intentional communication (i.e., requests), joint attention behavior (e.g., following and initiating), and affect sharing. This consists of a series of social-communicative interactions with an experimenter and a set of toys in a semi-structured play interview. For the purpose of this study, only the joint attention (following joint attention and initiating joint attention) and affect sharing variables were used. Coding of behaviors was based on the frequency of occurrence of Requesting, Joint Attention, and Social Interaction behaviors, which involves classifying the function of the behavior, identifying who initiated the function, and identifying the behavior code (Mundy et al., 1990). Finally, the duration of the behaviors and the total length of time involved in each presentation were coded. Interclass correlations were calculated for 20% of the videos to establish interrater reliability, coefficients ranged from .82 to .93.

2.3.4. Intentionality task

This task was adapted from Meltzoff's (1995) behavioral reenactment procedure by one of the study authors (S. Rogers). The purpose of this task is to assess a child's understanding of the intentions of others. Specifically, this task examined if children understand the goal the examiner is trying to reach, as she approximates but does not quite complete, a simple action with objects (for example, trying to put a string of beads in a cup, but missing so that they fall down the rim of the cup). If the child correctly performs the intended action after seeing the examiner's unsuccessful action, it is presumed that they are demonstrating evidence of understanding others' intentions.

In the present study, nine sets of intentionality toys were used: prong and two (2) loops; cup, stick and beads; plastic square with hole, post, and ball; two (2) small plastic nesting cups; dumbbell; two (2) wooden blocks with holes, rope; two (2) nets and toy grasshopper; Winnie the Pooh doll and chair; lily pad, frog/fish and cotton ball. The order of presentation of the toys was randomized. All toys were kept hidden before they were brought to the table for demonstration. The toys were then returned to a container before the next toy was presented. There were six trials for this task: three administrations of the target condition and three administrations of the failed intention condition. These administrations were also randomized. For 27% of the administrations, there were only two administrations of the target action because of problems with the toys. In the target condition, the experimenter modeled the entire target action with the toy successfully. In the failed intention condition, the experimenter tried to do the target action, but was unsuccessful.

Before each of the trials, the child was presented with each toy for that trial for at least a 20-s baseline period, or until the child had a chance to explore the toy. This initial baseline period established that they would not spontaneously make the target actions with the toys on their own without the experimental model. In the event that the child did spontaneously produce the action, the examiner performed a different target action during the trial. After this period, the examiner would take back the toy, saying, "Can I have a turn?". The experimenter then modeled the appropriate experimental condition with the toy, either the target condition or the failed intention condition. The action was repeated three times, in approximately 20-s, and then the child was given the toy for a 20-s response period. Timing started from when the child touched the object.

2.3.4.1. Coding of the intentionality task. Two coders (undergraduate research assistants) who were naïve to the hypotheses in this study coded the data. Cohen's kappa was calculated for 20% of the videos to establish interrater reliability ($\kappa = .84$). For each trial, they coded the action of the examiner and the action of the child. As per Bellagamba et al. (2006) and Huang, Heyes, and Charman (2002, 2006), when the examiner performed the target action, there were three responses coded for the child (target action, no action, other action) and four responses coded for the child when the examiner performed the failed intention condition (target action, no action, other action, imitate the failed intention). The definitions of these variables are presented in Table 2.

For some children performing the target action was difficult because they were not strong enough or had poor motor skills. Therefore, a code for 'trying' was defined as actively trying to complete the action, such that the child would have

Table 2
Definitions of variables coded in the intentionality task.

