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Rating Parent-Child Interactions: Joint Engagement, Communication Dynamics, and Shared Topics in Autism, Down Syndrome, and Typical Development

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Abstract

A battery of 17 rating items were applied to video records of typically-developing toddlers and young children with autism and Down syndrome interacting with their parents during the Communication Play Protocol. This battery provided a reliable and broad view of the joint engagement triad of child, partner, and shared topic. Ratings of the child's joint engagement correlated very strongly with state coding of joint engagement and replicated the findings that coordinated joint engagement was less likely in children with autism and symbol-infused joint engagement was less likely in children with Down syndrome. Ratings of other child actions, of parent contributions, and of shared topics and communicative dynamics also documented pervasive variations related to diagnosis, language facility, and communicative context.

Keywords

Autism; Down syndrome; parent-child interaction; joint attention

Social interactions between young children and their caregivers are transformed repeatedly as the child acquires new skills. Two especially dramatic changes typically occur during infancy. First, as the infant's joint attention skills consolidate during the latter half of the first year, he or she begins to sustain episodes of joint engagement during which objects and events are shared with a social partner (Bakeman & Adamson, 1984). Then, as the child begins to master language, symbols start to infuse these episodes of joint engagement (Adamson, Bakeman, & Deckner, 2004), expanding their scope to include a focus on words and reference to events beyond the here and now (Adamson & Bakeman, 2006).

Early transformations in shared attention are emphasized in both classical developmental theories of symbol formation (e.g., Vygotsky, 1978; Werner & Kaplan, 1963; see Adamson, 1996), and in several contemporary accounts of language acquisition (e.g., Bruner, 1983; Nelson, 2008; Tomasello, 2004) and social cognition (e.g., Carpendale & Lewis, 2004; Reddy, 2008; Wellman, 2002). Recently, interest in variations in these transformations has intensified as mounting evidence documents that the emergence of joint attention may be delayed by developmental disorders such as Down syndrome and disrupted by autism (e.g., Adamson, Bakeman, Deckner, & Ronski, 2009; Charman, 2004; Hobson, 2004; Mundy & Sigman, 1989) and that these difficulties are, in Charman's apt phrase, "pivotal" for subsequent social and cognitive development.

One of the challenges in studies of joint attention is that the phenomenon of interest necessarily involves a triadic arrangement of this child, his or her social partner, and their shared topic (Adamson & Bakeman, 1991). Yet, to date, researchers seeking to chart the emergence and variations of joint attention and engagement have, with excellent justification, usually focused solely on the child, using procedures that systematically vary the partner's actions and shared topic in revealing ways. For example, to assess how a child initiates and responds to bids for shared attention to objects, several standardized probes of joint attention skills control the examiner's acts (Mundy et al., 2003; Sigman & Ruskin, 1999; Wetherby & Prizant, 1993). Although there is some variation in the tasks and labels used, all of these assessments distinguish between the child's declarative communicative acts and acts related to requesting and to social interacting. Moreover, most of these assessments divide these declarative acts into two categories, those related to their production (e.g., *initiating joint attention* or IJA, Lord, Rutter, DiLavore, & Risi, 1999; Mundy et al., 2003; also called *commenting*, McDuffie, Yoder, & Stone, 2005) and those related to their comprehension (e.g., *responding to joint attention* or RJA, Lord et al., 1999; Mundy et al., 2003; also called *attention-following*, McDuffie et al., 2005).

Other procedures systematically observe the child with a caregiver rather than an examiner in an attempt to gain a view of the child's joint engagement during semi-naturalistic interactions. For example, we have developed a procedure, the *Communication Play Protocol* (Adamson, McArthur, Markov, Dunbar, & Bakeman, 2001; Adamson et al., 2009) that includes three communicative contexts— *commenting*, *requesting*, and *social interacting*—intended to parallel the communicative function distinctions usually made in assessments of joint attention skills. With this procedure, we can determine whether the child is actively sharing an object with his partner, and we can characterize a period of *joint engagement* as either *supported* (the child actively attends to the object without explicitly acknowledging the partner) or *coordinated* (the child actively attends to both the shared object and the partner). Moreover, we can note whether the child was attentive to symbols during a period of joint engagement (*symbol-infused joint engagement*).

Despite these many efforts to document joint attention using assessments and systematic observational protocols, a comprehensive view of the development of joint engagement is still lacking because of the near-exclusive focus on the child. The resulting gaps in the developmental picture are not due to principled arguments against documenting caregiver's contributions or the characteristics of the shared topic. Indeed, the compelling image of symbol formation being rooted in a "primordial sharing situation" drawn decades ago by Werner and Kaplan (1963) has been preserved in the definition of joint engagement as a triadic arrangement between a person, his or her social partner, and a shared topic (Adamson & Bakeman, 1991). Rather, the gaps likely reflect the formidable methodological challenge of balancing detail and feasibility when faced with generating a multi-faceted systematic description of this triadic arrangement in studies with relatively large samples of parent-child interactions.

In the present study, we address this challenge by formulating a new data capture strategy for gaining a comprehensive view of what transpires during joint engagement episodes. Our goal is to supplement information about the presence and form of the child's joint attention with information about each element of the joint engagement triad and the dynamic relation among these elements. Thus, our first goal was to determine whether a battery of rating items might reliably and efficiently provide a broad and simultaneous view of the joint engagement triad.

Compared to moment-by-moment observational coding of states and events or utterance coding of transcripts, which are amenable to sequential analysis and can address questions

of process, global ratings are more suited to addressing questions of product or outcome (Bakeman & Quera, 2011). But ratings do offer the appealing promise of greater efficiency that can allow several aspects of extended interactions to be characterized relatively rapidly. Moreover, they have already been used to characterize or evaluate various aspects of parent-child interactions (Pivot Behavioral Rating Scale; Mahoney, Kim & Lin, 2007), and they have proved useful when investigating children's interests (Adamson, Deckner, & Bakeman, 2010; Deckner, Adamson, & Bakeman, 2006) and maternal emotional availability (e.g., Bornstein et al., 2006) and maternal sensitivity (e.g., Haltigan, Lambert, Seifer, Ekas, & Messinger, 2012)—constructs that can be difficult to abstract from counts or durations of specific events. Further, rating scales have been used in concert with event codes related to joint engagement to characterize global aspects of adult and infant contributions such as maternal sensitivity and active involvement and infant engagement and contentment (see, e.g., Gaffan, Martins, Healy, & Murray, 2009). However, to date rating items have not been used as the primary data capture strategy to document either the child's joint engagement states during social interaction or the child and partner actions and shared topics that constitute these states.

