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Validating Dynamic Assessment of Triadic Gaze for Young Children with Severe Disabilities

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Abstract

Purpose—This research investigated a dynamic assessment (DA) to identify differences among young children with severe disabilities, which would predict progress in learning behaviors indicating coordinated joint attention (CJA).

Method—Six children 11–24 months of age were enrolled in a 16-week treatment for behaviors indicating CJA, specifically triadic gaze (TG), a three-point gaze shift between object and adult. An initial static assessment documented eligibility and baseline performance of TG. DA procedures were then implemented to determine each child's performance with examiner support in producing behaviors suggesting joint attention (i.e., tracking, gaze toward an object or an adult, scanning between objects, scanning an object and adult, and TG).

Results—Results demonstrated differences among children during the DA via a DA score and a behavioral profile. Further, these results were predictive of differences among children in subsequent learning of TG.

Conclusions—These data support the validity of DA for describing heterogeneity among young children with severe disabilities who look similar on static assessment but appear differently ready to learn behaviors associated with joint attention. This knowledge will assist clinicians in planning more efficacious services for young children who struggle to communicate and are at risk for extended therapeutic needs.

Purpose

The purpose of this research was to examine dynamic assessment (DA) as a tool for assisting speech language pathologists (SLP) to better understand the heterogeneity of young children (10–24 months) with severe disabilities when planning early communication intervention. This study focused on triadic gaze (TG) as an important behavioral manifestation of coordinated joint attention (CJA), a critical milestone in social communication development. Specifically this study explored the validity of DA for predicting progress in learning behaviors indicating CJA, specifically TG.

Joint Attention – Foundation of Early Learning

During the first six months of life, children's learning is built upon a foundation of joint attention during social interactions with their caregivers (Mundy & Acra, 2006; Mundy & Newell, 2007; Tomasello, 1999). Joint attention is a cognitive construct that assumes the child and adult are sharing focus on the same objects and events in the environment,

including each other. The capacity to share attention and information with someone about an object, an event, an emotion, or an idea is fundamental to participation in most, if not all, human social interactions and social learning situations (Mundy & Acra, 2006). "Practice with joint attention in the first months of life is thought of as a major contributor to, rather than a product of, the development of social cognition" (Mundy & Newell, 2007, p. 272). Joint attention has also been shown to be highly predictive of later language development (Mundy & Gomez, 1998; Mundy, Sigman & Kasari, 1990). During this early period of life, joint attention is manifested behaviorally by gaze, gestures, and vocalizations, which begin as single behaviors directed towards caregivers and gradually develop into coordinated behaviors linking objects and people in the environment.

Earliest behavioral manifestations of joint attention are apparent in shared gaze between caregiver and child. As early as five months, children can follow the gaze of their caregiver (Meltzoff & Brooks, 2009). As the child develops, he/she will expand gaze to include objects within a social interaction with an adult. Looking separately at adult or object (dyadic gaze) gradually becomes paired with gestures and vocalizations (Trevvarthen & Aitken, 2001). As children engage with people and objects in their environment during the first six months of life, they are learning essential cognitive concepts, including knowledge of self, differentiating self from others, and knowledge of objects (Piaget, 1954). They are also learning critical social cognitive concepts, including sensitivity to others' intentions, and the rewarding value of sharing with others (Trevvarthen & Hubley, 1978; Trevvarthen & Aitken, 2001). Bates and her colleagues (Bates, Camaioni & Volterra, 1975) have argued that this early period of development consists of behaviors that may be intentional as actions, but preintentional as communicative signals. She calls this the perlocutionary phase of development; Trevvarthen (1979) has labeled it primary intersubjectivity. A transactional perspective on development (Sameroff & Fiese, 1990) suggests that caregivers take on the role of natural teacher, manipulating the environment and contingently responding to their children's early gestural and vocal behaviors, facilitating the development of underlying concepts, which leads toward intentional communication (Dunst & Lowe, 1986; Kublin, Wetherby, Crais, & Prizant, 1998).

A pivotal point in development occurs around 9 months of age as children produce gaze behaviors that indicate their attention is moving from a focus on objects or adults separately to linking the two in coordinated joint attention (CJA). These new behaviors suggest an ability to integrate attention between a social communication partner and an object or event in the environment (Adamson & Chance, 1998; Bakeman & Adamson, 1984; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Trevvarthen & Hubley, 1978). At first coordinated looking is fleeting, but gradually it becomes more persistent and is combined with vocalizations and gestures. Bates et al. (1975) argue that children's ability to demonstrate behaviors suggesting CJA marks the emergence of intentional communication, which she has called the illocutionary phase of communication development. Trevvarthen has identified this milestone as secondary intersubjectivity (Trevvarthen & Hubley, 1978), and Dunst and Lowe (1986) have used the term "triadic gaze" to describe the back and forth, coordinated shift in gaze between object and adult. Following Piaget (1954), children's behaviors reveal knowledge of object relationships including means-end and knowledge of self and others as agent (Olswang & Carpenter, 1982a,b; Trevvarthen & Aitken, 2001). Mundy and Acra (2006) describe the emergence of CJA as reflecting a child's growing ability to monitor, relate, and integrate the behavior of self and others. As children demonstrate behaviors linking objects and people, their communicative intentions become clearer and their interactions become increasingly more successful. Behaviors of CJA, including shifts with gestures and vocalizations, contribute to the development of contingent communication between baby and caregivers (Dunst, Trivette, Raab, & Masiello, 2008). Importantly, this behavioral change is also associated with significant neurological

development in the infant (Mundy & Newell, 2007). The social and communicative achievements during the first year of life that surround joint attention are monumental, clearly establishing a robust foundation upon which later learning is built.

Impact of Severe Disabilities

For young nonspeaking children with severe disabilities such as cerebral palsy, congenital conditions, and genetic syndromes, development of joint attention can be severely disrupted both by child behavioral limitations and caregiver challenges in recognizing and responding to early signals. These children comprise a diverse clinical group whose early development can be affected by impairments across sensory, motor, cognitive, and social domains. Additionally, fragile health, seizures, and/or feeding difficulties may threaten survival. Some children may exhibit sensory impairments including hearing and vision deficits, perhaps exacerbated by oculomotor problems, such as nystagmus or divergent gaze (Dowden & Cook, 2002). Many children exhibit significant motor impairments, often characterized by hyper- or hypo-tonicity. These problems can interfere with head and trunk control, or result in a general lack of affect as exhibited by limited facial expression. Some young children with severe disabilities have concomitant cognitive impairments interfering with their development; however, appraisal of cognitive abilities is frequently complicated by the overlay of motor involvement and sensory problems. Many of these children exhibit difficulty with producing conventional gestures and vocalizations; gaze may or may not be a part of a child's behavioral repertoire, and when present, may not be easily recognized and responded to by caregivers (Pinder & Olswang, 1995). These behavioral limitations often result in the production of idiosyncratic signals as children attempt to interact with their caregivers, and may interfere with the development of more conventional communication forms. The motor and sensory challenges facing these children may reduce or prevent exploration of the environment, including interactions with others, which in turn likely threatens cognitive and social development. Behavioral restrictions make inferring joint attention a challenge, and even more significantly, may disrupt the development of this construct, which could negatively impact future learning.