Variable	Definition	Example
Target action	Successfully performing the target action as the examiner did or as the examiner intended to do on the failed intention administration	Successfully putting the beads into the cup
Imitation of the failed intention	Imitating the examiner's failure	Missing the cup and letting the beads slide down the side of the cup
Other action	Any action produced with the toys other than the target or imitation of the failed intention	Banging the toys together
No action	Not perform any actions with the toys	Not touching the toys or just holding the toys in their hands, but not producing an action with the toys

completed the task if they were stronger or had better motor skills. Coders also used facial expressions and eye gaze to determine if a child was actively trying (e.g., was their brow furrowed because they were concentrating, was their eye gaze on the target relevant parts of the toys, etc.). In addition, the coders also coded all of the actions the child performed during the 20-s response time, as per Huang et al. (2002, 2006). Previous research on intentionality has demonstrated that some children may perform an “other” action before performing the target action (Huang et al., 2002, 2006). It is unclear whether this pattern is due to slower processing for some children or the decision to use a trial and error strategy to successfully compete the target action (Huang et al., 2002, 2006). In the present study, the coders coded all of the actions they observed in the 20-s response period. After the 20-s response period had ended, the coders then indicated, for each trial, whether or not the target action and imitation of the failed intention was ever performed during the trial. This allowed for an overall summary of performance on each trial to be created for analyses.

When needed, the coders would meet with the first author to clarify any discrepancies in administration (e.g., if the examiner did a modified action from the task manual) or difficult administrations (e.g., how to proceed when there was a bad camera angle). The primary coder usually identified these issues. After the issue was resolved, the coders would then code the video independently. The purpose of this was to ensure that the video could be coded. Both coders were included in the discussion if the video was to be used for reliability.

2.4. Data analysis

In order to describe performance on the intentionality task in children with DS and DD, relative likelihood statistics and the confidence intervals associated with those statistics were used. This approach offers a simple interpretation of the relative differences in performance between the two groups (Fidler, Hepburn, Most, Philofsky, & Rogers, 2007), which may be more informative than the magnitude of the difference when the proportions are close to zero (Agresti & Finlay, 2009). Using relative likelihood statistics in the present study made it possible to examine group differences in performance even though the sample size was small. Also, use of this statistic allows for a clinically relevant interpretation of the relative differences between the two groups. A relative likelihood statistic of 2, for example, connotes that one group was twice as likely to perform an action as the other group (Fidler et al., 2007). For this analysis, the average relative likelihood of performing an action during the three target administrations and three failed intention administrations was calculated. This was calculated by examining the frequency of each child *ever* performing an action (i.e., target, imitation of the intention, or other) during the 20-s response period for each of the trials. Thus, this is the average performance of the three administration of the target and failed intention condition. Relative likelihood statistics, and the confidence intervals associated with those statistics, were also used in this study to compare the rate of joint attention and affect sharing, as measured by ESCS, between children with DS and DD.

Following Huang et al. (2002, 2006) the proportion of target actions, imitations of the intention, and other actions across the three target and intention administrations were calculated. For example, if a child performed the target action once during the three different failed intention administrations, then their proportion of target actions performed on the failed intention condition would be .33. Pearson *r* correlations were used to characterize the magnitude of the relationship between task performance, joint attention, and affect sharing in children with DS and DD. To examine if joint attention and affect sharing predicted performance on the intentionality task in children with DS and DD, multiple linear regression analyses were performed. For these analyses, the proportion of target actions on the failed intention administration and imitations of the failed intention were used as outcome variables and joint attention and affect sharing were used as predictor variables.

3. Results

Using the frequency counts of the actions performed during the intentionality task, average relative likelihood statistics for each type of administration were calculated for each of the dimensions of interest on the behavioral reenactment paradigm. On average, children with DS (correctly) performed the target action during the failed intention administration on

Table 3

Average proportion of performance of children with DS and children with DD during the intentionality task.

Action performed	DS		DD	
	M%	SD	M%	SD
Average proportion of target acts on target administration	70.83	44.73	58.37	47.7
Average proportion of target acts on failed intention administration	47.23	51.3	38.2	50.4
Average proportions of imitations of the failed intention	10.43	32.43	14.6	39.5
Average proportion of other acts on target administration	93.38	25	100	0
Average proportion of other acts on failed intention administration	100	0	93.38	25

Table 4

Means and standard deviations of the frequency per minute of joint attention and affect sharing in children with DS and children with DD during the ESCS.