In formulating a rating item battery, we first sought to establish that trained raters could reliably capture joint engagement and produce valid data using rating items. Accordingly, the first items were designed to characterize the amount and quality of different forms of joint engagement, thereby paralleling variables we had derived using observational coding in a study of toddlers with typical development, young children with autism, and young children with Down syndrome interacting with their parents (Adamson et al., 2004; Adamson et al., 2009). Our first set of hypotheses focused on the relation between engagement state coding and rating items for these states in order to assess the validity of the rating items. We expected that rating items would correlate strongly with corresponding variables derived from engagement state coding in all three groups of children. Moreover—as a reflection of their validity—we anticipated that ratings would reveal the same developmental and diagnostic group differences as observational coding. Thus, we expected that the rating items would capture the dramatic growth of symbol-infused joint engagement that typically occurs between 18 and 30 months of age (Adamson et al., 2004). Furthermore, we expected to replicate our prior findings that coordinated joint engagement would be compromised for children with autism and that supported joint engagement and symbol-infused joint engagement would be relatively spared when their engagement was compared with children with Down syndrome and typically developing children who were at comparable levels of language development (Adamson et al., 2009).

The remaining items we formulated were designed to characterize aspects of the joint engagement triad other than the child's engagement state. As displayed in Table 1 (see also Appendix 1), there are 13 additional rating items. They cluster into three groups based on whether they focus primarily on the child, the partner, or their shared topic. The child cluster comprises five items. In line with the burgeoning literature utilizing the heuristic distinction between communicative skills involved in initiating and responding (e.g., Mundy et al., 2007), we included an item that captures how often and clearly the child initiates communication and an item that characterizes the child's responsiveness to the partner's communicative bids. The additional three items provide a basic description of the child's current level of expressive language use, the quality of behavior patterns, and the use of affective communication. The partner cluster comprises four items. The item that rates how well a partner scaffolds a child's activity was included to help clarify how supportive actions might influence the child's joint attention (Flom & Pick, 2003; Hobson, Patrick, Crandell, Garcia Pérez, & Lee, 2004) and be adjusted to the children's characteristics of age (Adamson & Bakeman, 1984) and diagnosis (Adamson et al., 2001; Kasari, Sigman, Mundy, & Yirmiya, 1988). Items related to how the partner highlights symbols (Adamson &

Bakeman, 2006) and follows the child's attention (Akhtar, Dunham, & Dunham, 1991; Harris, Kasari, & Sigman, 1996; McDuffie & Yoder, 2010; Siller & Sigman, 2002; Tomasello & Farrar, 1986) were included to probe how the partner is guiding the child toward crucial accomplishments, including language. The fourth item rates the parent's use of affective communication. The third cluster comprises four items that capture information about the complexity of the shared topic (both its elaboration and scope; Adamson & Bakeman, 2006) and about the way the shared topic is sustained and embedded in a fluent, connected conversation.

Our second set of hypotheses focused on these additional rating items and, as with the rating items for joint engagement, was essentially methodological. Again, as a reflection of their validity, we anticipated that these ratings would reveal sensible diagnostic group and language proficiency differences. Specifically, because young children with autism are often more difficult social partners than either young children with Down syndrome or typically developing children, we expected that (a) their affective communication and quality of behavior as well as their initiation of communication and responsiveness to the partner's communication would be lower, (b) their caregivers would have more difficulty scaffolding their interactions and following-in on the child's focus of attention, and (c) topics would be less sustained and elaborated and conversations less fluent and connected. We also anticipated that caregivers in both the autism and Down syndrome groups would assume the role of language teacher more often, obtaining higher ratings on the item related to symbol highlighting.

Our third set of hypotheses probed the effects of language proficiency on parent-child interactions. To check language proficiency differences, we compared ratings before and after children passed the milestone of acquiring a 50 word expressive vocabulary, a size that has often been used as a marker that the child has moved beyond the very early stage of vocabulary acquisition in both typically developing children (e.g., Goldfield & Reznick, 1990; Nazzi & Bertoncini, 2003) and young children with autism (Charman, Drew, Baird, & Baird, 2003) and Down syndrome (Hart, 1996). We expected that the change from a limited to a relatively substantial vocabulary would be evident in the item related to language level and also several other items that focus on processes that depend on symbols—for example, symbol-infused joint engagement, the scope and elaboration of the shared topic, the fluency and connectedness of conversations—and, even more interestingly, on items that capture information about processes that may either facilitate language acquisition (such as the adult's scaffolding, symbol-highlighting, and following-in) or be clarified by it (including the child's initiation and responsiveness).

In addition to gaining a broader view of parent-child interaction for children with different diagnoses and at different levels of early language proficiency, we also designed the battery of rating items in hopes of addressing more nuanced questions about the effects of autism and Down syndrome on early communication development. One factor to consider is context, specifically, how variations in communicative contexts might differentially affect parent-child interactions. Diagnosis-specific context effects have often been found in studies that use standardized probes of joint attention skills. For example, young children with autism are more likely to display a skill deficit when communication about a shared object is declarative than when such communication is either imperative or about a desired object or action focusing on social interacting (Mundy, 1995; Sigman & Ruskin, 1999; Tager-Flusberg, 1994; Wetherby & Prutting, 1984). In contrast, young children with Down syndrome appear to find requesting objects or assistance with objects particularly difficult during these standardized assessments (Mundy, Kasari, Sigman, & Ruskin, 1995). But such effects have yet to be found in observational studies. In our observational study of parent-child interactions in typically developing young children and children with autism or with

Down syndrome (Adamson et al., 2009), we did find that context differentially affected how often children were *unengaged* with people and objects; children with autism were more often unengaged during commenting and children with Down syndrome were more likely unengaged during both commenting and requesting than during activities that focused on interacting. However, context effects for different forms of joint engagement did not vary by diagnostic group; in all three groups, children tended to spend more time in symbol-infused joint engagement during the commenting than the interacting context.