The need for early intervention is crucial for young, nonspeaking children with severe disabilities (Arens, Cress, & Marvin, 2005; Goossens' & Crain, 1987; Paparella & Kasari, 2004; Pinder, et al., 1993; Pinder & Olswang, 1995; Reinhartsen, 2000; Wetherby, Yonclas & Bryan, 1989; Woods & Wetherby, 2003). For those children who have adequate vision but are constrained by motor and other sensory limitations, gaze is viewed as an important conventional signal of communication to target in treatment (Woods & Wetherby, 2003; Wetherby et al., 1989; Pinder, Olswang, & Coggins, 1993; Pinder & Olswang, 1995; Olswang, Pinder, & Hanson, 2006). This is particularly true for children who may later require augmentative and alternative communication strategies (Goossens' & Crain, 1987). While the need for early intervention is clear, the challenge lies in designing treatments tailored to individual child characteristics and needs.

Planning Early Intervention: Dynamic Assessment

As with any clinical population, planning intervention requires valid and reliable assessments for accurately describing a child's behaviors, both those in his/her current repertoire and those that can be produced with adult assistance. At the same time, we need assessments that will provide guidance about ways to optimize a child's learning. Static assessments, including norm-referenced and criterion-referenced tests, are designed to document a child's habitual level of functioning without adult assistance. These assessments evaluate the acquisition of major developmental milestones relative to a peer group. Such information is useful for qualifying a child for services and supports decisions about the

classification of performance relative to diagnoses. However, static assessments are not designed to examine the learning process or barriers to performance, including locus of control, motivation, frustration, accessibility to teaching strategies, etc. (Tzuriel, 2000). The shortcomings of static assessments are magnified for children with severe disabilities. Standardized testing procedures may result in low levels of performance that conceal underlying competencies and lead to misjudgments about abilities. Furthermore, static assessments do not provide information reflecting learning potential for behaviors that may be acquired more slowly or demonstrated in idiosyncratic ways. By design, these assessments will not provide the kinds of prescriptive information that clinicians need as they consider intervention options.

In contrast, dynamic assessment (DA) is designed to fill many of these gaps by documenting a child's optimal level of functioning when provided with adult assistance (Feuerstein, Rand, & Hoffman, 1979; Lidz, 1983; Tzuriel, 2000). DA is built on Vygotsky's (1978) theory that one can predict prospective learning by identifying a child's "zone of proximal development", the distance between a child's independent performance (actual) and his/her performance when assisted by others (potential). DA incorporates deliberate and planned teaching into the assessment process, and examines the results of that teaching on the learner's performance under optimal conditions (Haywood & Tzuriel, 2002; Tzuriel, 2000). Further, DA reveals the amount of examiner effort needed to bring about child change (Peña, 2000). Observing a child's performance with adult assistance suggests underlying competencies in the child, reflecting potential to learn the skill or behavior being assessed (i.e., learning potential) (Kozulin, 2011). This is based on the perspective, as offered by Vygotsky (1978) and others, that learning occurs within periods when the child is sensitive to external input that serves to shape and nurture change (Feuerstein, et al., 2010; Feuerstein, et al., 1979; Rogoff, 1990; Rogoff & Wertsch, 1984; Wertsch, 1985). For this reason, DA may be especially powerful when evaluating young children with severe disabilities, who often face barriers to performance as a result of motor and sensory limitations (Crais, 2011).

DA has a threefold significance for planning intervention. By evaluating a child's responsiveness to adult assistance, a clinician can obtain information about: a) a child's immediate potential to benefit from procedures designed to facilitate learning of a target behavior, b) behaviors considered precursors to the target behavior, and c) specific procedures that are more or less successful at removing barriers and enhancing performance. When assessing a young child with severe disabilities who is considered a preintentional communicator, the speech-language pathologist (SLP) can implement DA procedures to evaluate the child's current behaviors that are possibly communicative, whether conventional (e.g. gaze, gestures and vocalizations) or idiosyncratic forms (e.g., arching the back). DA will also provide information regarding a child's potential to use behaviors that are not in his/her repertoire, such as shifting gaze between objects and people as a manifestation of CJA. Further, DA can demonstrate the specific strategies that are successful for eliciting these behaviors. For example, procedures utilizing tactile prompting to accompany visual and verbal prompts may help shape a child's reaching as he/she gazes between object and adult.

Implementation of DA procedures can vary depending upon one's conceptual framework. The traditional DA approach, referred to as a "mediated learning experience", involves the examiner using procedures that are designed to stimulate cognitive and socioemotional capacities assumed to enhance learning. Procedures may include focusing the child's attention, assisting the child in discovering meaning, regulating the child's behaviors and encouraging planning, and rewarding the child's efforts (Feuerstein, Rand, & Hoffman, 1979; Klein 1997). The delivery of DA procedures is tailored to the child and the task, simulating natural socio-cultural learning as la Vygotsky (Rogoff, 1990). Learning potential

is typically measured by examiner effort and child responsiveness, including the ability to transfer performance to new tasks (Tzuriel, 2000; Peña, 2000). Campione (1989) and colleagues (Ferrara, Brown, & Campione, 1986) offer an alternate approach to DA. Their “graduated prompt” approach involves the examiner delivering predetermined prompts, structured from general to specific, to scaffold a child’s performance toward successful completion of a task. The type and amount of scaffolding needed to yield desired performance is taken as a measure of examiner effort. When this information is combined with child responsiveness to prompts and ability to transfer skills, the results suggest the child’s learning potential and modifiability (Kozulin, 2011). Both the MLE and graduated prompt approaches can inform intervention planning, specifically in regards to a child’s potential to learn specific behaviors when supported by particular teaching strategies.