Characteristic	Down syndrome (N = 14)		Developmental disabilities (N = 11)	
	M	SD	M	SD
Joint attention	.79	.46	.62	.52
Affect sharing	.54	.43	.31	.31

Table 5

Relationship between performance, joint attention, and affect sharing in children with Down syndrome (N = 14).

	1	2	3	4	5	6	7
1. Proportion of target act on target administration	–	.42	.28	–.37	–.25	.43	.28
2. Proportion of target acts on failed intention administration	–	–	–.28	.11	.21	.32	–.15
3. Proportions of imitations of the failed intention	–	–	–	.18	–.62*	.32	.80**
4. Proportion of other acts on target administration	–	–	–	–	–.02	–.01	.41
5. Proportion of other acts on failed intention administration	–	–	–	–	–	–.68**	–.58*
6. Joint attention	–	–	–	–	–	–	.43
7. Affect sharing	–	–	–	–	–	–	–

* $p < .05$.** $p < .01$.

47.23% of trials, compared with the average of 38.2% correct failed intention trials in the DD group (see Table 3). Therefore, children with DS were 23.6% more likely to produce the target action on the failed intention administration (relative likelihood = 1.236, 95% CI .89–1.71) than children with DD. Children with DD, on the other hand, were 39.9% more likely to imitate the failed intention (relative likelihood = 1.399, 95% CI .66–2.94) than children with DS. Differences in performance between the two groups on joint attention and affect sharing were also compared using relative likelihood analyses (see Table 4 for means and standard deviations). On average, children with DS were 27% more likely display joint attention (relative likelihood = 1.27, 95% CI = .20–8.00) and 74% more likely to display affect sharing (relative likelihood = 1.74, 95% CI = .06–54.24) than children with DD.

3.1. Intersubjectivity correlates

Table 5 presents the Pearson r correlations for task performance, joint attention, and affect sharing in children with DS. For children with DS, a significant positive correlation was observed between imitations of the failed intention and affect sharing ($r(14) = .80$, $p = .001$). This suggests that as affect sharing abilities increase in children with DS, increased imitation of failed intention—rather than accurate reading of the experimenter's intention—was observed. Also, performing an “other action” (e.g., any action the child performed other than the target action or imitation of the failed intention) on the failed intention administration was negatively correlated with both joint attention ($r(14) = -.68$, $p = .01$) and affect sharing ($r(14) = -.58$, $p = .03$). This suggests that for children with DS, an increase in the performance of actions unrelated to the experimenter's intended goal during the intentionality task was related to lower levels of joint attention and affect sharing abilities. No other statistically significant associations were found between task performance and joint attention or affect sharing. Results of a post hoc power analysis indicated that there was sufficient power (power = .80) in the present study, despite the small sample size, to detect significant correlations above .58. All the significant correlations described above meet this criteria.

For children with DD, no statistical significant associations were found. However, a marginally significant positive correlation was found between performing the target action on the failed intention administration joint attention ($r(11) = .56$, $p = .08$, see Table 6). In addition, a marginally significant negative correlation was observed between the performance of imitations of the failed intention and affect sharing, $r(11) = -.54$, $p = .06$. A post hoc power analysis was performed. Results of this analysis indicated that there was insufficient power (power = .80) in the present study, to detect significant correlations above .63. This may account for the marginally significant correlations observed in this study.

Table 6 Relationship between performance, joint attention, and affect sharing in children with developmental disabilities ($N = 11$).