One possible explanation for these contrasting findings may lie in the way caregivers adjust their actions across contexts in ways that might at least partially compensate for diagnostic-specific skill deficits. By design, such adjustments should not occur during standardized probes (and, as Tager-Flusberg, 1999, cogently noted, the lack of such adjustments as well as the unfamiliarity of the examiner may make such probes especially difficult for children with autism). Findings from an earlier study in which we observed how mothers of sons with and without autism issued attention-regulating bids during the Communication Play Protocol (Adamson et al., 2001) suggest that mothers do indeed tailor their bids as a function of communicative context, with mothers of sons with autism issuing fewer, more literal, and longer bids during the commenting context than either the requesting or interacting contexts.

Using our new battery of rating items, we were able to probe further how communicative context affects not only the child's joint engagement states but also other aspects of the interaction. We were especially interested in the contrast between the commenting and requesting contexts; although both include a focus on shared objects, they differ in whether they afford a declarative or an imperative communicative force. Our fourth and final set of hypotheses focused on how this difference in communicative context might affect various aspects of parent-child interaction. We expected that this difference could be reflected in the child's engagement state (e.g., higher symbol-infused joint engagement during commenting) and in other items related to language use (i.e., the child's expressive language and the caregiver's symbol highlighting would likewise be higher during commenting). More interestingly, we also expected differences in the dynamic of communication, with commenting providing a context for heightened parental scaffolding and following-in on the child's focus and requesting providing the context for heightened child activity (as indicated by higher ratings related to initiation and responsiveness and child affective communication) and increased topic scope as internal desires as well as immediate objects are shared. Further, we expected that the social interacting context would be characterized by heightened coordination (as evidenced by higher ratings on coordinated joint engagement), child and caregiver affective communication, and sustained shared topics, and by more limited language use (as evidenced by lower ratings on items related to child expressive language and symbol-infused joint engagement, caregiver symbol highlighting, and the scope of the shared topic). Finally, in line with the results of our previous study using engagement state coding, we anticipated that we would observe few interactions qualifying any main effects of diagnosis and context—although any that might emerge could highlight specific ways that commenting for children with autism and interacting for children with Down syndrome affect the dynamics of parent-child communication.

Method

Participants

The participants were 108 children who were enrolled in a longitudinal study of the emergence of symbol-infused joint engagement (Adamson et al., 2004; Adamson et al., 2009). They were divided into three groups based on the child's status as typically developing (TD) or diagnosed with either autism (AU) or Down syndrome (DS). The study's design called for each child to be observed with their caregiver up to 5 times at

approximately 3-month intervals. The caregivers, all of whom spoke English as their primary language, were in all but two cases the mother.

Participants in the TD group were recruited when the parent responded to a letter of invitation sent to seek subjects for child development research. The 56 TD toddlers started the study on average at 18.1 months of age ($SD = 0.3$). During the first visit, all of the mothers confirmed that the child was full-term and healthy at birth and that they had experienced no health or developmental problems other than minor childhood illnesses during their first 18 months. Fifty-four completed 5 sessions and 2 completed 4 sessions.

The 23 participants in the AU group were referred to us by clinicians who had diagnosed the child with autism. Their parents were administered the *Autism Diagnostic Interview-Revised* (ADI-R; Lord, Rutter, & Le Couteur, 1994), an interview that assesses behavior in three core domains of social interaction, communication, and restricted or repetitive behaviors. ADI-R results were consistent with the clinician referrals in all cases. All of the children scored above cut-off for autism on the social interaction and restricted or repetitive behavior domains; all but one scored above the cut-off on the communication domain, and this child scored just one point below cut-off on the nonverbal version of the communication domain. The children in this group began the study on average at 30.8 months ($SD = 4.6$); 19 were observed five times, 1 three times, and 3 two times, for a total of 104 sessions.

The 29 participants in the DS sample were recruited through both clinical and community sites. They were, on average, 30.3 months ($SD = 4.9$) at the initial visit; 15 were observed five times, 9 four times, 4 three times, and 1 two times, for a total of 125 sessions.

Comparison Designs

We used three different designs to examine the effects of age, diagnostic group, and language proficiency on the rating items characterizing the joint engagement triad. The first design let us examine how various aspects of joint engagement typically change during late infancy as language is acquired and compared two repeated samples: the TD children at their 18-month and at their 30-month visit (for further detail, see Table 1 in the online Appendix).

The second design let us examine the three diagnostic groups at comparable levels of expressive language proficiency and compared three samples: as in previous studies (Adamson et al. 2009; 2010), the TD children at their 18-month visit and the children with AU and with DS at the visit when their age was closest to 30 months. Comparison of the children's scores on both the *MacArthur Communication Development Inventory* (CDI; Fenson et al., 1993), which the parent completed prior to each session, and the *Mullen Scales of Early Learning* (Mullen, 1995), which was administered at either the participant's first or second visit, indicated that the expressive language level of the children in the AU and DS groups at 30 months of age were approximately comparable (albeit a higher CDI median for the TD and a higher interquartile range—i.e., more spread out scores—for the AU group; for details see Table 1 in the online Appendix). Thus, the more appropriate comparison for our study of the joint engagement triad for 30-month-old children in the AU and DS groups was to the 18-month, rather than the 30-month, TD sessions.

The third design let us probe changes in various aspects of the joint engagement triad when the child's expressive language develops and compared two repeated samples: children whose parents reported fewer than 50 words on one visit and 50 or more on a subsequent visit, as assessed with the CDI. Fifty children had such sessions (26 TD, 8 with AU, and 16 with DS; for further detail, see the online Appendix); not included were children whose

word count never exceeded 50 (7 with AU, 6 with DS) or was already 50 at their first visit (30 TD, 8 with AU, 7 with DS).

Communication Play Protocol and Video Records

Observations of parent-child interactions were made using the Communication Play Protocol (CPP; Adamson et al., 2001). The CPP consists of six 5-min semi-structured scenes during which the parent (as supporting actress) is asked to perform a Communication Play with her child (the star). The six scenes probe three communicative contexts (social interacting, requesting, commenting). (a) *Social interacting* is encouraged in the *Music* scene, for which props that produce songs and objects that produce sounds are provided and the parent is encouraged to sing and dance with her child, and in the *Turn Taking* scene, for which props such as a ball and a stacking toy that could be used in a turn-taking game are provided. (b) *Requesting* is stimulated in the *I Want* scene, for which three attractive toys (a toy clock, a stuffed doll or animal, and a favorite toy from home) are placed on a high shelf, and in the *Help Me* scene, for which props are three objects (such as a balloon, a bubble making toy, and a mechanical car) that are too difficult for toddlers to use fully on their own. (c) *Commenting* is afforded in the *Art Gallery* and the *Container* scenes, both of which encourage the parent to share a series of pictures or objects with the child.