A small number of studies have researched DA principles for assessing prelinguistic communication in young children with disabilities. Letto, Bedrosian and Skarakis-Doyle (1994) demonstrated the use of structured prompts to elicit and enhance prelinguistic communicative initiations of a young child with cerebral palsy during interactions with an adult partner. This case study documented the child’s progression through his current zone of proximal development. Their data revealed the child’s learning potential as measured by the difference in nonverbal initiations without adult assistance at baseline (0% initiations) and with adult assistance during the initial DA session (30% initiations). Their data also suggested transfer of learning as documented by the child’s initiations of different communicative behaviors to express a variety of communicative functions during the 10-month longitudinal portion of the study (Letto et al., 1994). Snell (2002) provided case examples for two children and one adult with complex communication needs to illustrate how DA can be used to examine learner and partner skills, along with environmental factors that facilitate performance. The results of this pilot work suggested that DA procedures can be applied to learners who are nonsymbolic or preintentional in their communication to reveal more accurate descriptions of abilities. The outcomes of the DA appeared to be useful for identifying the participant’s needs, as well as providing examiners a better perspective on learning potential. These studies along with the theoretical perspective offered by Feuerstein and others (1979, 1981) offer support for the application of DA to the assessment process for preverbal individuals with severe disabilities. The unique characteristics of this population challenge our ability to assess the construct of joint attention because associated behaviors such as gaze, gestures, and vocalization, are difficult to recognize and interpret, particularly using static assessments. DA can not only serve to help identify the behaviors in a child’s repertoire, but also offer insight as to his/her potential for learning more conventional forms.

Given the challenges facing young children with severe disabilities in producing behaviors suggesting joint attention, intervention targeting gaze is widely accepted and highly advised for achieving social communication connections (Arens, Cress & Marvin, 2005; Goossens’ & Crain, 1987; Paparella & Kasari, 2004; Pinder & Olswang, 1995; Reinhartsen, 2000; Wetherby et al., 1989). Such intervention has been shown to be successful (Pinder et al., 1993; Pinder & Olswang, 1995). The research has demonstrated that young children with severe disabilities can learn to use gaze (with or without gestures and vocalizations) to request the continuation of a discontinued action, and to make a choice between objects. Further, the research has documented the progression from dyadic to triadic gaze, and concomitant increases in object play behavior (Olswang & Pinder, 1995). While all of the children in these studies showed change in acquiring gaze as a communicative form, variation across children was striking. Arguably, the different degrees of success resulted from a number of factors, in particular the extent of motor and sensory impairments, and possibly underlying cognitive impairments. To maximize treatment outcomes for children with complex profiles, treatments should be individualized within frameworks of validated

protocols (Embry & Biglan, 2008). DA can inform clinicians about behaviors in a child's repertoire that would be expected to change and the child's responsiveness to adult assistance under ideal conditions, thus providing valuable information for maximizing treatment outcomes.

Research Focus

This study served as a preliminary investigation of the validity of DA for discriminating differences among young children with severe disabilities regarding their potential for learning specific gaze behaviors that suggest the capacity for joint attention. A DA based on mediated learning experience and graduated prompt approaches was implemented to document children's abilities to produce visual tracking, dyadic gaze to an object or an adult, scanning between objects, scanning between an object and an adult, and ultimately triadic gaze (TG) with or without gestures and vocalizations. We hypothesized that the DA results would more accurately document differences in performance among the children in the production of all behaviors suggesting joint attention over static assessment (evidence of construct validity). Further, we hypothesized that the children's differential performance in DA, described by a DA score and behavioral profile, would predict TG learning as a manifestation of CJA during a subsequent intervention (evidence of predictive validity). Specifically, the following questions were addressed:

1. Do children who perform similarly on a baseline static assessment of TG productions perform differently during a DA using procedures designed to elicit TG and other behaviors suggesting joint attention?
2. Do performance differences during DA predict TG acquisition, as measured by comparing percent TG produced during DA to peak percent TG productions measured during the treatment phase?

Method

General Procedures

This research was part of a larger study at the University of Washington Child Language Research Laboratory that investigated the efficacy of a treatment for teaching TG as a manifestation of CJA to children 10–24 months of age with severe disabilities characterized by motor impairments. The children's motor involvement likely impacted development of clear, predictable gestures and vocalizations and thus made them good candidates for learning gaze as a conventional and reliable communication signal. The current research is a retrospective study of a subgroup of children who participated in a DA prior to being enrolled in treatment, comparing data from the DA to progress made during treatment. Children were recruited from birth-to-three centers in the Seattle area. Initial static assessments to determine eligibility for the study included standardized testing and a baseline measurement of each child's actual (unassisted) performance of TG during approximately 25 structured opportunities to communicate with an adult. A DA was then conducted to determine potential levels of performance with adult assistance in the children's production of gaze behaviors suggesting joint attention. Following the DA, children received treatment designed to teach TG as a manifestation of CJA for approximately 16 weeks. They also participated in static measurement sessions every three weeks throughout the treatment phase of the study. Figure 1 illustrates the three major phases of the study.

Participants

Six children qualified for enrollment based on meeting the following criteria during initial standardized testing conducted by an SLP: a) age between 10 and 24 months, b) moderate to severe motor delay as measured by a motor composite score of ≥ 2 standard deviations below the mean on the *Bayley Scales of Infant and Toddler Development, Third Edition (BSID-3)* (Bayley, 1993), c) adequate vision measured by passing 5 of the first 7 items on the *Visual Reception Subtest* from the *Mullen Scales of Early Learning (MSEL)* (Mullen, 1995), d) adequate hearing judged by passing 4 of the first 6 items on the *Receptive Language subtest* from the *MSEL* (Mullen, 1995) coupled with behavioral observation consistent with functional hearing, and e) English sufficiently spoken by the primary caregiver to read and sign the consent form and engage with the SLPs during measurement and treatment sessions. During testing children had to show evidence of interest in toys and people, as revealed through change in muscle tone, facial expression, vocalization, and/or direction of gaze. In addition, children had to be at the preintentional stage of communication development as defined by demonstrating $>80\%$ dyadic gaze (i.e., sustained gaze to adult or object) and $<20\%$ triadic gaze between adult and object during the baseline measurement session. Table 1 provides descriptive information for each child per caregiver report and qualifying standardized test scores at the time of enrollment.

The previously described eligibility criteria were used to ensure homogeneity among the participants on the basis of static assessment. In the motor domain, all of the participants demonstrated delays, most with abnormal muscle tone (either hypo- or hypertonicity) or choreic movements. None of the children were walking independently; most were not sitting independently. Except for Child #4, all of the children had fine motor involvement, resulting in difficulty manipulating toys. In addition, all of the children evidenced some type of sensory challenge, including hyper- or hyposensitivity to sensory input (e.g. sounds, textures, light).

The eligibility criteria were also designed to achieve homogeneity in expressive communication development among the children. Despite the variety of diagnoses, all of the children could be characterized as preintentional communicators on the basis of the baseline assessment described above. Specifically, they displayed intentional behaviors (e.g. looking at an object or adult) but did not use these behaviors explicitly to communicate with an adult as a means to an end.

