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Kelli Arens

University of Nebraska-Lincoln

Cynthia J. Cress

University of Nebraska-Lincoln, ccress1@unl.edu

Christine Marvin

University of Nebraska - Lincoln, cmarvin1@unl.edu

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Gaze-Shift Patterns of Young Children with Developmental Disabilities who are at Risk for being Nonspeaking

Kelli Arens, Cynthia J. Cress, and Christine A. Marvin
University of Nebraska-Lincoln

Abstract: Children with developmental disabilities often have difficulty with joint attention that can affect more advanced communication skills. This study evaluated the complexity of child engagement behaviors demonstrated by twenty-five pre-intentional children (age 9 to 25 months), who had developmental disabilities and were at risk for being nonspeaking. During free play with their parents, these children demonstrated infrequent and simple gaze shifts and focused more on individual objects or people than shared attention with parents during play. These children seldom engaged in coordinated attention behaviors such as shifting gaze back and forth between people and objects during their play with parents. Type and frequency of engagement behaviors are discussed relative to understanding the unique challenges for children with developmental disabilities that include motor and visual impairments.

The quality of joint attention with adult partners has been found to influence the later communicative development in children with disabilities (Legerstee & Weintraub, 1997, Mundy & Willoughby, 1996, Yoder & Farran, 1986). Joint attention is defined as a state in which the attention of a caregiver and child are focused on the same object, typically demonstrated in early infancy through simple gaze shift patterns (Bakeman & Adamson, 1984). Joint attention allows a child to realize that meanings can be exchanged between people and suggests an understanding that social partners can serve an instrumental function.

By six months of age, typically developing

children begin to gaze shift between caregivers and objects (Bakeman & Adamson, 1984). Generally by thirteen months of age, children demonstrate three-point gaze shifts, coordinating their attention back and forth between a person and shared objects of attention (i.e. adult → toy → adult, or toy → adult → toy) (Bakeman & Adamson, 1984). With three-point, “coordinated” joint attention, children can actively engage in or monitor activities jointly with partners, by sharing attention to an object or topic of interest. It is possible, but unclear, whether children engage in some two-point gaze shifts where they look only once at a person and an object at a time (i.e. adult → toy, or toy → adult) before they can engage in coordinated three-point joint attention.

It is important to consider the impact of any joint engagement on the communication development in children at high risk for communication disorders, such as children with motor, visual or expressive language impairments. Several researchers have proposed that variations in parental attention, prompting, gestures, or vocal behaviors can influence the relative timing and skill of children’s early engagement behaviors (Farran & Kasari, 1990; Goldfield, 1990; Harris, Jones, & Grant, 1983; Striano & Rochat, 2000). Also, individual learning processes, social experiences, and

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neurobiological differences among children may influence their ability to develop joint attention with adult partners (Mundy & Willoughby, 1996). Young children with developmental disabilities may have difficulty in establishing joint attention with caregivers and therefore have fewer opportunities to engage in meaningful shared interactions. For instance, the inability to physically lift arms or hands to point towards a distant object of interest is likely to limit or delay children's ability to learn how their own actions can convey messages to other people (Cress, 2002). Children with developmental disabilities initiated fewer joint attention communicative acts during structured temptations for communication at 20 and 32 months of age compared to typically developing norms in a study by Cress, et al. (1999). And although these children with intentional communication could successfully demonstrate three-point gaze shifts similar to their same age peers, they showed significantly fewer. The specific type and frequency of gaze-shift patterns preintentional children display is not clearly understood (Cress, Andrews, & Reynolds, 1998). Knowledge of these patterns could provide insight into the possible relationship of early engagement experiences and communication delays.

Young children with developmental disabilities may show impaired engagement behaviors during preintentional communication stages that contribute to their long-term joint attention differences. For example, some children with developmental disabilities have shown specific difficulties in controlling social interaction with other people (Romski, Sevcik, & Adamson, 1997), which may influence even simple engagement behaviors in parent-child interactions. Karns and Romero (1997) showed that parents of young children with motor impairments looked at their children for a shorter duration, looked at toys more, and looked away more often than parents of children showing typical development. Mothers of twins with physical and developmental disabilities noted the attentional focus of the child with the disability less often than the child with typical development (Yoder & Farran, 1986). Wasserman, Allen, and Solomon (1985) found that while mothers of children with disabilities showed more en-

couragement and supportive joint attention than mothers of children at-risk for developmental delays, one-third of the mothers of children with disabilities had ignored their children at least once during the observed interaction. Children's physical, neurological, and cognitive problems could each contribute to the challenge these parents face in noting joint engagement opportunities with their children.