Following standard CPP procedures, before the Play began, the parent was told that we were interested in observing her child's current ways of communicating during a series of scenes. Before each scene, the parent was given a cue card that specified the scene's plot and props that might be used during the scene. Directorial suggestions were provided but a script was not. The stage for the CPP was our laboratory playroom; video records were made using two cameras that were situated behind one-way mirrored windows on its opposing walls; recordings were synchronized for subsequent coding. The three communicative contexts lasted on average 620 s each ($SD = 20$), with no differences between groups. A manual for the CPP is available upon request.

Observational Coding of Joint Engagement States

Observational coding of engagement states was done for all CPP sessions (Adamson et al., 2004; 2009). Trained and reliable coders who were masked to the study's hypotheses applied a coding scheme that segmented the child's attention to people, objects, and symbols into a series of mutually exclusive and exhaustive engagement states that, by definition, lasted at least 3 seconds. The scheme contained 11 codes, 4 of which (*nonsymbol-infused supported joint engagement*, *symbol-infused supported joint engagement*, *nonsymbol-infused coordinated joint*, *symbol-infused coordinated engagement*) characterized the child's engagement to an event or object that was shared with the parent. A coding manual is available upon request.

These four engagement states vary on two dimensions. The first concerns whether the child, in addition to being actively involved with the same object or event, overtly acknowledges the partner's participation. For this dimension, joint engagement states were considered *supported* when the child focused almost exclusively on the shared object or event without actively acknowledging the partner, and they were considered *coordinated* when the child actively and repeatedly attended to the partner as well as the shared object or event. The most common indicator of attention to the partner was repeated or sustained visual regard, but attention could also be indicated by calls to the partner even without eye contact. For the second dimension, engagement states were coded *nonsymbol-infused* or *symbol-infused*. We expected observation of receptive and expressive speech to be the most common indicator of symbol-infused engagement, but coders were also instructed to look for evidence of symbol use in other modalities such as gestures and to be attentive to indications

that the child and partner were engaged in pretense. Reflecting these dimensions, for the current study we combined the initial joint engagement codes into four variables: the *total* proportion of time the child was observed in *joint engagement* (no matter the dimension), in *supported joint engagement* (pooling symbol-infused or not), in *coordinated joint engagement* (again pooling symbol-infused or not), and in *symbol-infused joint engagement* (pooling supported and coordinated symbol-infused).

Engagement state was coded by observers who worked in teams of two. Each CPP was divided in half; teams were randomly assigned half-sessions (each containing one scene related to social interacting, requesting, and commenting) to code. Coders viewed and reviewed the two recordings as needed in both regular and slow speed; typically it would take about an hour to code a 5-min scene. Codes were recorded using James Long Company software (www.jameslong.net). To establish reliability, at least 15% of the video records for each diagnostic sample were independently coded by two teams who were not aware when sessions were used for reliability. Reliability was assessed with kappa, a summary index for nominal scales that corrects for chance agreement (Cohen, 1960). Pooled kappas were .76, .69, and .71 for the AU, DS, and TD samples, respectively; with a scheme of 11 codes, these values suggest observers who were 88%, 85%, and 86% accurate (see Bakeman & Quera, 2011).

Rating Items

A battery of 17 rating items was formulated to characterize activities during the CPP. Each item was a 7-point Likert scale whose anchors were designated to span the range of possibilities observed within a sample of 18–30 month old typically developing toddlers as well as samples of children with developmental disorders with language levels comparable to children in the TD sample. The items are listed in Table 1 and a description of each item's anchors and midpoint is provided in the appendix. A manual detailing each rating item and the rating procedure is available upon request.

To produce ratings for the three comparison designs (TD₁₈ vs. TD₃₀; TD₁₈, AU₃₀, and DS₃₀; < 50 vs. 50 words), the rating battery was applied to 226 CPP sessions. Like engagement state coders, trained raters were randomly assigned half-sessions. Unlike the engagement state coders, raters worked individually rather than in teams of two. The raters assigned ratings for all 17 items to a 5-min CPP scene before moving to another scene. This typically entailed viewing the scene three times at regular speed so that rating a scene took approximately 25 minutes. Digital multimedia files were viewed and ratings recorded using Mangold International's INTERACT system (www.mangold-international.com). To check agreement, 15.5% of each rater's corpus was independently rated by a second observer (stratified by diagnostic group; raters did not know which of their half-sessions were double coded). Agreement was assessed with weighted kappas (Cohen, 1968). The range of weighted kappas for ratings within 1 point on the 7 point rating scale was .74–.97, values that suggest observers were at least 87% accurate and often much better (see Bakeman & Quera, 2011).

Results

Correlations Between Coded Percentages and Rating Items for Joint Engagement

The first four rating items were designed to capture aspects of joint engagement that corresponded to variables derived from observational coding. To determine whether rating items captured essentially the same information as observational codes (as specified in our first set of hypotheses), we computed correlations for rating item scores and corresponding observational percentages at the 18-month visit for the TD sample; at the 30-month visit for

the TD, AU, and DS samples; and, for the samples defined by language use, at the visit mothers reported fewer than 50 words and the subsequent visit when they reported 50 or more words. All corresponding correlations exceeded .5 ($M = .79$, range = .56 to .96) and were significant, $p < .001$, as shown in Table 2.

Analyses of Coded Percentages and Rating Items for Joint Engagement

To determine whether analyses of coded percentages and rating item scores for joint engagement variables would yield similar results, we employed analyses of variance using three different designs: (a) a repeated-measures design comparing TD children at their 18- and 30-month visits; (b) a cross-sectional design comparing TD children at the 18-month visit with AU and DS children at the 30-month visit (when their expressive language development was approximately matched); and (c) a repeated-measures design comparing children whose mothers reported their child was using fewer than 50 words at one visit and 50 or more words at a subsequent visit. For *total*, *coordinated*, and *symbol-infused joint engagement*, effect sizes and differences between the TD paired samples, the diagnostic group samples, and the number of words (NW) paired samples were essentially the same (see Table 3). The single exception was *supported joint engagement* for diagnostic group: both coded percentages and ratings item scores suggested similar differences for *supported joint engagement*, but these differences were significant only for the rating items ($\eta^2 = .25$ vs. .03). Thus, regardless of whether joint engagement was measured by rating items or by state coding, all forms of joint engagement, especially symbol-infused joint engagement, increased significantly from 18- to 30-months in the TD sample. Moreover, diagnostic group affected coordinated joint engagement, with children in the AU group significantly lower by both measures than either the children in the TD or DS samples. Finally, when children moved from < to 50 words, symbol-infused joint engagement also increased, whereas neither ratings nor percent of time spent in supported or coordinated joint engagement changed significantly.