	1	2	3	4	5	6	7
1. Proportion of target act on target administration	–	–.14	–.001	–.22	–.15	–.11	–.10
2. Proportion of target acts on failed intention administration	–	–	–.06	.10	–.15	.56 [#]	.12
3. Proportions of imitations of the failed intention	–	–	–	.03	.14	–.30	–.54 [#]
4. Proportion of other acts on target administration	–	–	–	–	–.23	.53 [#]	.59 [#]
5. Proportion of other acts on failed intention administration	–	–	–	–	–	.07	–.02
6. Joint attention	–	–	–	–	–	–	.79 ^{**}
7. Affect sharing	–	–	–	–	–	–	–

[#] $p < .10$.^{**} $p < .01$.**Table 7**Regression analyses for variables predicting performance on the intentionality task from joint attention and affect sharing in children with Down syndrome ($N = 14$).

Variable	Target actions on failed intention			Imitations of the failed intention		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Joint attention	.30	.19	.47	–.01	.09	–.03
Affect sharing	–.24	.20	–.35	.42	.10	.81 ^{**}
R^2			.20	.64		
$F(2,11)$			1.40	9.73		

^{**} $p < .01$.**Table 8**Regression analyses for variables predicting performance on the intentionality task from joint attention and affect sharing in children with developmental disabilities ($N = 11$).

Variable	Target actions on failed intention			Imitations of the failed intention		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Joint attention	.80	.24	1.22 ^{**}	.11	.17	.31
Affect sharing	–.92	.40	–.85 [*]	–.47	.28	–.77
R^2			.58	.33		
$F(2,8)$			5.58	1.95		

^{*} $p < .05$.^{**} $p < .01$.

Nonetheless, this provides suggestive evidence that, in contrast with the pattern observed in the DS group, for children with DD, an increase in the performance of imitations of the failed intention was related to lower affect sharing abilities.

3.2. Predicting the understanding of intentionality

Multiple regressions were conducted for each group to examine if performance on the intentionality task could be predicted from joint attention and affect sharing abilities. For each group, a multiple regression was conducted with joint attention and affect sharing as predictor variables, while the criterion variable was either performing the target action on the failed intention administration or imitations of the failed intention. For children with DS, a significant model emerged for incorrect imitations of the failed intention, $F(2,11) = 9.73$, $p = .004$ (see Table 7). Approximately 64% of the variance in imitating the failed intention could be accounted for by the linear combination of joint attention and affect sharing. Examination of the predictor variables showed a significant effect for affect sharing ($\beta = .81$), such that children with DS who had higher levels of affect sharing performed more imitations of the failed intention.

For children with DD, a significant model only emerged for performing the target action of the failed intention administration, $F(2,8) = 5.58$, $p = .03$ (see Table 8). Approximately 58% of the variance in performing the target action on the failed intention administration could be accounted for by the linear combination of joint attention and affect sharing. Examination of the predictor variables showed a significant effect for both joint attention ($\beta = 1.22$) and affect sharing ($\beta = -.85$), such that children with DD who had higher levels of joint attention and who had lower levels of affect sharing performed more target actions on the failed intention administration.

4. Discussion

The first goal of this study was to examine the relationship between the understanding of intentionality and early intersubjective skill (i.e., joint attention and affect sharing) in young children with DS. Past research has noted strengths in early intersubjective skills in this population (Fidler, 2006; Kasari et al., 1995; Mundy et al., 1988; Sigman & Ruskin, 1999). These early strengths in social cognitive skills should support the development of more complex social cognitive skills, like the understanding of intentionality. In the present study, affect sharing significantly predicted imitating the failed intention in children with DS, such that children with higher levels of affect sharing imitated the failed intention more. It is possible that children with DS who have higher affect sharing abilities were more focused on sharing in the emotional experience with the examiner, leading them to imitate the action they observed. Children with DS in the present study showed high rates per minute of both joint attention and affect sharing, suggesting similar strengths in these skills to those reported in other studies (Fidler et al., 2008; Gilmore et al., 2003; Kasari et al., 1995; Mundy et al., 1990). The combination of these findings suggests that although children with DS show high levels of affect sharing, these affect sharing skills may not facilitate the transition from sharing in an emotional experience to interpreting a social partner's intention.

