

Exploring Assessment of Situational Intelligibility in Children with and without Speech-Language Disorders

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Abstract

Parents of young children typically respond to their child's communications with language that is syntactically and semantically appropriate to what the child said. However, parents of children with speech-language disorders (SLD) may not always understand their child and so may not respond to the child's communication attempts in a language-promoting manner. The goal of the present study is to explore the use of a new questionnaire about children's situational intelligibility, the *Caregiver/Parent Understanding-the-Child Questionnaire (CPUCQ)*. The *CPUCQ* asks parents to respond to 31 common communication situations, ranging from saying "Thank you" to telling a story. Parents indicate the child's mode of communication in each situation (*Speech only*, *Speech plus gesture*, *Gesture only*, or *Child does not do this*), and they also rate how well they understand the child. The *CPUCQ* and various language measures were administered to 54 typically developing (TD) children and 34 children with SLD in the age range 2;0 – 6;8. Both groups showed developmental change over the age range in the mode of communication and in the understandability ratings. Further study of the *CPUCQ* as an assessment instrument is warranted, particularly as it may provide valuable information that can be used clinically to determine treatment goals.

Keywords: children, development, gesture, intelligibility, preschool-age, speech-language disorders

1. Introduction

For infants and toddlers, learning how to communicate effectively with others is one of the primary tasks of their early life. For many children, this learning proceeds uneventfully and at a rapid rate. In early social interactions around language, toddlers explore some of the rules of conversation such as joint attention, turn-taking, and following the partner's topic (e.g., Rice, 1993). By age three, most children are able to communicate intelligibly with people in their everyday environment, although unfamiliar listeners may have more trouble understanding the child (McLeod, 2020). For children who have developmental speech/language disorders (SLD), communication even with caregivers may prove a daunting task. Children with language disorders are often poorly intelligible (Rice et al., 2010), as are children with speech sound disorders (McLeod et al., 2012). The caregivers of children with poor intelligibility may adapt in non-facilitating ways to the difficulty of understanding their child (Hurt, 1991; Van Balkom et al., 2010). The difficulties in conversational interactions may have a self-perpetuating effect. For example, mothers' responsiveness, or lack thereof, to their toddlers' verbalizations and gestures has been shown to predict the child's language performance at ages three and four (Hudson et al., 2015).

The early conversational difficulties of children with SLD are likely to affect subsequent development in many domains. In the psychosocial and academic domains, children with language disorders often experience substantial difficulties in preschool and beyond (e.g., Dubois et al., 2020; Gertner et al., 1994). Children with speech sound disorders may also experience social impacts such as not engaging in peer activities requiring verbal communication (e.g., McLeod et al., 2013), and they are particularly vulnerable in academic areas such as phonological awareness, reading, and vocabulary (e.g., Benway et al., 2021).

This review of children's communicative, social, and academic outcomes shows that the early experiences that children have in conversational interactions with caregivers are critically important for subsequent development. There have been numerous studies of how parents of typically developing (TD) young children respond in communication-promoting ways in these conversations (for a recent example, see Leung et al., 2021), but all of these studies allow the inference that the parents usually understand what the child attempts to communicate. It is

not likely that parents of young SLD children understand their children most of the time, especially as the children's utterances shift from single words to strings of words.

1.1 Assessing Intelligibility

The concept of intelligibility has a long history of study and use in the area of speech sound disorders (e.g., Lagerberg et al., 2014; McLeod et al., 2012). Intelligibility has most often been measured exclusively from the audio-recorded speech signal using measures such as percentage of words understood in a conversational sample (Shriberg & Kwiatkowski, 1982), percentage of words understood from a list of words (e.g., Hustad et al., 2020), percentage of syllables perceived as understood in a conversational sample (e.g., Lagerberg et al., 2014), percentage of intelligible utterances in conversation (e.g., Rice et al., 2010), and Percentage of Consonants Correct (Shriberg & Kwiatkowski, 1982). The child's speech that is evaluated for these measures is typically elicited in a single session in a clinical setting rather than in the child's usual environment, and the listeners for these measures have usually been research assistants or clinicians. Unfamiliar listeners such as these are less likely than familiar partners such as family members to understand the child (McLeod et al., 2012; McLeod, 2020).