Analyses of Non-Engagement State Rating Items

The remaining 13 items focused primarily on the child, the partner, or their shared topic. To determine whether analyses of these rating items would reflect sensible differences (as specified in our second and third set of hypotheses), we again used the three designs described in the previous paragraph. Differences were pervasive (see Table 4): For the TD and NW paired samples 10 of the 13 items and for diagnostic group 9 of the 13 items suggested differences. Specifically, (a) for the TD paired samples, 18-month means were lower than 30-month means for all items but one, for which they were essentially equal (*mother affective communication*). (b) For diagnostic group, AU means differed from TD means for 7 of the 13 items (lower for *initiation of* and *responsiveness to communication*, *quality of behavior patterns*, *child affective communication*, *sustainability of shared topic*, and *conversation fluency* and higher for *symbol highlighting*). In contrast, DS means differed from TD means for only three items (lower for *initiation of communication* and *quality of behavior patterns* and higher for *symbol highlighting*). AU means differed from DS on four items (lower for *responsiveness to communication*, *child affective communication*, and *maternal scaffolding* and higher for *expressive language level*). (c) For the NW paired samples, less-than-50-words means were lower for all items but one, for which they were essentially equal (*mother affective communication*). The only differences not significant were *following in on child's focus* and *mother affective communication* for all three samples, *child affective communication* for the NW paired sample, *symbol highlighting* for the TD paired sample, and *elaboration* and *scope of shared topic* for the diagnostic group sample.

Analysis of Rating Items by Context

To determine whether and how communicative context affected the 17 rating items (as specified in our fourth set of hypotheses), we employed a mixed design, diagnostic group by context analysis of variance. Context effects were significant for 13 of the 17 items (see Table 5; diagnostic group results were detailed in Tables 3 and 4). Follow-up tests showed that for all three context comparisons (interacting to requesting, interacting to commenting, requesting to commenting), means differed for 9 of the 17 items. Comparing interacting to both requesting and commenting, means were lower for *symbol-infused joint engagement*, *initiation*, *expressive language*, and *scope* and higher for *following in*, *elaboration*, and *sustainability*. Comparing interacting to requesting, means were also lower for *fluency* and higher for *scaffolding*; comparing interacting to commenting, means were also lower for *symbol highlighting* and higher for *coordinated joint engagement*. Finally, comparing requesting to commenting, means were lower for *scaffolding*, *symbol highlighting*, and *mother affective communication* and higher for *coordinated joint engagement*, *initiation*, *responsiveness*, *sustainability*, *scope*, and *fluency*.

As noted in Table 4, diagnostic group by context interactions were significant for 6 of the 17 items. Results of follow-up analyses for these six variables are detailed in the online only Appendix. For all but *child affective communication*, effects sizes for the context main affect were greater than for the interaction, which suggests that interaction results may not substantially alter the main effects detailed in Table 5. The interaction results suggest that the context main effects detailed in Table 4 are seen primarily in some diagnostic groups and not others. Specifically, effects for *symbol-infused joint engagement* and *scaffolding* were seen in the TD and DS but not the AU group, for *expressive language level* in the TD group only, for *child affective communication* in the AU group only, for *symbol-highlighting* most strongly in the TD group, and for *elaboration of shared topics* in the AU and DS but not the TD group.

Discussion

This study's findings demonstrate that rating items are a viable option for measuring multiple aspects of caregiver-child interactions as typically developing toddlers and young children with developmental disorders begin to acquire language. Ratings and state coding generated a remarkably similar view of children's joint engagement. Moreover, ratings markedly expanded the description of the joint engagement triad, providing compelling evidence that early language acquisition transforms joint engagement, communication dynamics, and shared topics, and that autism, far more than Down syndrome, has a pervasive effect on all aspects of the triad.

As we noted in the introduction, the desire to gain a broader view of early parent-child interactions was a primary motivation for our exploration of rating as a method of data capture. Construction of rating items was informed by our conception of joint engagement, which in turn had been shaped by our earlier work systematically coding children's engagement states, first in infants (Bakeman & Adamson, 1984) and then young children with and without developmental disorders (Adamson et al., 2004; 2009; Prezbindowski, Adamson, & Lederberg, 1998). Although we remain advocates of well-executed observational coding (Bakeman & Quera, 2011), we also recognize the challenges of applying this strategy to large samples of interactions, especially its high cost in terms of coder time and commitment. Moreover, there are several aspects of communication dynamics, such as the flow of conversation and parent scaffolding, that may be captured better by ratings that summarize minutes of action than by the analysis of moment-by-moment codes.

We designed the battery of 17 rating items described here for the Communication Play Protocol which is comprised of a series of 5-minute scenes that sample a range of common communicative contexts. Raters were able to apply items to scenes relatively rapidly and with excellent reliability. The use of 7-point ratings seemed both manageable for the raters and sufficiently fine grained for meaningful reliability assessments and nuanced analyses. Furthermore, raters generally used the full scale effectively with means often hovering near the midpoint. Most exceptions, such as the low means for the child's expressive language use, the amount and quality of symbol-infused joint engagement, and the scope of the shared topic when typically developing children were 18 months old and the children in the autism and Down syndrome groups were 30 months old, were reasonable given our intention of comparing diagnostic groups when children were just starting to acquire language. The effect sizes when ratings of 18 and 30 month-old typically developing children were compared on these three items were notably large, indicating that the items captured the expected expansion of language across this developmental period. Only the mean rating for the coordinated joint engagement item remained a 3 or lower in all samples, reflecting its relative infrequency compared to supported and symbol-infused joint engagement, whose items had the same anchors and mid-point descriptions. The range of the average mean ratings for each of the items also suggests that all of them were appropriately scaled. The only range that appeared narrow (defined as a mean range of less than 3.0) was for the parent's affective communication item for which ratings tended to cluster around the midpoint, a constriction that likely reflects the generally positive tenor parents usually display when they play with their child.