Ensuring homogeneity in terms of receptive language and/or cognition is much more difficult in this population, even using the relevant subtests of the *BSID* and *MSEL*. When these tests are used with very young children, receptive language and cognition are assessed by asking the child to physically act upon the environment. According to DeVenez, Hoffman, & Cress (2012), children with limited hand and arm control cannot complete 70% of the test items on the cognitive scale of the *BSID*, regardless of their underlying language and cognition. While children with motor and sensory impairments could certainly have delays in language and/or cognition, these tests cannot examine those underlying skills independent of motor control. Five of the six children in our study had such poor hand control that the receptive language and cognitive test results reported (see Table 1) cannot be considered informative.

Finally, as described in Table 1, two of the children were from multi-lingual households. Following the American Speech-Language-Hearing Association's position statement for "Clinical Management of Communicatively Handicapped Populations," the research team considered language differences as they might impact assessment and treatment for the children (American Speech-Language-Hearing Association, 1985). Prior to enrollment, families were queried about language use and preferences in the home and with their birth-

to-three service providers. Interpreter services were offered to all families of multi-lingual households through their birth-to-three centers. The parents of Child #1 indicated English was the primary language spoken to each other and to the child. They estimated that exposure to Spanish or Norwegian occurred 2–3 hours per week directly to the child or between adults in the presence of the child. They also indicated their child heard music from other languages approximately 5 hours per week. The parents requested that the research procedures be conducted in English. Child #5 lived with her foster family from approximately three months of age. The foster family, with whom this research was conducted, spoke English to the child. Her biological parents spoke Spanish during their approximately two-hour weekly visits with the child. All multi-lingual caregivers spoke English to the SLPs and in the presence of their children during research sessions.

Session Procedures

DA session—The DA was administered by a different SLP than those who administered the static assessment, conducted the measurement probes, or provided treatment. This SLP, the third author, had over 25 years experience working on an interdisciplinary team with young children with severe disabilities and had been involved in previous research designed to teach behaviors associated with joint attention. Following the static assessment, the DA was administered within a separate 20 – 30 minute play session, typically in the home. The DA started by observing the child with his/her caregiver. The caregiver described the child's favorite toys and reactions to sensory input (e.g., whether particular stimuli were pleasant or irritating for the child). This information was used to incorporate materials that were appropriate and interesting to each child in the DA. In consultation with caregivers, the SLP observed which toy characteristics (e.g., color, lights, sounds) were most effective in securing the child's attention and used those to facilitate engagement. The caregiver also assisted with positioning as needed, including adapting seating (e.g., using foam inserts) to maximize alignment and postural stability for play. Once positioning was established, the SLP initiated play that included structured communication opportunities.

The SLP provided opportunities for the child to request an object (e.g., a toy) or an action with a toy, or to choose between two toys. Opportunities were designed to elicit child behaviors suggesting joint attention (i.e., gaze, gestures and vocalizations), including TG as an exemplar of CJA. In structuring the opportunities, the SLP considered how toys were presented, including rate of presentation and distance from the child. At the start of each opportunity, the SLP demonstrated the toys that were being offered to the child, held them up and asked one of two elicitation questions: "Do you want more?" or "Which one do you want?". The elicitation question was followed by approximately 10 seconds of wait time, giving the child sufficient time to respond. This wait time allowed the SLP to assess the child's ability to produce any of the gaze behaviors without assistance.

During each opportunity the SLP gradually added support to progressively scaffold the child's behaviors toward TG. Behaviors included tracking object movement, sustaining dyadic gaze to an object or adult, scanning between objects, scanning between an object and an adult, and ultimately producing TG. For example, if the child sustained gaze (dyadic) to one toy when two were presented, the SLP prompted the child to shift gaze between the toys (scanning between objects). Similarly, if the child sustained gaze to a toy to request more action upon that toy, the SLP prompted the child to shift gaze toward her (scanning object-adult), to demonstrate the link between object and adult. Scaffolding included the delivery of verbal, visual, auditory and tactile prompts. Prompts were provided in a graduated manner following Campione (1989), starting with one prompt (e.g., verbal) then adding additional prompts (e.g., visual, auditory, and/or tactile) as appropriate. Table 2 provides examples of graduated prompting implemented in this DA. Given the children's individual strengths and

motor and sensory challenges, the SLP was encouraged to tailor her scaffolding procedures to match each child's responsiveness to different prompt modalities. Further, following Klein (1997; Klein & Hunsdale, 1996) and a mediated learning experience approach, the SLP attempted to focus the child's attention, show excitement, provide meaning to objects and events, and help the child plan before acting. These DA procedures assisted the child in experiencing the connection between adult and object, by modeling and scaffolding behaviors that demonstrated the adult as a means to an end.

Treatment sessions—The treatment sessions were designed to teach TG as an exemplar of CJA. These sessions occurred for approximately 30 minutes, twice per week over a 16 – 18 week period. Treatment was conducted by one of three certified SLPs who had 2 to 8 years' experience working with children with severe disabilities. None of these SLPs participated in the static assessment, DA, or measurement sessions. While the structure of the treatment sessions mirrored the DA procedures, treatment was designed and implemented independent of the DA results. The treatment included the following core elements: provide opportunity, wait, recognize and respond to child's behavior, and scaffold behaviors to TG. Responding to the child's behavior included delivering the desired toy and playing. Play was an important aspect of treatment, as it was designed to reinforce the child's communicative attempt and to facilitate development of underlying cognitive concepts, particularly means-end relations. Treatment sessions took place in the children's homes, thus caregivers had the opportunity to observe the therapy. Caregivers were also given an educational manual with information about early communication, the importance of gaze, and a description of the treatment. Caregivers were never directly instructed on therapeutic techniques.

Measurement sessions—To monitor children's progress in the development of gaze behaviors suggesting joint attention and CJA, measurement sessions were conducted approximately every three weeks during the course of the study. This included a baseline measurement as part of the static assessment to determine actual, unassisted production of TG. Measurement sessions were conducted primarily in the child's home by an SLP who did not administer the DA or treatment. During these sessions, the measurement SLP engaged the child in play and mimicked the core elements of the DA and treatment protocols (i.e., providing clear opportunities, waiting and responding to the child's behaviors), with the exception of scaffolding. These sessions were designed to sample child behaviors without adult assistance. Each session included approximately 10 choice opportunities, 10 request opportunities, and 5 comment opportunities. Choice and request opportunities are described above. Comment opportunities included the SLP introducing a toy that might elicit an acknowledgement from the child, such as a novel toy or an unexpected sound.