In contrast, during more typical interaction situations, a listener has not only the auditory signal (speech) available, but also signal-independent features, such as visual information, the speaker's gestures, situational cues, and contextual knowledge to help determine meaning (Yorkston et al., 1996). In the case of children, the listeners who are best equipped to make use of these varied cues are the parents and caregivers who interact with the children in everyday life. Because of the importance of the parents' and caregivers' responses to a child's communication attempts, the ways in which the child communicates with and is understood by these familiar people is a primary concern of professionals serving the child. Moreover, the need to assess the child in familiar settings and activities is one of the emphases of the International Classification of Functioning, Disability and Health—Children & Youth Version (ICF-CY; World Health Organization, 2007). Until recently, information about the child's interactions in familiar settings has come primarily from items in child language inventories such as the *Rossetti Infant-Toddler Language Scale* (Rosetti, 2006) that are not focused on how well the parent understands the child. To date, the most widely used instrument to assess intelligibility as judged by parents is the *Intelligibility in Context Scale* (ICS; McLeod et al., 2012), a screening instrument in which the parent rates the child's intelligibility with seven types of interlocutors, ranging from family to strangers. Even the ICS, however, does not provide a comprehensive picture of how well the child's communications are understood in a large number of familiar contexts with familiar people.

1.2 The Role of Gesture in Child Communication

Young children communicate with others in their environment using not only speech but also gesture, which Goldin-Meadow (2020) has defined as "empty-handed movements used in communicative situations" (p. S279). Within the existing literature on the development of gesture in TD children, several authors (e.g., Crais et al., 2009; O'Neill & Chiat, 2015) have found that in the early preschool years, TD children routinely use gesture to accompany speech until about 24 months. In the later preschool years, they often use speech alone, except in specific pragmatic contexts such as narration. There is consensus that for TD children, gesture is an essential precursor to the equivalent ideas later expressed verbally. Early on, children routinely accompany single-word utterances with gestures such as pointing, extending the arm, or shaking the head (Morford & Goldin-Meadow, 1992), and many children may use baby signs, a rudimentary system of signs taught by their parents (Goodwyn & Acredolo, 1993). Beyond that early stage, gesture may assist the child with pragmatic aspects of language (Goldin-Meadow, 2020), help the child navigate the social-emotional world (Vallotton & Ayoub, 2010), aid in regulation of emotion (Konishi et al., 2018), facilitate executive function (O'Neill & Miller, 2013), aid in memory (Delgado et al., 2011), and buy time to find words (Clark & Lindsey, 2015).

There appear to be no published reports of studies about how use of gesture by children with speech sound disorders affects intelligibility. However, for groups composed of children with SLD, routine use of gesture appears to persist to older ages than in TD children, and gesture appears to be an important component of their communication with others (e.g., Crais et al., 2009). For example, Lavelli and Majorano (2016) found that children with language impairment used gestures more frequently than their age-matched peers, perhaps in a compensatory manner and to scaffold their speech.

1.3 Purpose of the Investigation

The purpose of the present investigation was to undertake an exploratory assessment of a new questionnaire for caregivers and parents about their young child's intelligibility in multiple pragmatic situations ranging from "The child says 'Thank you'" to "The child attempts to tell a joke." For each pragmatic situation, the parent or caregiver is asked whether the child uses gesture, speech plus gesture, or speech only to convey their intent, or *Does not do*

this. The parent also indicates how well they understand the child in that context on a five-point rating scale. The questionnaire was administered to parents of 54 typically developing children between the ages of 2;0 and 6;5, and to parents of 34 children receiving clinical services for speech and/or language disorders in a similar age range. Preliminary data were also collected about the validity and reliability of the questionnaire.