Two alternative hypotheses may also explain why children with developmental disabilities apparently develop joint attention problems during the late infancy period (between 6–24 months). Although a three-point coordinated gaze shift is usually expected from children with typical development as they learn to meaningfully associate people and objects, it is possible that children with limited head control may produce a restricted two-point gaze shift movement that serves a similar developmental purpose. Medically high-risk pre-term infants also have shown difficulty shifting their attention because of delays in motor development and have experienced difficulty inhibiting a response to one visual stimulus to attend to another (Landry, 1995). Children with or at risk for physical disabilities were less likely to follow parental gaze and therefore may have been inhibited from attending to objects (Wasserman et al., 1985). In children with traumatic brain injury, the two behaviors that interrupted joint attention most frequently were the children's primitive or abnormal reflexes and unfocused gaze patterns (Yoder & Farran, 1986). Therefore, development of even the two-point gaze pattern may be challenging for children with overall developmental disabilities.

If difficulty establishing joint attention is not simply an implication of poor reflexive gaze, head control, or visual attention, then the breakdown of joint attention may occur as children are expected to produce more complex three-point gaze shifts. Infants with cerebral palsy have reportedly initiated less eye contact and engaged in fewer referential gaze patterns than children with typical development (Hanzlik, 1990). Children with Down syndrome also have difficulty shifting attention between referents when the situation has a high cognitive load, as when checking for parent attention while engaging in a separate

play task (Kasari, Freeman, Mundy, & Sigman, 1995). Children with other developmental disabilities may experience similar difficulty in cognitive load as children with Down syndrome. Additional cognitive load may be introduced by the increased difficulty they have in planning, controlling, and monitoring physical movements. Children with developmental disabilities are notably slower at initiating communication than typically developing children and they may lose the attention of their partner before establishing the desired joint attention (Cress et al., 1999). Use of joint attention and specifically two-point and three-point gaze behaviors is not clearly understood in young pre-intentional children with physical disabilities.

The present study was designed to examine engagement behaviors of 25 pre-intentional children who have diagnosed developmental disabilities during their unstructured play activities with their parents. There were three specific questions. First, what kinds of engagement behaviors expected for typically developing infants are produced by pre-intentional children with developmental disabilities? Second, do pre-intentional children with developmental disabilities, who have better motor skills (higher motor age-equivalent scores) show more gaze shift behavior than children with poor or more limited motor skills (lower motor age-equivalent scores)? Third, do pre-intentional children with developmental disabilities who have lower overall developmental scores (for cognitive processing or problem solving) show less gaze shift behavior than children with higher overall developmental scores?

Method

Participants

Data were collected from 25 infant participants with a mean corrected age of 17 months (range 9-25 months), who were part of a 50-participant longitudinal study of communication development for children at risk for being non-speaking (Cress, 1995). Participants were selected due to their limited use of intentional communication, such that all failed to demonstrate sufficient coordinated joint attention or intentional communication acts

during free play necessary for scoring of the *Communication and Symbolic Behavior Scale* (CSBS) (Wetherby & Prizant, 1993) used in the longitudinal study. In other words, children selected did not observably direct communication acts such as gestures or vocalizations toward a listener with eye gaze or other partner-oriented behaviors. In some instances, parents of these children would interpret behaviors or vocal productions as intentional communication when the examiners would not. For example, participant #13 displayed an expressive language age of 16 months by parent report, on the *Battelle Developmental Inventory* (Newborg, Stock, Wnek, Guidibaldi, & Svinicki, 1984), but did not initiate any intentional communication acts during the administration of the CSBS activities.

Participants had disabilities with physical or oral/motor involvement associated with diagnosed cerebral palsy ($n = 12$), acquired brain injury/illness ($n = 8$, e.g. meningitis, encephalitis, anoxia, glutamic acidurea or traumatic brain injury), congenital conditions ($n = 1$, microcephaly), syndromes ($n = 3$), or multiple disabilities ($n = 1$). Participants were also classified as being at risk for being nonspeaking. To meet this classification, participants had to meet two of the following four criteria: 1. Prematurity, birth anoxia, or prenatal conditions considered to be high risk factors. 2. Feeding difficulties or persistent oral/motor control problems. 3. Delayed onset of vocalizations and/or speech relative to same-age peers. 4. Evidence of any neuromotor deficits that may be related to speech development (McDonald, 1980). A summary of the descriptive information on the 25 participants can be found in Table 1.