Data Collection and Reduction

DA session—Each child's DA session was videotaped for later review. Data were coded by the first two authors of this paper. Ten consecutive opportunities during which the child was engaged with (i.e., attending to) the toy or SLP were sampled for coding. Sampling was meant to ensure data were collected on opportunities that reflected optimum performance by the child. Start and stop times were identified for each opportunity. An opportunity began when the DA SLP delivered an elicitation question (e.g., "Do you want more?" or "Which do you want?") and waited expectantly. An opportunity ended when the SLP acknowledged the communicative behavior and engaged the child in play with the desired toy. Data collection started with identifying the opportunity type (choice or request) and toys that were used (see Appendix A: DA Data Collection Form). For each opportunity, the observer identified the occurrence of the following six gaze behaviors: visually tracks objects, dyadic gaze to an object or an adult for at least three seconds, scans between two objects, scans

between object and adult or adult and object, and triadic gaze between object-adult-object or adult-object-adult.

For each behavior coded on the DA Data Collection Form, the observer noted if the behavior was **spontaneously** produced or **scaffolded**. Behaviors were considered **spontaneous** if they were produced during the 10-second wait time after the elicitation question but before scaffolding by the SLP. No prompting was provided beyond the initial elicitation (i.e., question + waiting). Elicitations were presented naturally in the context of play; thus the child's response to this presentation was defined as a spontaneous production. **Scaffolded** behaviors required some type of prompt to elicit the behavior from the child. Finally, if a behavior was scaffolded, an overall judgment was made about the **degree of effort** (minimal or maximal) required by the SLP in assisting the child. Minimal effort was defined as providing one prompt following the initial elicitation question, resulting in the child's relatively quick response. Maximal effort was defined as the need to: a) repeat a prompt, b) combine prompts (e.g., verbal, visual + tactile prompts), and/or c) wait a significant amount of time for the child's delayed response.

Data from the 10 opportunities recorded on the DA Data Collection Form were transferred to the DA Data Reduction Form for scoring (see Appendix B). Point values were given for each of the six gaze behaviors, on a scale of 0 – 6. The scoring utilized a criterion-referenced approach, in which each of the behaviors was noted as occurring spontaneously or scaffolded, once or more than once, and with minimal or maximal SLP effort required. Point values for the calculation of the DA score and descriptions of performance are listed in Table 3.

Points for each behavior were totaled as a DA score that ranged from 0–36 for each child. The range of numbers reflected the capacity to produce behaviors associated with joint attention, with higher numbers reflecting a greater capacity (i.e., more spontaneous performance/less scaffolding required) than lower numbers. The children were first rank ordered by score and then profiles of performance were created. Profiles reflected the child's ability to produce gaze behaviors with varying degree of independence (described further under Data Analysis).

Measurement sessions—All measurement sessions were videotaped for later review. Each video was coded by at least two graduate students (one primary and one reliability coder) in the Department of Speech and Hearing Sciences at the University of Washington. A total of six graduate students participated in the coding over the course of the study. Data were coded directly from videos using The Observer XT 7.0 event logging software (Noldus Information Technologies). For this research, spontaneous productions of TG served as the primary dependent variable; however, since this research was part of a larger study, these videos were coded for all dyadic, scan and triadic gaze behaviors with and without gestures and vocalizations. Interobserver agreement was examined on the more inclusive set of behaviors. The occurrence of TG per opportunity was counted and percent productions calculated per measurement session. Each child's peak percent TG reflected optimal performance and was used to examine progress during the treatment phase of the study.

Procedural and Measurement Reliability

Reliability was judged for the fidelity of implementation of the DA, treatment, and measurement procedures. Following Billingsley, White and Munson (1980), templates were created that identified the core elements for each type of session. In all cases, these elements included providing opportunities, waiting, recognizing and responding to the child's signals, and in the case of the DA and treatment, scaffolding the children's responses toward TG. For DA sessions, at least 10 clear opportunities were required (requesting or choosing); for

the measurement session, at least 15 opportunities were required (5 each for requesting, choosing and commenting). Actual delivery of core elements were examined for approximately 10% of each type of session across children and shown to be between 92–100% accurate.

Measurement reliability consisting of interobserver agreement was examined for gaze behaviors during the DA and measurement sessions. (Note: no data were collected nor reported for performance during delivery of treatment for this research.) For the DA measures, 50% (3 of 6) of the children's videotapes were independently coded and scored by two observers (first two authors of the manuscript). Point-by-point agreement in coding each of the six gaze behaviors per opportunity was examined. Of the three videotapes independently coded, results indicated 91% point-by-point agreement between observers. When disagreements were noted, actual coding was examined, errors were corrected, and disagreements were left unchanged. Measurement session data were examined for interobserver agreement in coding gaze with and without gestures and vocalizations for all children. Two independent observers coded 85% (35/41 sessions) of the total measurement sessions for the six children. Cohen's kappa (1960) was calculated for each session, which ranged from .61 to .87. Using guidelines by Cicchetti & Sparrow (1981), kappa values of 0.60 – 0.74 are judged as good agreement, and 0.75 as excellent. Only 4 of the 35 sessions (11%) yielded kappa <0.70. These videos were re-examined; errors in coding were corrected and disagreements were left unchanged. When errors were corrected, all kappa values were >0.75.

Data Analysis

Data were initially analyzed to reveal actual and potential levels of TG performance. Actual performance was determined by calculating percent TG produced during 10 opportunities in the baseline measurement session, prior to administration of the DA. Potential performance was determined by calculating a DA score for each child, as described above. Based on the logic that the DA score provides a “snapshot” of how a child is likely to perform during extended treatment, the score was used to rank order the children in order of their potential to learn TG as an exemplar of CJA. The highest DA scores would indicate the greatest potential for change in producing TG; the lowest DA scores would suggest least potential for change in producing TG. This rank ordering was done prior to examining each child's TG measurement data (i.e., the authors were blind to each child's peak TG performance). In addition, a behavioral profile of performance during the DA was created for each child. The profile supplemented the DA score, providing a description of gaze behaviors associated with joint attention that the children were able to produce either spontaneously or with scaffolding. The profile was created by calculating percent production of each of the six gaze behaviors (tracks objects, dyadic gaze to an object or an adult, scans between two objects, scans between object and adult, and triadic gaze).

The second level of analysis compared performance during the DA, as suggested by the DA score and behavioral profile, to progress made in the production of TG during subsequent treatment. Progress was judged by peak performance in TG production during measurement sessions, as described above. Spearman rank correlations between each child's DA score and peak production of TG were calculated to examine this relationship. This analysis was supplemented by a closer examination of the DA results (DA score and the behavioral profile) in relationship to each child's progress in learning TG during treatment.