The correlations between observed percentages and rating items for joint engagement were consistently strong in all six of our samples, supporting the conclusion that the rating items provide a valid record not just of total joint engagement but also its coordinated, supported, and symbol-infused forms. This conclusion is reinforced by the strikingly similar results when codes and ratings were used to compare groups of children. As we reported elsewhere (Adamson et al., 2004), the most dramatic change in joint engagement in typically developing toddlers is a substantial increase in symbol-infusion; effect sizes using codes and ratings were large ($\eta^2 = .87$ and $.91$) and nearly identical. In contrast, increases in coordinated and supported joint engagement were modest in both data sets. And, consistent with the results based on observational coding (Adamson et al., 2009), ratings of joint engagement revealed that children with DS at 30 months of age patterned their joint engagement much like typically developing 18 month olds while 30-month-old children with autism displayed an expected deficit in coordinated joint engagement.

The only notable difference occurred with supported joint engagement: means were lower for the autism group, but whereas group differences were large and significant with ratings ($\eta^2 = .25$, $p < .001$), they were small and not significant with coding ($\eta^2 = .03$, $p = .22$). We did not expect ratings that characterized 5 minutes of activity to be more sensitive to group differences than moment-by-moment coding. However, we think that this may happen when raters are asked to consider not only the sheer amount but also the quality of the state when deciding between two adjacent ratings. Thus the raters may have provided a slightly more nuanced reading than we gained by calculating quantity (i.e., proportion of time in a state) based on engagement state coding.

Supplementing information about children's joint engagement with information provided by rating items about the child's and partner's activities and their shared topics revealed how widespread the influence of language acquisition, developmental disorders, and communicative context were on the joint engagement triad. Our first longitudinal design compared typically developing children at 18- and 30-months of age. Clearly, compared to just a year earlier, the typically-developing two-and-a half year olds were transformed social

partners. The breadth of the change is particularly noteworthy. In addition to expected increases in expressive language and in items such as symbol-infused engagement that depend on language use, there were large shifts in raters' assessment of the quality of the child's behavior patterns and the child's initiation of communication, two items that are not inextricably tied to language use. Moreover, the dyad's conversations were far more fluent and connected and their shared topics were expanded in scope and more elaborated. In noteworthy contrast, the parent's contributions appeared far more stable, with ratings for scaffolding, symbol highlighting, following in, and affective communication remaining, on average, near each item's mid-point during both ages. The relative stability of parents' activity as child and topics change has been noted elsewhere (e.g., Masur & Turner, 2001, most consistently in research characterizing persistent parental styles during conversations with preschoolers about the past (e.g., Fivush, Haden, & Reese, 2006).

Our second longitudinal design probed directly how change in language facility impacted the joint engagement triad by comparing interactions that occurred before and after a child acquires a 50 word expressive vocabulary. The age when children in our samples passed this milestone varied considerably but the interval between the paired observations for each child was only a matter of months. Not surprisingly, the shift in vocabulary size was captured by a substantial rise in the rating of child expressive language and in symbol-infused joint engagement. More interestingly, the shift was also manifest in several other ratings, most notably in increases in the child's initiation of communication, the quality of behavior patterns, the scope and elaboration of the shared topic, and the fluency and connectedness of conversation. Again, however, changes were less evident in the parent's activity—although it is noteworthy that symbol-highlighting was significantly higher at the post-50 word observation, an increase that may indicate that explicit vocabulary teaching accelerates when a child indicates a readiness to rapidly accumulate words.

Our third design, which compared typically developing 18 month old children with 30 month old children with either autism or Down syndrome, likewise demonstrated the usefulness of rating items in describing variations in the joint engagement triad. Two points deserve comment. First, the size and breadth of the effects are clearest for autism, which unlike Down syndrome is defined in part by a disruption in communication. In addition to its effect on the child's joint engagement, autism negatively impacted four of the five child rating items, sparing only expressive language, the variable which by design we hoped would be comparable across groups. Moreover, it hampered the sustainability of shared topics as well as the fluency and connectedness of conversation. In contrast, Down syndrome did not have as pervasive an influence, although compared to typically developing children, the children with Down syndrome less often initiated communication and, not surprisingly, displayed lower quality behavior patterns. As in our other analyses, the impact on parent contributions was subtler but well in line with our expectations. Parents tended to highlight symbols more for children with developmental disorders, whose language was markedly delayed, than for typically developing toddlers, a finding that presents a somewhat puzzling contrast to the findings that they also tended to highlight symbols more as language facility increased. A second interesting finding is that parents interacting with a child with autism erected less supportive scaffolds than parents interacting with a child with Down syndrome. It is noteworthy that this finding is in line with the pattern of ratings of child responsiveness and affective communication, which likewise present a similar pattern. Taken together, these results underscore the need to investigate further the effects of variations children's "readability" across developmental disorders on parents during social interactions (compare, e.g., Hyche, Bakeman, & Adamson, 1992, and Walden, 1996) as well as the complexity of designing nuanced parent-implemented early language interventions (see Kaiser & Roberts, 2011, for a state of the art review of this area).

Second, rating items revealed interesting differences in how communicative context might influence interactions. In many ways, context affected interactions similarly across groups. For example, as found previously with observational coding, ratings indicated that symbol-infused joint engagement at this early stage of language development was relatively infrequent in all three groups regardless of context. Moreover, ratings of coordinated joint engagement tended to occur least often during commenting contexts, a finding that coincides well with the notion that contexts that afford early word learning may concentrate attention on symbols and shared objects rather than on the link between shared object and partners (see, e.g., Bloom, 1993). However, there were also indications that autism may influence a dyad's modulation of interactions across contexts. Only for children with autism was affective communication heightened in the requesting context. In contrast, commenting did not appear a privileged context for symbol-infused joint engagement for the children with autism as it was for children in the other two groups. And, unlike parents in the other groups, the parents interacting with a child with autism did not modulate their scaffolding across contexts, raising its level during commenting (and in the DS group, interacting as well).