Participants lived in both urban and rural areas and 36% were from racial minority groups; 40% were living in single-parent households. Parents of the participants represented a full range of educational backgrounds and occupations. Forty percent of the parents reported having a high school degree or less and 60% reported completion of some college courses; 20% had college degrees. Occupations of parents were rated using the International Socio-Economic Index of Occupational Status (ISEI) categories established by Ganzeboom and Treiman (1996). The mid-point of the ranked occupational categories in

TABLE 1

Descriptive Information for Children with Developmental Disabilities Participating in Study

Subjects	Age (mos)	Gender	Developmental Age Scores (months) ^a					Motor Skills	Vision Status	Visual Acuity Grating (cp/cm) ^b	Diagnosis
			Overall Development	Receptive Language	Expressive Language	Motor Skills	Vision Status				
1	18	F	6	6-7	6	6	VI-P ^b	0.5	Traumatic brain injury		
2	17	F	8	8-9	10	5	Adequate	4.0	Multiple disabilities		
3	18	F	2	10	4	2	VI-P ^b	NA ^{c**}	Viral encephalitis		
4	14	F	3	4	2	3	VI-P ^b	NA ^{**}	Cerebral Palsy		
5	21	M	3	6-7	4	3	VI-P ^b	NA ^{**}	Meningitis		
6	18	M	7	8-9	6	4	Adequate ^d	2.0	Microcephaly		
7	22	M	7	6-7	12	5	Adequate	4.0	Cerebral Palsy		
8	25	M	12	19-20	8	8	Adequate	2.0	Cerebral Palsy		
9	14	M	7	13-14	4	7	Adequate	2.0	Opitz syndrome		
10	21	F	3	5	2	2	VI-P ^b & VI-A ^c	2.0	Vader's syndrome		
11	16	F	6	6-7	6	3	VI-P ^b	2.0	Anoxia		
12	13	M	6	13-14	6	4	VI-A ^c	8.0	Cerebral Palsy		
13	18	M	8	17-18	16	4	Adequate	0.5 ^{**}	Achondroplasia		
14	13	M	4	5	1	3	VI-P ^b & VI-A ^c	4.0	Viral encephalitis		
15	12	M	7	5	7	5	Adequate	8.0	Cerebral Palsy		
16	26	F	8	11-12	5	5	Adequate ^d	2.0	Glutamic acidurea		
17	15	M	8	13-14	13	4	Adequate ^d	8.0	Cerebral Palsy		
18	17	M	4	13-14	7	3	VI-P ^b	NA ^{**}	Spina Bifida/meningitis		
19	18	F	6	11-12	6	4	Adequate	8.0	Cerebral Palsy		
20	16	M	8	13-14	10	5	VI-P ^b & VI-A ^c	2.0	Cerebral Palsy		
21	17	F	10	8-9	9	9	Adequate	8.0	Meningitis		
22	15	M	5	5	5	4	VI-P ^b	NA ^{**}	Cerebral Palsy		
23	21	M	5	8-9	5	3	VI-P ^b & VI-A ^c	4.0	Cerebral Palsy		
24	15	M	8	8-9	11	5	VI-A ^c	8.0	Cerebral Palsy		
25	9	M	9	10	4	3	Adequate	4.0	Cerebral Palsy		
Mean	17 mos.		6 mos.	9.6 mos.	6.8 mos.	4.4 mos.		4.2 cp/cm			

^a Age in months as reported from the Battelle Developmental Inventory.

^b VFP = visual impairments – processing problems.

^c VI-A = visual impairments – acuity problems.

^d Adequate with corrected vision.

^e NA = not available.

* cp/cm = cycles per centimeter.

** Scores below normal limits for mental age.

their standardization scale was just above 40 points and represented supervisory labor positions. The average occupation score for the parents in the present study was 37.2 suggesting skilled manual labor positions, with 12 parent's occupations scored higher than 40 (independent employers, supervisors, and professional positions) and 12 occupations scored below 40 (skilled and semi-skilled laborers, farmers). One single parent was a student, considered not codeable for occupation.

On the *Battelle Developmental Inventory* (Newborg et al., 1984), participants had a mean developmental age of 6 months (range 2-12 months), a mean receptive communication age of 9.6 months (range 4-20 months), and a mean expressive communication age of 6.8 months (range 1-16 months). All children had scores one standard deviation below the mean for their corrected age. In addition, the children had notable delays in motor skills with a mean motor age of 4.4 months (range 2 – 9 months). All demonstrated sufficient hearing for communication on a battery of tests including the *HearKit* screener for response to calibrated noisemakers (BAM World Markets, 1991).