Results

Construct validity

The first research question asked whether children who perform similarly on a baseline static assessment of TG productions perform differently during a DA using procedures designed to elicit TG as an exemplar of CJA, as well as other behaviors more broadly suggesting the capacity for joint attention. Table 4 displays the results of each child's performance: a) at baseline static assessment, b) during DA, and c) peak TG production during treatment. Children are rank ordered in Table 4 by DA score.

As can be seen in Table 4, all the children produced a limited number of TG behaviors during baseline static assessment, when no SLP assistance was provided. Percent TG produced at baseline ranged from 0% to 12% in 25 opportunities. Percent TG produced during DA, when SLP assistance was provided, ranged from 0% to 30% in 10 opportunities. All but one child (#5) demonstrated an increase in percent TG at static assessment compared to DA.

The DA Behavioral Profile in Table 4 reports percent productions of additional gaze behaviors associated with joint attention. Shading indicates the degree of SLP assistance required to elicit any given behavior. The following results highlight children's performance by behaviors as presented in each column of Table 4. All children demonstrated tracking of objects (Tr) and dyadic gaze to objects (DyO). This was not the case for dyadic gaze to adult (DyA), where three children (#2, #4, #5) were unable to produce DyA even with assistance. Five children (#3, #1, #2, #4, #5) were able to scan objects (ScO) spontaneously, and one (#6) was able to do so with SLP assistance. These data suggest the children had the capacity to focus on objects. Three children (#3, #1, #2) were able to produce scan between adult and object (ScA) spontaneously, and two children (#6, #5) were able to do so with SLP assistance. One child (#4) was unable to produce ScA, even with SLP assistance. Only one child (#3) produced TG spontaneously; four children (#1, #6, #2, #4) produced it with SLP assistance. One child (#5) was unable to produce TG even when SLP assistance was provided. Overall, three children (#3, #1, #6) produced *all* behaviors associated with joint attention, including TG, either with or without SLP assistance.

Finally, to examine variability in performance as suggested by DA performance, the second to last column in Table 4 presents each child's DA score. DA scores ranged from 17 – 31 ($M = 23.67$, $SD = 5.47$). Children with the highest DA scores (#3, #1, #6) produced all gaze behaviors associated with joint attention, including TG, either spontaneously or when provided with SLP scaffolding. The child with the lowest DA score (#5) demonstrated difficulties producing a range of gaze behaviors, most notably not benefitting from adult scaffolding for the production of gaze to adult and TG. These data, as captured in the behavioral profiles and the DA score, illustrate that the DA was useful in capturing the variability among the participants in producing TG and related gaze behaviors when adult assistance was available.

Predictive validity

The second research question whether DA performance predicted TG acquisition during the treatment phase. First, the DA score was compared to percent TG produced at the peak measurement session during the treatment phase. These data are presented in Table 4. Recall, DA scores ranged from 17 to 31 ($M = 23.67$, $SD = 5.47$). Percent TG produced at peak measurement session during the treatment phase, as shown in the last column in Table 4, ranged from 10% to 52% in 25 opportunities ($M = .37$, $SD = .16$). Using a Spearman rank correlation, a strong, positive relationship ($r = .81$, $p < .05$) was found between the DA score

and peak performance of TG. In this sample, children who ranked higher based on DA score produced a higher percent TG at peak measurement session during the treatment phase.

Next, using the behavioral profile in combination with the DA score, children's DA performances were examined with respect to learning TG. As illustrated in Table 4, the child with the highest DA score produced the most TGs in treatment, and the child with the lowest DA score produced the fewest TGs. As noted previously, three children (#3, #1, #6) produced all gaze behaviors associated with joint attention, including TG as a signal of CJA, either spontaneously or when provided with SLP scaffolding. These children also achieved the largest peaks in TG productions during the treatment phase (52%, 42% and 50%, respectively). One child (#5) had difficulty producing gaze behaviors associated with joint attention, either spontaneously or with scaffolding; this child also achieved the lowest peak in TG production during treatment (10%). The two children whose performance during the DA seemed less associated with their TG progress were Child #2 and Child #4. The absence of productions of dyadic gaze to adult, even with scaffolding, suggests something rather unusual in their profiles. However, they were able to produce TG with scaffolding, and subsequently move forward in learning to produce TG as reflected by their peak percent TG produced during the treatment phase (29% and 37%, respectively).

Discussion

Summary of Findings

This research was a preliminary investigation of DA as a tool for examining individual differences among children with severe disabilities that might inform early intervention for behaviors indicating joint attention. Static assessment describes a child's current, habitual level of functioning, but falls short in providing prescriptive information for planning intervention. DA procedures use examiner support as a means of revealing barriers to performance and discovering a child's underlying competencies. DA is designed to reveal individual performance differences among children and determine each child's learning potential for new behaviors and concepts. Specifically, this study examined the construct and predictive validity of DA as a way of discriminating children's potential for learning TG as a behavior suggesting the capacity for CJA, a critical milestone in the larger construct of joint attention.

Construct validity—Evidence of construct validity was demonstrated by examining whether the DA results would discriminate among children who performed similarly on a norm-referenced test of early development (i.e., the *BSID*) and a static measure of TG as an exemplar of CJA. The DA results were defined as a composite DA score and a profile of gaze behaviors associated with joint attention, including dyadic gaze to an object or an adult, scanning between objects, scanning between an object and adult, and ultimately TG. Results revealed that the DA score was useful in capturing variability among the participants in producing gaze behaviors related to joint attention, including TG, when adult assistance was available. While useful, the DA score alone did not capture the richness of information gathered through the DA. A profile of behaviors produced without and with adult assistance added descriptive information about children's abilities, which went beyond the DA score. Note for example, that two children (#6 and #2) received the same DA score, but exhibited different behavioral profiles. This descriptive information revealed important differences among the children not captured by static assessments or the DA score alone, as will be discussed below.

Predictive validity—Evidence of predictive validity was demonstrated by examining the DA score and behavioral profile in relationship to progress made in TG treatment. The data

showed that some children were more responsive to SLP scaffolding during the DA than others. Examining performance based on DA score alone reflected a significant correlation between DA performance and progress in treatment for TG. The more responsive to SLP support during the DA, the better the outcome in treatment. These results suggest that the DA score shows promise in discriminating differences among young children with severe disabilities who appeared similar on static assessment; however, the more revealing information came from the behavioral profiles. Breaking down the DA performance behaviorally created sharper distinctions among the children, which in turn suggested potential for learning TG and supported the predictive validity of DA. The individual profiles highlighted the heterogeneity among the children, shedding light on the nature of their impairments and providing information that could enhance intervention planning. We turn now to examining the behavioral profiles as a more comprehensive outcome measure for DA.