To understand whether this pattern of performance was specific to development in children with DS, or whether this pattern is a function of developmental delay in general, we also examined the relationship between performance, joint attention, and affect sharing in children with DD. Interestingly, in children with DD, lower levels of affect sharing and higher levels of joint attention were associated with more target actions on the failed intention administration, a pattern of associations that differs from the pattern observed in the DS group. These findings provide suggestive evidence that perspective taking abilities and theory of mind in DS may follow a specific, and possibly unique, pathway in development in DS. This pathway may differ from other children with DD, and perhaps typically developing children, because emerging social cognitive skills may not be supported by foundational intersubjective competencies, as per Cebula and Wishart (2008).

Another important finding from this study relates to production of responses unrelated to the experimenter's intended action. In children with DS, lower levels of joint attention and affect sharing were related to the production of more "other actions" on the failed intention administration. In children with DD, significant correlations were not observed between the performance of "other actions", affect sharing, and joint attention, but the correlation coefficients were positive. Thus there appears to be a different pattern of associations between performing "other actions" and early intersubjective skills in children with DD. However, in order to interpret the target action during the failed intention administration, children needed to recruit their joint attention skills and gain the necessary information to successfully perform the target action. It is possible that children with DS who have lower levels of joint attention may have missed the information needed to successfully perform the target action because they lacked the necessary supporting skills (shared attention) needed to interpret others' intentions. This lack of skills may be why children with DS performed more "other actions". However, both groups performed "other actions" frequently during the intentionality task. It is possible that the nature of the task leads children to perform "other actions" as part of a trial and error process or it may be random. Taken together, it is possible that the associations between performing "other actions" and early intersubjective skills maybe related to other skills not examined in the present study, like means-end thinking or task persistence. Future studies on intentionality may want to consider if there are aspects of the task, or the strategies children use in attempting to solve the task, that lead to producing other actions.

The second goal of this study to examine whether children with DS are predisposed to specific areas of strength or challenge in the understanding of intentionality when compared to MA-matched children with DD. The ability to successfully read another person's intentional action indicates that children have begun to understand people as mental beings who have intentions, emotions, desires, and, ultimately, a different perspective than the child (Tager-Flusberg, 2005; Trevarthen, 1978; Trevarthen & Aitken, 2001; Zinck, 2008). These skills are critical for understanding complex social dynamics and interactions (Zinck, 2008), and influence other aspects of development (Bukowski, Newcomb, & Hartup, 1996; Carpendale & Lewis, 2006; Cebula & Wishart, 2008; Flavell, Miller, & Miller, 2002). In the present study, children with DS were 23.6% more likely than children with DD to correctly interpret the target action during the failed intention administration. Although this suggests that children with DS were more successful at interpreting their social partners failed intention, this is not a very large advantage. However, children with DD were 39.9% more likely to imitate the failed intention than children with DS. This means that children with DD were more likely than children with DS to miss the intentional information presented during the intentionality task leading them to imitate the action they observed. It is noted that, for both of these findings, the confidence intervals for the likelihood ratios included the likelihood ratio of 1. Confidence intervals for each analysis may have been narrower with larger sample sizes in each group. Nonetheless, these findings provide suggestive evidence of a small advantage in the ability to understand the intentions of others in children with DS. More longitudinal research with a larger sample is needed to examine the development of the understanding of intentionality in DS to help to clarify whether this is an area of strength.