On the *Baby Screen Kit* (Vision Associates, 1996), for preferential looking to grating acuity cards and materials, all but seven of the children had a visual grating acuity value within normal limits of their mental age as measured by cycles per centimeter (CPM). CPM refers to the number of lines in each centimeter of the visual testing surface. Each cycle corresponds to one degree of visual angle. For instance, at two cycles per centimeter at optimal viewing distance there are four lines or two cycles in each degree of a child's visual angle. There is no way of converting the grating acuity values to optotype acuity such as 20/20 vision. Other measurements used to gain a more complete picture of the children's visual function included the *Functional Vision Assessment* (Vision Associates, 1996) on which all of the children showed age-expected responses to visual information in the environment. Although all the participants demonstrated at least a minimum of functional vision, 28% were reported to have visual processing difficulties; 8% exhibited only acuity problems; and 16% of the children presented both acuity and processing difficulties.

Three children wore glasses but had no other reported processing or uncorrected acuity concerns.

Procedure

Data collection. Data that were used for this study were part of the database from the longitudinal study of young children with developmental disabilities who are at risk for being non-speaking (Cress, 1995). As part of the larger study, all children and parents took part in six sessions in the family's home that lasted approximately two hours every three months for eighteen months. These sessions were used to interview parents and assess children's communicative and cognitive development over time. For purposes of the present study, however, only data collected during the first home session when parents and children were engaged in natural play activities were used. For example, in between structured play activities with the examiner, parents were observed playing with their children when the opportunity to play arose naturally. In some cases, free play involved the parent trying to engage their child in a toy or activity. As needed, parents were questioned about children's normal activities and favorite things to do and were encouraged to engage in these activities as naturally as possible. The goal of these instructions to the parent was to have them play naturally with their child instead of constructing play episodes to demonstrate particular skills or behaviors.

Each session was videotaped on S-VHS tapes with a Panasonic AG 456 video camera. Segments that included parent-child interaction were dubbed onto coding tapes with an average of 20.3 minutes (range: 2.5-60.5 min; median 17.7 min) of parent-child activity. The outliers were included because the average time when the outliers were excluded (19.3 min) was not notably different. Because of differing parental interaction strategies, children did not have equal interaction times with their parents. Some participants had relatively short parent-child interaction time, which may have been due to reluctance to interact before the camera. Other participants had longer periods of parent-child interaction time that could be attributed to the child's reliance on specific parent positioning or play

strategies during the assessment period. Therefore, frequency of children's various engagement behaviors were scored from videotapes, and rate of each behavior per minute was calculated (total frequency of each behavior divided by time). To account for relative amount of time children spent in any given engagement behavior, the specific behavior rate per minute was divided by the overall rate of total engagement behaviors per minute to produce percent of time spent in each specific behavior. For example, if a child had 32 unengaged behaviors in an 8-minute period, this would result in a rate of four unengaged behaviors per minute. But the child could also have had other engagement behaviors noted during the 8 minutes accounting for an additional 1.25 behaviors per minute for a total of 5.25 codable behaviors per minute. Therefore, the child had spent $4/5.25$ or 76% of the time being unengaged.

Data scoring. Video segments of parent-child interaction were viewed in S-VHS format on a JVC BR-S378U video deck with a 20" JVC AB20BP6 monitor. To be considered a parent-child interaction, the parent and child had to both be engaged in an activity, such as object

or social play without experimenter involvement. In some cases, the parent might be attempting to interact with the child even if the child did not respond to the parent; these segments were included in the coding. A coding scheme, adapted from Bakeman and Adamson (1984), looked at seven categories of child engagement including *unengaged*, *onlooking*, *with persons*, *with objects*, and three types of joint attention, *passive joint*, *two-point gaze shifts*, and *coordinated three-point gaze shifts*. See Table 2 for operational definitions of these terms. Unlike Bakeman and Adamson (1984), the present study utilized three categories for joint attention instead of two. This more specific coding was included to test the hypothesis that pre-intentional children with developmental disabilities might show more gaze shifts if two-point shifts were also scored.