Heterogeneity and Implications for Planning Intervention

The behavioral profiles provided in Table 4 suggest varied strengths and challenges among the children that might have influenced the progress they made in treatment. The discussion that follows examines the differences among the children's behavioral profiles, relates these differences to the progress they made in treatment, and speculates about possible modifications that might have been made in intervention. Three patterns in DA performance emerged in this study when examining behavioral profiles along with DA scores. Three children (#3, #1, #6) responded successfully to structured opportunities and scaffolding to produce the six gaze behaviors that are associated with joint attention, including tracking objects, dyadic gaze to objects and to adults, scanning objects, scanning object and adult, and ultimately, TG. These children also demonstrated the highest peaks in TG performance. Perhaps the DA served to uncover the children's underlying abilities and capacities to understand and produce behaviors associated with joint attention that were being blocked by motor impairments. The DA may have served to remove barriers to performance, enabling the children to demonstrate their joint attention knowledge through gaze behaviors that increased in sophistication. Three children (#2, #4, #5) demonstrated less success with scaffolding. Of particular interest was their apparent avoidance of looking at the examiner during the DA, as shown by the absence of dyadic gaze to adult even with assistance. Their profiles were additionally surprising in that two of the children (#2, #4) demonstrated TG with scaffolding and went on to produce it during subsequent treatment. The third child (#5) was unable to produce TG during the DA, and in turn made very little progress in treatment. Their unique profiles begin to suggest developmental differences that might complicate conventional approaches to treatment, a point discussed below. (Of note, following participation in this research, Child #4 was diagnosed with autism spectrum disorder.) Of significance in this study is that the DA results (DA score + behavioral profile) highlighted differences among children that static assessments did not reveal. Further, the DA behavioral profile documented heterogeneity among the children, which appeared to be related to subsequent learning of behaviors related to joint attention. Young children with severe disabilities have many challenges in their development and many unknowns regarding underlying capacities for change; using a behavioral profile to sort through their strengths and weaknesses may be the first step in creating treatment approaches to yield optimal outcomes.

How does understanding heterogeneity contribute to planning intervention? Intervention requires decision-making regarding what and how to teach. "What" refers to long and short-term objectives of the treatment; "how" refers to teaching strategies. Understanding differences in child performance sets the stage for making these clinical decisions. DA results in this study reflected the heterogeneity among the children, highlighting differences

in their abilities to benefit from adult support. Furthermore, these differences appeared related to progress in treatment for learning TG, for most of the children. Thus, the DA provided information regarding both what and how to treat.

For children who were responsive to SLP scaffolding, the conclusion could be drawn that TG was an appropriate treatment objective; progress in treatment confirmed this for children #3, #1, and #6. For children who were less responsive to scaffolding during the DA, particularly for TG, perhaps different treatment objectives might have been selected. These children might not have been ready for TG, but rather needed to learn more fundamental joint attention behaviors (e.g., dyadic gaze to objects and adults, scanning objects, scanning objects and adults), which likely serve as “building blocks” to TG. Treatment might have been more effective by targeting these precursors as behavioral objectives en route to a more clear and conventional expression of coordinated joint attention (i.e., TG). In this study, participants #2, #4, and #5 showed gaps in their performance of dyadic gaze to adults even with adult assistance; perhaps their treatments might have started with this behavior as an objective. Further, child #5 did not produce TG during the DA, more dramatically suggesting the value of starting treatment with precursor behaviors. Such treatment would not only focus on behaviors, but on the underlying cognitive concepts that support joint attention. Treatment could highlight experiences to teach knowledge of objects and object relations, specifically others as agent and means to desired ends. This could be accomplished through play with toys, guiding exploration, while demonstrating and labeling relationships (e.g., retrieving a toy out of reach and describing the action). Such experiences would also enhance the child’s cognitive processes of attending, discovering meaning in actions, generalizing from one experience to another, determining what actions lead to success, and planning actions. By establishing a foundation of cognitive concepts, processes and behaviors, treatment to the next developmental milestone is likely to be more easily accomplished.

DA results can also be informative for making decisions concerning “how” to teach (i.e., individualizing teaching strategies). Here we refer to the value of DA in identifying the type of scaffolding that most successfully removes barriers to learning for children with severe disabilities. In this research, scaffolding was defined as the administration of multi-modality prompts (visual, verbal, auditory and tactile). Since this was a retrospective study, systematic delivery of these prompts was not manipulated in treatment. However, one could speculate that scaffolding prompts that appeared most successful during the DA could be translated into subsequent intervention. This would certainly be a benefit of DA procedures when administered to children with severe disabilities. Stating the obvious, intervention for early signals of communication may take many forms and focus on many learning objectives, using a variety of teaching strategies; matching these options with child needs is the heart of planning the most efficacious service.

Better planning in early intervention has powerful implications for treatment dosage and service delivery options. Arguably, understanding “what” and “how” to treat should result in more effective and efficient treatment outcomes, whether the treatment is delivered by clinicians or caregivers. Evidence indicates that interventions focusing on parent-child interactions (specifically, parent responsivity) are “most effective when they are timed to co-occur with expected child developments” (Brady, Warren, & Sterling, 2009, p. 14). This suggests that SLPs need to clearly advise caregivers on appropriate behaviors to emphasize during interactions with their children. Further, results of earlier work by Olswang et al. (2006) have shown that scaffolding children’s performances to TG is difficult for parents to learn, even when they are provided with direct instruction. This evidence suggests the importance of being able to clearly identify the behavioral objectives and the means by which to teach them.

Limitations

While this research has provided promising evidence regarding the application of DA for children with severe disabilities in regards to planning early intervention for teaching joint attention, several limitations must be highlighted. First, this study was retrospective in its design. The DA results were not known prior to the implementation of treatment, nor prior to the calculation of treatment outcomes. This blind analysis of data enhances our conclusions that the DA results (DA score + behavioral profile) were a valid predictor of progress made in treatment. However, the limitation of the retrospective design was that information obtained through the DA was not used in designing treatment. This prevented us from examining how DA could provide information regarding how to treat. Second, even though the influences of a multi-lingual environment did not appear related to results, we cannot rule out possible confounding effects, particularly for Child #5. Third, the DA procedures, though sensitive to identifying heterogeneity among the children, narrowly sampled communicative functions (e.g., behavior regulation in choice and request contexts) and scaffolding (i.e., types of prompts and the way in which they were administered). By building on the conceptual framework Feuerstein and others (Feuerstein et al., 2010; Tzuriel, 2000; Klein, 1997; Klein & Hundeide, 1996), and the graduated prompting research by Campione (1989) and colleagues (Ferrara et al., 1986) the DA could be refined to include other social communicative functions and strategies for removing barriers that are tailored to individual child characteristics. This will require a more systematic approach to the administration of SLP scaffolding. In addition, we would like to explore a DA that more directly focuses on underlying cognitive processes and concepts that support learning of joint attention. These additions would allow us to more closely adhere to Feuerstein's intent (2010) of using DA to reveal a child's capacity to learn how to learn.