Overall, we conclude that the methodological move towards rating items was successful, at least in this context where the focus was on outcome and not process. Especially when applied across groups and over time to observations made within the relatively stable frame of the Communication Play Protocol, they can produce valid and reliable data that expands our view of the development of joint engagement. We think that they will be especially usefully in applied research, including studies of early intervention effects on joint attention and language, where they could provide a relatively rapid means of data capture. Moreover, the work reported here provides a heuristic foundation for future studies about the development of the joint engagement triad. For example, patterns of findings related to specific items such as quality of parental scaffolding and the amount of symbol-highlighting suggest that more detailed descriptions of the parents' contributions could help clarify variations in the child's joint engagement experiences. Finally, heartened by the evidence that these rating items can provide a reliable, valid, and broad record of variations in the joint engagement triad, we are now poised to expand our samples so that we can explore the interrelation between items in order to gain fuller descriptions of the child, partner, and shared topics as joint engagement develops after infancy.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1**Rating Items**

Focus	# Rating item
Joint engagement	1 Total joint engagement
	2 Supported joint engagement
	3 Coordinated joint engagement
	4 Symbol-infused joint engagement
Child	5 Initiation of communication
	6 Responsiveness to communication
	7 Expressive language level & use
	8 Quality of behavior patterns
	9 Child affective communication
Parent	10 Scaffolding
	11 Symbol highlighting
	12 Following in on child's focus
	13 Parent affective communication
Shared topic	14 Elaboration of shared topic
	15 Sustainability of shared topic
	16 Scope of shared topic
	17 Fluency & connectedness of conversation

Note. For further detail, see appendix.

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Table 2
Correlations Between Coded Percentages and Rating Item Scores for Joint Engagement

Joint engagement variable	Sample				
	TD ₁₈	TD ₃₀	AU ₃₀	DS ₃₀	<50 words
Total	.71	.78	.86	.66	.80
Supported	.66	.56	.77	.76	.67
Coordinated	.77	.77	.89	.91	.93
Symbol-infused	.90	.85	.96	.91	.81

Note. *n* = 56, 23, 29, and 50 for TD, AU, DS, and number of word samples, respectively; *p* < .001 for all.

Table 3
Analysis of Coded Percentages and Rating Item Scores for Joint Engagement Variables with Three Different Designs

Joint engagement variable	TD paired		η^2	<i>p</i>	Diagnostic group			# words		
	TD ₁₈	TD ₃₀			TD ₁₈	AU ₃₀	DS ₃₀	<50	50	<i>p</i>
Observational coding										
Total	66	76	.41	<.001	66 _b	50 _a	71 _b	65	68	.11
Supported	50	56	.17	.001	50	45	50	47	49	.02
Coordinated	16	20	.13	.007	16 _b	5 _a	22 _b	18	20	.03
Symbol-infused	8	49	.87	<.001	8	10	6	5	12	.39
Rating item										
Total	5.7	6.3	.32	<.001	5.7 _b	4.3 _a	5.6 _b	5.3	5.5	.06
Supported	5.5	5.9	.18	.001	5.5 _b	4.4 _a	5.1 _b	5.0	5.1	.02
Coordinated	2.5	3.0	.16	.002	2.5 _b	1.5 _a	2.7 _b	2.5	2.7	.05
Symbol-infused	2.1	5.7	.91	<.001	2.1	2.3	1.8	1.8	2.6	.46

Note. Scores are means, $n = 56, 23, 29$, and 50 for TD, AU, DS, and number of words (NW) samples, respectively. For the TD and NW paired samples, effects sizes (η^2) are based on repeated samples t -tests. For diagnostic group, effects sizes are from a mixed-design analysis of variance (see Table 5); means that do not differ significantly, $p < .05$, per a Tukey post-hoc test share a common subscript.

Table 4

Analysis of Non- Engagement State Rating Item Scores with Three Different Designs

Joint engagement variable	TD paired		Diagnostic group					# words					
	TD ₁₈	TD ₃₀	η^2	<i>p</i>	TD ₁₈	AU ₃₀	DS ₃₀	η^2	<i>p</i>	<50	50	η^2	<i>p</i>
Initiation of communication	4.6	6.2	.68	<.001	4.6 _b	3.3 _a	3.4 _a	.21	<.001	3.8	4.4	.20	.001
Responsiveness to communication	4.2	4.7	.32	<.001	4.2 _b	2.8 _a	4.0 _b	.34	<.001	3.7	4.0	.11	.015
Expressive language level & use	2.1	6.3	.96	<.001	2.1 _{ab}	2.7 _b	1.8 _a	.08	.010	1.9	2.7	.44	<.001
Quality of behavior patterns	3.4	5.8	.91	<.001	3.4 _b	2.6 _a	2.8 _a	.29	<.001	2.9	3.3	.38	<.001
Child affective communication	4.1	4.5	.35	<.001	4.1 _b	3.0 _a	4.1 _b	.41	<.001	3.8	3.9	.03	.27
Scaffolding	4.0	4.3	.21	<.001	4.0 _{ab}	3.5 _a	4.2 _b	.10	.004	3.9	4.1	.10	.025
Symbol highlighting	4.0	4.2	.06	.068	4.0 _a	4.5 _b	4.6 _b	.12	.001	4.3	4.7	.22	.001
Following in on child's focus	3.8	4.0	.06	.060	3.8	3.4	3.7	.04	.12	3.5	3.6	.03	.23
Parent affective communication	4.2	4.2	.01	.59	4.2	4.3	4.4	.02	.44	4.2	4.2	.01	.58
Elaboration of shared topic	4.2	5.5	.67	<.001	4.2	3.8	4.3	.05	.068	4.1	4.4	.13	.009
Sustainability of shared topic	4.4	5.3	.47	<.001	4.4 _b	3.5 _a	4.5 _b	.22	<.001	4.3	4.6	.11	.019
Scope of shared topic	2.2	4.4	.76	<.001	2.2	2.0	2.1	.01	.71	2.1	2.6	.33	<.001
Fluency and connectedness	3.4	5.6	.88	<.001	3.4 _b	2.9 _a	3.0 _{ab}	.07	.018	3.1	3.5	.24	<.001

Note. Scores are means, $n = 56, 23, 29$, and 50 for TD, AU, DS, and NW samples, respectively. For the TD and NW paired samples, effects sizes (η^2) are based on repeated samples t -tests. For diagnostic group, effect sizes are from a mixed-design analysis of variance (see Table 5); means that do not differ significantly, $p < .05$, per a Tukey post-hoc test share a common subscript.