Coding was done in 15-second intervals and activities had to occur for at least three seconds to be coded. Exceptions included the two-point and three-point gaze shift categories for which every instance was rated. Video segments were not coded if there were no physical opportunities for eye contact between the parent and child (joint attention). For exam-

TABLE 2

Child Engagement Coding Scheme Definitions

-
-
1. Unengaged: The child is not engaged in anything, looking off into space.
Example: Child's eyes are not fixated on any one thing.
 2. Onlooking: Child is looking but not taking part in the activity.
Example: Child may be looking at what the adult is doing but is not actively involved.
 3. Objects: The child is attending to only the object the child is involved with.
Example: Infant is engaged in a toy and is not looking to the adult.
 4. Persons: The child is engaged with the person, social play.
Example: Adult may be making silly faces at child and child is responding to them.
 5. Passive joint attention: Infant and adult are involved with the same object, but child does not look at adult.
Example: Adult is interacting with the object the child is attending to, but the child is not looking at the adult.
 6. Two-point gaze shift: The infant looks from person to object but doesn't look back to person or vice versa. This needs to be a clear attention shift.
Example: Child is looking at an object and then looks to the adult or vice versa. The child does not make the third transition.
 7. Three-point gaze shift: Three-point attention shift between object-person-object and vice versa. This has to be a clear attention shift.
Example: The child looks at the adult then the object and back at the adult.
 8. Face not visible: This occurs when the child's face is not visible.
 9. Off Camera: This occurs when the child is off camera.
-

Adapted from a coding scheme by Bakeman and Adamson (1984).

ple, if the child was being bottle-fed in a position where visual contact was not possible, then eye gaze behaviors were not coded during that activity unless the child was repositioned.

Interobserver Agreement

Primary coding was completed by the first author and interobserver agreement of coding was established by a trained graduate research assistant. Before coding of the tapes took place, both coders were trained in using the present coding scheme by rating child engagement behaviors of pilot children who had developmental disabilities, but not included in this study. Coders discussed specific examples of what constituted a codable unit and how it should be scored to improve consistency. Then videotape segments were viewed independently and coded until interobserver agreement exceeded 80% with at least two consecutive pilot children. Interobserver agreement was then established for a random sample of 20% of the research participants in the present study. Overall agreement of coding was 78.6 % (range 73%-90%), calculated by number of agreements divided by the total number of agreements plus disagreements. A Cohen's Kappa of .67 was also calculated. The moderately low Kappa may be due to difficulty collecting gaze shift behavior data from children within a home based setting.

Results

Engagement Behaviors

Table 3 shows means and standard deviations of engagement behaviors coded for the 25 pre-intentional children with developmental disabilities. On average, the children spent more than half their observed time with parents unengaged. These children spent 39.1% of their time with parents, however, in some type of engaged behavior. Most of this behavior was gaze to objects (16.9%) and gaze to people (14.9%). During the play interaction with their parent, children spent relatively little time showing onlooking (2.5%) and passive joint attention (4.2%) behaviors.

The children in the present study were observed using coordinated three-point gaze

TABLE 3

Child Engagement Behaviors (mean % of time) for Children with Developmental Disabilities (DD)

<i>Engagement Behaviors</i>	<i>M (SD)</i>
Unengaged	54.8 (26.5)
Onlooking	2.5 (4.2)
With Objects	16.9 (17.1)
With Persons	14.9 (17.0)
Passive Joint Attention	4.2 (6.6)
Coordinated (<i>3-point gaze shifts</i>)	0.2 (0.5)
Combined (<i>2-point + 3-point gaze shifts</i>)	0.6 (1.1)
Unobserved Behaviors (<i>face not visible + off camera</i>)	6.1 (7.5)

shifts only .2% of the time. However, they used twice as many two-point gaze shifts (.4%) making active gaze shifts evident a total of .6% of the time in play with parents. The combined category of two-point plus three-point gaze shifts was reported to allow comparison with literature on gaze shifts in discussion of typically developing populations.

Motor and Developmental Correlations

Computer-based correlations were computed (*StatView 4.0*, Abacus Concepts, 1992) using percent of time children spent in each engagement behavior instead of frequency of occurrence. When computing these analyses, the categories of two-point and three-point gaze shifts were again combined to expand the range of possible gaze shift behaviors for this population of children with poor motor (head) control. Correlations between developmental characteristics and engagement behaviors for the pre-intentional children with developmental disabilities are presented in Table 4. Significant positive correlations were noted for amount of engagement with objects and children's motor and overall developmental skills. Children with better motor skills (higher motor age scores) displayed higher rates of attention to objects than children with poorer motor skills. There were also significant positive correlations between onlooking behaviors and overall developmental skills (age scores), and passive joint attention and children's motor skills. Children with better

TABLE 4

Correlations for Developmental Characteristics and Engagement Behaviors of Children with Developmental Disabilities ($n = 25$)