Taken together, these findings add support to past research suggesting that there may be a somewhat different trajectory for the development of social cognition in DS (Fidler, 2006) and that intersubjective skills may not be supporting the development of more complex social cognitive skills in children with DS in the manner that has been noted in typically developing children (Cebula & Wishart, 2008; Wishart, 2007). These findings suggest that the phenotypic characteristics of children with DS may have a cascading effect on the understanding of intentionality (Fidler, Lunkenheimer, & Hahn, 2011). Specifically, it seems that early intersubjective skills may influence the development of more complex social cognitive skills

via two pathways. First, children with DS who experience deficits in joint attention (Cebula & Wishart, 2008; Legerstee & Weintraub, 1997) may miss the intentional information needed to interpret the intentions of others. Second, the intersubjective strengths associated with DS, such as MA-appropriate levels of joint attention and high affect sharing (Fidler et al., 2005; Kasari et al., 1995; Mundy et al., 1988; Sigman & Ruskin, 1999) may not be supporting the development of more complex social cognitive skills, such as the understanding of intentionality, in the manner that is expected (Cebula & Wishart, 2008; Wishart, 2007). However, in the present study a direct link between early intersubjective abilities and the understanding of intentionality was not observed. In fact, children with DS showed better joint attention, affect sharing, and intention reading than children with DD. These findings suggest that children with DS do have an advantage in these skills as compared to children with DD. There may be mediators between these skills (i.e., facial recognition, social attribution, eye gaze, attention) not examined in the present study that prevented the detection of a direct link between early intersubjective skills and the understanding of intentionality. More research is needed to examine the relationship between, and potential mediators of, early intersubjective skills and theory of mind in DS, including early theory of mind abilities such as intentionality and perspective taking.

Although the findings of the present study add insight into the development of intersubjectivity in DS, it is also important to consider how the age of the current sample may have influenced the findings of this study. Considering that research on typically developing children indicates that joint attention emerges at 9 months (Trevarthen & Aitken, 2001), and intentionality is consistently used by 18 months (Meltzoff, 1995), the present sample was both chronologically and developmentally older. However, both joint attention skills and the understanding of intentionality in typically development improve with age (Bellagamba & Tomasello, 1999; Bellagamba et al., 2006; Mundy et al., 2007). It is possible that the finding that early intersubjective skills may not be supporting more complex social cognitive skills, like intentionality, in children with DS may be related to a shift in the way these skills are linked later in development that was not explored in this study. Another possibility is that children with DS may not have MA-appropriate understanding of intentionality. Therefore, the link between early intersubjectivity and more complex social cognitive skills may be disrupted early in development in children with DS. In order to examine the age-related changes in intentionality and later social cognitive skills, longitudinal research starting in infancy in children with DS with a MA-matched group of typically developing infants is warranted.

There are several important limitations to the present study. The sample size in the present study was small, which means the findings of this study may be due to greater variability within the sample. Therefore, the findings presented in study should be interpreted with caution and warrant replication. Also, both of these samples were non-random samples, which means that inference is not entirely valid. For this reason, the present study examined group differences using percentages and likelihood ratios. Furthermore, confidence intervals were included because they provide the range of possible values of the likelihood ratios. Another potential confound in the present study was that all of the experimenters were female. It is possible that the results of this study may be influenced by differences in gender communication. Finally, the current study was cross-sectional, and therefore, it was not possible to examine the trajectory of the development of intentionality. In order to truly characterize the development of intentionality in DS, longitudinal studies with larger sample sizes and an examination of potential mediators in understanding the intentions of others will be necessary.

5. Conclusions

This study is among the first to examine the development of the understanding of intentionality in young children with DS. Findings from this study can inform our growing understanding of the development of intersubjectivity, theory of mind, and social cognition in DS. This study provides suggestive evidence that the understanding of intentionality may follow a qualitatively different trajectory in children with DS when compared to other children with DD at similar developmental levels, which has been suggested in other aspects of social cognition in DS (Cebula & Wishart, 2008). However, in order to examine the emergence of intentionality over time and with greater precision, larger-scale, longitudinal research is needed. Nonetheless, this study also highlights the potential cascading effects of behavioral phenotypes on development in DS (Fidler et al., 2011). Further characterizing social cognition in DS will help to identify potential areas for targeted intervention to help promote positive development in social cognition and other aspects of development.

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