Conclusions

Joint attention and social engagement are critical developmental accomplishments that are in extreme jeopardy for young children with severe disabilities. The need for early intervention is clear, yet designing optimum services in light of impairment severity and population heterogeneity remains a major challenge. This study has provided preliminary evidence regarding the validity of DA for just this purpose. The DA administration protocol and scoring procedures not only documented differences among children who appeared similar on static assessments, but served to predict subsequent progress in learning behaviors indicating joint attention. Implementation of DA in to practice could greatly assist SLPs in their decision-making about what and how to treat, which should maximize change and ultimately help inform service delivery options.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Phases of the Dynamic Assessment Study

Actual		Potential	16-Week Treatment Phase	
Eligibility Determination		Dynamic Assessment	Treatment (2x/week)	Measurement (every 3 weeks)
Standardized Testing	Baseline TG Measurement			
<i>BSID, MSEL</i>	Static TG Probe	Scaffold behaviors associated with JA	Scaffold to Teach TG	Static TG Probe
(Unassisted)		(Assisted)	(Assisted)	(Unassisted)

Note: BSID = Bayley Scales of Infant Toddler Development (3rd ed.); MSEL = Mullen Scales of Early Learning; TG = triadic gaze; JA = joint attention.

Figure 1.

	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6
Characteristics						
<i>Age</i>	11 mos. ⁺	14 mos.	19 mos.	20 mos.	22 mos.	24 mos.
<i>Gender</i>	Male	Female	Female	Male	Female	Male
<i>Racial/Ethnic Identity</i>	Caucasian	Caucasian	Caucasian	Caucasian	Not reported	Pacific Islander
<i>Language(s) in the Home</i>	English, Spanish, Norwegian	English	English	English	English, Spanish	English
<i>Household Income</i>	\$100,000 ⁺	\$50,000 – 59,999	No data reported	\$100,000 ⁺	\$50,000 – 59,999	No data reported
<i>Caregiver Education</i>	High School	2-Year College	4-Year College	4-Year College	High School	Graduate School
<i>Primary Diagnosis</i>	Down syndrome	Microcephaly	Unknown syndrome	Osteogenesis Imperfecta	TBI, Cerebral palsy	Chromosomal abnormality
<i>Complications</i>	Plagiocephaly, Feeding	Feeding, Respiratory	Seizures, Orthopedic differences	None	None	Infantile spasms
<i>Muscle Tone</i>	Hypotonia	Hypotonia	Hypotonia	Hypotonia	Tone WNL	Mixed tone
<i>Motor Abilities</i>	Independent sitting	Supported sitting	Independent sitting	Independent sitting	Supported sitting	Supported sitting
<i>Vocalizations</i>	Vocal	Minimally vocal	Minimally vocal	Vocal	Vocal	Vocal
<i>Gestures (Attempted)</i>	Reaching, banging	Reaching with one arm	Reaching, clapping	Reaching, pointing	Reaching, banging	Leaning forward
Standardized Test Scores^I						
<i>Cognitive</i>	85	55 [*]	55 [*]	90	55 [*]	55 [*]
<i>Language</i>	83 [*]	59 [*]	56 [*]	65 [*]	59 [*]	47 [*]
<i>Motor</i>	58 [*]	46 [*]	46 [*]	79 [*]	58 [*]	46 [*]

Note:

^I Language and motor = composite scores on the *Bayley Scales of Infant Toddler Development (3rd ed.)*

^{*} = performance below 85;

⁺ = tested on the *Bayley* at 8 months but participated in DA at 11 months of age.

Table 2**Graduated Prompting**

Modality	Prompt	Example
Verbal	Descriptive feedback	<i>"You're looking at the ball!"</i>
	Direct prompt	<i>"Look at me."</i>
Visual	Gaze intersect	<i>Move self and/or toy into child's line of vision</i>
	Manipulate toy	<i>Act on the toy in some manner (e.g., shake, press).</i>
Auditory	Non-speech vocalizations	<i>Click, whistle, and/or engage in vocal play.</i>
	Activate toy	<i>Turn on a musical or electronic toy.</i>
Tactile	Physical interaction	<i>Touching, tapping, jostling the child.</i>
		<i>Provide physical assistance for reaching.</i>

Table 3**Dynamic Assessment Scoring**

Point Value	Child Performance and SLP Scaffolding
6	Behavior produced spontaneously, more than once, without scaffolding.
5	Behavior produced spontaneously, only once, without scaffolding.
4	Behavior produced spontaneously, more than once, but only when scaffolded in previous opportunities.
3	Behavior produced spontaneously, only once, but only when scaffolded in previous opportunities.
2	Behavior produced only when scaffolded. Minimum effort is defined as one scaffolding cue provided within the opportunity.
1	Behavior produced only when scaffolded. Maximum effort is defined as multiple (more than one) visual, verbal, auditory, and/or tactile scaffolding cues are provided within the opportunity.
0	Behavior not produced, despite maximum scaffolding.

Table 4

Gaze Productions Measured Throughout the Study Period

	Static Assessment		Dynamic Assessment						Treatment	
			Behavioral Profile							
	Baseline	TG	Tr	DyO	DyA	ScO	ScA	TG	DA Score	Peak TG
Child 3	5%		100%	90%	50%	40%	30%	10%	31	52%
Child 1	4%		100%	40%	30%	30%	30%	10%	29	42%
Child 6	0%		100%	80%	30%	10%	20%	10%	23	50%
Child 2	12%		100%	70%	0%	10%	10%	20%	23	29%
Child 4	5%		100%	90%	0%	20%	0%	30%	19	37%
Child 5	4%		100%	90%	0%	30%	30%	0%	17	10%

Note: Percent behavior produced within opportunities at three points (baseline, DA, and measurement sessions); Tr = tracks moving object; DyO = dyadic (sustained) gaze to object; DyA = dyadic (sustained) gaze to adult; ScO = scans (looks between) two objects; ScA = scans (looks between) adult and object in a two-point gaze shift; TG = looks between adult and object in a three-point gaze shift; Dark grey = behaviors produced spontaneously; Light grey = scaffolded behaviors; White = behaviors not produced.