<i>Engagement Behavior</i>	<i>Overall Development^a</i>		<i>Motor</i>		<i>Receptive Language</i>	
	<i>R²</i>	<i>(p)</i>	<i>R²</i>	<i>(p)</i>	<i>R²</i>	<i>(p)</i>
Unengaged	*-.640	(.0004)	*-.453	(.02)	-.355	(.08)
Onlooking	*.504	(.01)	.271	(.19)	.275	(.19)
With Objects	*.566	(.003)	*.605	(.001)	.321	(.12)
With Persons	.177	(.4)	.047	(.83)	.110	(.61)
Passive Joint Attention	.288	(.17)	*.428	(.03)	.222	(.29)
Combined Gaze Shifts	.32	(.12)	.318	(.12)	.204	(.33)

* $p < .05$.

^a Scores for overall development, motor and receptive language are from the Battelle Developmental Inventory.

overall developmental skills displayed higher rates of onlooking behavior than children with poorer developmental skills and children with better motor skills displayed higher rates of passive joint attention than children with poorer motor skills. Results show a significant negative correlation, however, between unengaged acts and motor and developmental skills, with children who had better motor and overall developmental skills showing fewer unengaged acts than children with poorer skills. The gaze shift behaviors were not correlated significantly with children's developmental skills. None of the engagement behaviors were significantly correlated with receptive language skills of participants.

Discussion

For pre-intentional children with developmental disabilities, it was hypothesized that three-point gaze shifts might be physically more difficult than two-point gaze shifts, but that all types of gaze shifts would be relatively infrequent. In previous studies, pre-intentional children demonstrated relatively few three-point gaze shifts (Landry, 1995). In the study reported by Bakeman and Adamson (1984), children at developmental ages similar to participants in the present study showed relatively few three-point gaze shift behaviors. Typically developing children produced three-point gaze shifts 2.3% of the time at 6 months of age (Bakeman & Adamson, 1984).

Children with developmental disabilities in the present study produced gaze shifts (two-point + three-point) .6% of the time at an average developmental age of 6 months. Similar reports of limited gaze shifts during tasks with high cognitive load have been described for children with Down syndrome who were chronologically older than children in the present study (Kasari et al, 1995; Ohr & Fagen, 1994). It is reasonable to assume that some cognitive processing skills are involved in three-point coordinated gaze shifts for any children at this stage of communicative development. However, the presence of motor delays/disabilities may make even the use of two-point eye gaze a challenge.

Motor skills such as head control may have had an impact on the success the pre-intentional children with developmental disabilities had at gaze shifting in the present study. It is possible that the motor skill of shifting the head and eyes between the persons or objects in different positions or visual fields may be an added source of difficulty for children with these developmental disabilities. Children's positioning during parent-child play may also have influenced the relative ease with which children shifted their gaze between objects and parents. For instance, if parents were seated behind the children, it was difficult for the children to turn to look at their parents and complete a two-point or three-point gaze shift. It is possible that the pre-intentional children with developmental disabilities

showed fewer three-point gaze shifts than they were cognitively capable of producing because of motor and positioning limitations. Production of more two-point gaze shifts, which require limited head and visual control such as a single movement to readjust the child's gaze orientation, suggests that these children did aim to establish simple forms of joint attention. Two-point gaze shifts are a plausible developmental phase in the process of transitioning from single point attention to three-point gaze shifts. No research to date has coded for two-point gaze shifts for children with typical development (Bakeman & Adamson, 1984, Adamson, Russell, & McArthur, 1997, Adamson, Bakeman, & Deckner, 2001). It is not clear whether typically developing children also produce simple two-point gaze shifts to reduce cognitive complexity of early shared engagement, or whether limited motor skills increased the likelihood of two point gaze shifts in children with developmental disabilities in this study.

The pre-intentional children with developmental disabilities were often able to perform gaze shifts if prompted by an examiner in structured play, suggesting an interaction between partner behavior and a child's developmental abilities. The prompts consisted of partner behaviors such as holding a toy within the child's line of vision, tapping objects to draw attention, and positioning the partner's face within the same visual space as an object during play. Shifting gazes between referents and listeners is used as an indicator of cognitive ability because it requires the child to focus on more than one thing simultaneously (e.g. Ohr & Fagen, 1994). Since children with developmental disabilities were anecdotally observed to include gaze shifts more consistently when prompted, it suggests that the skill may be within their physical capability. Factors that might limit children's initiation of gaze shifts include restrictions in children's ability to: a) understand the interaction between person and object, b) recognize the signaling function of gaze shifts, c) persist at difficult tasks, or d) independently express communicative signals without partner cues. All these factors could be influenced by the overall developmental delays evidenced in the present sample.