Table 5

Analysis of Rating Item Scores by Context

Joint engagement variable	Context			η^2	p	Comment (context main effect)	G×C	
	Interact	Request	Comment				η^2	p
Total joint engagement	5.5	5.4	5.3	.03	.072	—	.03	.17
Supported joint engagement	5.2	5.1	5.1	.003	.74	—	.03	.26
Coordinated engagement	2.5 _b	2.4 _b	2.1 _a	.08	<.001	Interacting & requesting > commenting	.004	.93
Symbol-infused joint engagement	1.8 _a	2.3 _b	2.2 _b	.18	<.001	Requesting & commenting > Interacting	.05	.023
Initiation of communication	3.1 _a	4.8 _c	4.0 _b	.48	<.001	Requesting > commenting > Interacting	.03	.12
Responsiveness to communication	3.8 _{ab}	4.0 _b	3.7 _a	.04	.011	Requesting > commenting	.02	.45
Expressive language level & use	1.9 _a	2.3 _b	2.3 _b	.18	<.001	Requesting & Commenting > interacting	.04	.046
Quality of behavior patterns	3.1	3.1	3.0	.02	.19	—	.04	.082
Child affective communication	3.8	3.9	3.8	.02	.074	—	.09	.001
Scaffolding	4.1 _b	3.5 _a	4.3 _b	.22	<.001	Commenting & interacting > requesting	.05	.038
Symbol highlighting	3.6 _a	3.8 _a	5.6 _b	.66	<.001	Commenting > interacting & requesting	.08	.002
Following in on child's focus	4.0 _b	3.6 _a	3.4 _a	.13	<.001	Interacting > requesting & commenting	.01	.73
Parent affective communication	4.3 _{ab}	4.2 _a	4.4 _b	.06	.002	Commenting > requesting	.02	.36
Elaboration of shared topic	4.4 _b	4.0 _a	4.0 _a	.06	.001	Interacting > requesting & commenting	.06	.015
Sustainability of shared topic	4.8 _c	4.4 _b	3.6 _a	.39	<.001	Interacting > requesting > commenting	.01	.83
Scope of shared topic	1.6 _a	2.5 _c	2.2 _b	.28	<.001	Requesting > commenting > interacting	.03	.11
Fluency and connectedness	3.0 _a	3.4 _b	3.2 _a	.12	<.001	Requesting > Interacting & commenting	.03	.22

Note. $N = 108$. Effects sizes (η^2)—from a mixed design, diagnostic group (G) by context (C) analysis of variance ($n = 56, 23$, and 29, for TD18, AU30, and DS30 diagnostic groups)—are for the context effect and the group by context interaction; effect sizes for diagnostic group are given in Tables 3 and 4. Means that do not differ significantly, $p < .05$, per a Tukey post-hoc test share a common subscript.

Appendix

Rating Items and Their Anchors

1. Child's total joint engagement

- 1 No episodes of the joint engagement state
- 4 In joint engagement for approximately half of the scene (displays several brief or a few relatively sustained episodes)
- 7 Almost always in the joint engagement state

2. Child's supported joint engagement

- 1 No episodes of the supported engagement state
- 4 Spends about a third of the scene in supported joint engagement that is of moderate quality, or briefly in supported joint engagement in a strikingly high quality manner
- 7 Frequently in rich and varied episodes of supported joint engagement

3. Child's coordinated joint engagement

- 1 No episodes of the coordinated engagement state
- 4 Spends about a third of the scene in coordinated joint engagement that is of moderate quality, or briefly in coordinated joint engagement in a strikingly high quality manner
- 7 Frequently in rich and varied episodes of coordinated joint engagement

4. Child's symbol-infused joint engagement

- 1 No episodes of the symbol-infused engagement state
- 4 Spends about a third of the scene in symbol-infused joint engagement that is of moderate quality, or briefly in symbol-infused joint engagement in a strikingly high quality manner
- 7 Frequently in rich and varied episodes of symbol-infused joint engagement

5. Child's initiation of communication

- 1 Never made a communicative initiative
- 4 Takes the lead at least a few times during interactions with the caregiver
- 7 Continually made clear communicative initiations

6. Child's responsiveness to partner's communication

- 1 Almost always resists or ignores bids
- 4 Responds to bids regularly but not continually
- 7 Complies with and anticipates almost every bid

7. Child's expressive language level and use

- 1 No expressive language
- 4 Produces many different single words during a scene with none or few word combinations
- 7 Fluent and frequent use of sentences

8. Child's quality of behavior patterns

- 1 Repetitive and restricted movements and expressions
- 4 Behavior is neither markedly restricted and repetitive nor remarkably varied and fluid.
- 7 Varied and fluid movements and expressions

9. Child's affect

- 1 Affect is either disruptive, highly inappropriate, or very flat and constricted
- 4 Affect appears mellow or content as opposed to flat; affect does not impede communication, but neither does it enhance it
- 7 Affect is smoothly modulated, appropriate, and serves to enhance other modes of communication

10. Parent's scaffolding

- 1 Provides minimal support for the child's communication and/or actions on objects
- 4 Provides moderate levels of support

7 Continually supports and extends the child's actions

11. Parent's symbol highlighting

1 Rarely emphasizes symbols

4 Moderate number of attempts are made

7 Almost continual attempts to focus attention on symbols

12. Parent's following in on child's focus

1 Rarely follows in on the child's current focus

4 Builds on the child's focus on a regular, but not continual basis

7 Almost continually joins and acts to sustain the child's interest

13. Parent's affect

1 Tense, disruptive, or affectively flat, to the point of being expressionless and subsequently very hard to read

4 Mellow or content as opposed to flat; affect does not impede communication, but neither does it enhance it

7 Smoothly modulated, appropriate, and serves to enhance other modes of communication

14. Elaboration of shared topic

1 Dyad shares only one topic that involves only a single activity

4 Dyad able to generate at least a few topics that entail more than one element (e.g., varying play with an object)

7 Detailed and varied topics

15. Sustainability of shared topic

1 Fleeting topics

4 Topics are maintained for a moderate duration (e.g., sustaining a conversation or play for a few turns)

7 Sustained topics

16. Scope of shared topic

1 All topics involve perceptible objects and events in the here and now

4 Dyad shares a few displaced references or several displaced references about the same topic

7 Repeated displaced references about several topics

17. Fluency and connectedness of conversation

1 No conversation is established

4 Conversation lacks smoothness, appears to be largely dominated by one partner

7 Fluid and balanced conversation that is often sustained