Environmental factors, however, may con-

tribute to the extent that children perform gaze shifts in typical interactions with their parents. For instance, parents in this study were rarely observed prompting for the children's gaze transition (i.e. holding an object and tapping it to encourage the child to shift their gaze) which could influence number of times the children made gaze shifts. If parents perceived that their children experienced problems in visually following events when re-directed, as was observed in children with Down syndrome (Harris, Kasari, & Sigman, 1996), they may have limited their attempts to elicit gaze shifts from their children. Furthermore, typical free play with young infants who have developmental disabilities often involves social play without objects; this minimizes the physical demands for the children and doesn't require gaze shifts to a separate referent. For instance, parents in this study tended to initiate routines such as tickle or turn-taking games in which children retained attention to the parent. If children have their parent's attention already and don't have to shift in order to get that attention, they may not spontaneously make gaze shifts to more distant objects in the environment.

Conversely, if parents of children with developmental disabilities have difficulty in noticing their children's attentional focus, as was reported by Yoder and Farran (1986), children with developmental disabilities may decide that shifting their gaze to elicit the partner's attention isn't worth the physical effort. Because gaze shifts are relatively challenging tasks for children with any type of head control or visual difficulties, children may be less likely to produce these behaviors that are within their capacity without specific prompting or motivation to overcome the difficulty (Cress et al., 1998).

Children with developmental disabilities in the present study were frequently observed as unengaged and infrequently observed onlooking (watching the parent do something). This could be influenced by limitations of the coding system for the 13 children who had visual processing impairments. For instance, children with cortical visual impairments tend to have difficulty focusing on or processing different visual events for more than a brief direct glance, although they may be attending to events using peripheral vision. Seven of the

children had visual acuity that was not within expectations for their mental age. However, all seven children showed expected responses to visual information in the environment on the Functional Vision Assessment (Vision Associates, 1996) and their parents reported children's systematic use of gaze behaviors in interactions at home. Therefore, the seven children with visual grating acuity values below what was expected for their mental age were still included. In gaze coding, however, the coding system forced observers to code these seven children as unengaged when observers were unable to discern if children were looking at something. Because children with developmental disabilities as a group spent greater time being unengaged, there may have been less opportunity for simple onlooking of parent activity. If these children had difficulty focusing on a parent's activities that occurred around them without prompting, they may not have spent as much time actively watching what the parent was doing. Also, because parents tended to engage in frequent social play there was less opportunity for the children with developmental disabilities to watch their parents conducting a play activity with an object that the children could observe.

Children with developmental disabilities spent comparable amounts of time looking at objects (16.9% of the time) and at persons (14.9% of the time) during interactions. Reports of gaze behavior in 6-month-old typically developing children showed relatively higher object gaze (37% of the time) at similar developmental ages to children in the present study (Bakeman & Adamson, 1984). If parents did not hold the object within the children's field of vision or actively prompt the children to look at the objects, children with developmental disabilities frequently tended to spend time unengaged. These findings are consistent with Hanzlik's (1990) findings, where children with cerebral palsy were less likely to initiate eye contact with parents than expected. Children with developmental disabilities in the present study had notable motor delays and tended to have poor hand and arm skills and were unlikely to grasp an item themselves for visual inspection or interaction. Also, given children's difficulty in independently shifting positions, they tended to be more restricted to the activity being presented by the parent

than expected for typically developing children. For instance, if a child was seated upright and shifted gaze from a parent to a toy on the floor, the child may have had insufficient head control to return the gaze to the parent. Because the parent is more directly able to engage the child's attention, the child may concentrate his/her gaze efforts on the parent rather than the object. If children did shift gaze from parent to the object, there tended to be an intervening period of unengagement as they gradually shifted their head position to focus back on the parent or on a new activity. This delayed gaze shift process may contribute to the limited amount of object attention and three-point gaze shifts reported for children in the study.

Children with developmental disabilities spent relatively little time engaged in passive joint attention behavior compared to data reported for children with typical development. Bakeman and Adamson (1984) reported passive joint attention 16.9% of the time for 6-month-old typically developing children, but children with developmental disabilities in the present study only demonstrated passive attention 4.2% of the time. By definition, in order to code for passive joint attention, both parties needed to be involved with the same object. Parents of children with developmental disabilities did not socially engage their children very often when the children were involved with objects. Karns and Romero (1997) reported similar findings, in which parents of children with motor impairments tended to look away from the child or look at toys more often than reported for parents of children with typical development. Instead of interacting with their children, parents in the present study often watched the children and made occasional comments; the children were typically coded for gaze on an object when the opportunity existed for active joint attention. If parents were playing with an object that the child could not successfully access or control, the child was often coded for onlooking or unengaged behavior. Parents may have perceived that their children had difficulty interacting with people and objects at the same time so they chose to let the children interact with an object or watch the parent independently.

Some specific engagement behaviors were

associated with the motor or overall developmental skills of children with developmental disabilities. Children with higher developmental or motor scores spent less time unengaged and more time onlooking or engaged with objects. This suggests that children are able to engage in activities that are more complex as they show greater developmental or motor skills. If children had better motor abilities, they could physically engage with objects and play with them instead of just looking at the objects or adult activity with the objects. Wasserman et al. (1985) found that physical impairments tended to reduce the extent to which children followed a parent's gaze or attended to objects. Children in the present study who had better motor skills were more likely to engage in passive joint attention behavior (both parties involved with the object) than children with poorer motor skills. Better motor skills likely allowed children to independently engage the object with the parent in play and provided a reason to monitor the parent's actions instead of passively watching the parent with onlooking behavior. Also, parents were observed to respond and play jointly with the object more readily when their child was initiating actions with the toy rather than simply watching the toy. Children who initiated joint play with objects were also observed to have more conventional play strategies, which may have prompted more conventional parent-child interaction and children's engagement behaviors. For instance, children with sufficient motor skills to activate a music toy could take turns with their parent in a manner similar to typically developing children.

Only the overall developmental scores, not motor scores, were significantly associated with greater onlooking behaviors, presumably because onlooking requires cognitive awareness of events and activities but does not require particularly complex motor skills. None of the engagement behaviors were correlated significantly with receptive language skills, which suggest that early visual engagement in joint activities does not depend upon specific verbal comprehension.

Future Research

Future research is necessary to determine the validity of two-point gaze shifts as a develop-

mentally meaningful skill for coordinated joint attention both in children with typical development and children with developmental disabilities. It is not possible from the present data to determine whether the two-point shifts demonstrate equivalent association between object and person for children with developmental disabilities, as three-point shifts do for typically developing children. Further longitudinal data could determine whether children with developmental disabilities produce two-point gaze shifts for an extended period of time, evolve to increased use of three-point gaze shifts, or whether the simpler gaze shifts remain prevalent in children with disabilities who demonstrate intentional communication.

This study suggests an interaction may exist between environmental, social, developmental and motor factors that may influence children's gaze behaviors. However, relatively small sample size and variability among children limits the extent to which the interaction between these factors can be explored. For instance, there may be a specific interaction between type of play (e.g., social vs. object) and quality of children's gaze shifts between people and objects. Furthermore, both types of play and gaze shifts can be directly influenced by parental actions or prompting.

Variability in motor and gaze behavior is unavoidable in a population of children who are nonspeaking. However, future research might examine further correlations between gaze and head control or gaze and visual acuity/processing. Future research could also address the extent to which children's engagement behaviors improve over time as physical, cognitive, and/or visual skills improve. Because gaze shifts have been associated with the transition to interactive skills such as intentional communication in typically developing children, behaviors of pre-intentional children with developmental disabilities should be tracked to determine if gaze shifts have a similar relationship with their development of intentional communication.

Clinical Implications

If two-point gaze shifts are confirmed by further research to have developmental validity, partners may be encouraged to watch for and

selectively reinforce two-point gaze shifts as indications of children's attention or intent. Even if two-point gaze shifts are shown to consistently indicate simpler cognitive skills than three-point shifts, it may be useful to coach children in expanding their motor plans for gaze shifting during play if they have limited head or gaze control. Partners may also be coached to position children so that both the object and partner are within their feasible visual field during object play. Children who do not spontaneously gaze shift from objects to their parents and back may be prompted for each successive gaze shift with tactile, kinesthetic, or visual cues. In particular, children with visual processing difficulties may respond to gaze prompts more effectively with light, sound, or movement cues, including toys that have light and sound characteristics. For children who demonstrate poor gaze shifts, separate activities may be useful to promote children's motor plans for head control and gaze shifts and to elicit children's communicative signals and acts about the shared play activities and objects of interest. In particular, intervention addressing joint attention may need to include specific coaching in gaze shift skills such as attention checks with a partner. Children who have difficulty shifting their gaze in play are likely to have further difficulty using gaze shifts to interpret or anticipate communicative acts from others.

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