2. Method

2.1 Development of a Questionnaire about Situational Intelligibility

The questionnaire included 31 pragmatic situations in which children are expected to communicate frequently over the preschool age span (approximately from age two to age six). The list includes Brown's early pragmatic functions, such as requesting (Brown, 1973), as well as more complex pragmatic functions, such as telling a joke or telling the parent about food likes and dislikes (Owens, 2008). The questionnaire also included several situations suggested by four practicing speech-language pathologists (SLPs) who held the Certificate of Clinical Competence (CCC) from the American Speech-Language-Hearing Association (ASHA) and who worked extensively with young children.

2.1.1 Questionnaire Format

The first question on the *CPUCQ* was "The child asks you for more," and the remaining 30 pragmatic situations were randomized. As shown in Figure 1, for each situation, the respondent notes the child's mode of communication (*Speech only*, *Speech plus gesture*, *Gesture only*, or *Child does not do this*) and also rates how understandable the child is (*Never understand*, *Rarely understand*, *Sometimes understand*, *Usually understand*, and *Always understand*). The term *understandability* was used in the questionnaire rather than *intelligibility* because parents were not likely to be familiar with the latter term. Although the Understandability scale was developed independently of the *Intelligibility in Context Scale (ICS)*, the defined points are the same. The resulting questionnaire was the *Caregiver/Parent Understanding-the-Child Questionnaire (CPUCQ)*. The complete *CPUCQ* may be seen in the Supplemental Information #1 online.

UNDERSTANDABILITY SCALE

| 1 | 2 | 3 | 4 | 5 |
|------------------|-------------------|----------------------|--------------------|-------------------|
| Never understand | Rarely understand | Sometimes understand | Usually understand | Always understand |

| SITUATION | HOW | UNDERSTANDABILITY |
|---|--|--|
| <p>Note 1: The word <i>gesture</i> refers to actions such as pointing, or shaking the head, and also to using baby signs. Not all children use gestures.</p> <p>Note 2: If the child uses vocalizations, such as grunts, that help to convey meaning, you should consider them speech. However, please note the nature of the vocalizations in the Comments area for each item.</p> | <p>How does the child usually indicate this? Please circle or mark one option.</p> | <p>Use the scale above to indicate how well you understand the child. Circle the appropriate number.</p> |
| <p>1. The child asks you for more.</p> <p><i>Comment?</i></p> | <p>Speech only Speech plus gesture Gesture only Child does not do this</p> | <p>1 2 3 4 5</p> |
| <p>2. The child tells you about food likes and dislikes.</p> <p><i>Comment?</i></p> | <p>Speech only Speech plus gesture Gesture only Child does not do this</p> | <p>1 2 3 4 5</p> |
| <p>3. The child tells about a recent activity or event not known or not experienced by the listener (you).</p> <p><i>Comment?</i></p> | <p>Speech only Speech plus gesture Gesture only Child does not do this</p> | <p>1 2 3 4 5</p> |

Figure 1. First page of the CPUCQ showing types of situations and response options

2.1.2 Development of a Composite *CPUCQ* Score

The score for each of the 31 situations is based on two scales. The Mode scale indicates whether the child uses gesture, speech, both, or is not yet attempting to communicate in that situation (i.e., *Child does not do this*). The five-point Understandability scale indicates how understandable the child's communication is when attempting to communicate in that situation. Although each scale is informative, it is also important for assessment purposes to have a single composite score—the Communication Score—that takes into consideration both the Mode and Understandability scores for each situation. To determine the Communication Score for each possible combination of Mode and Understandability scores, five ASHA-certified SLPs who each had more than 20 years of experience with children were asked to rank all possible combinations in order of increasing communication performance. The 16 combinations were written on cards (e.g., *Mode: Gesture plus speech; Understandability rating: 4 "Usually understood"*) and randomly presented to these five expert raters, who worked independently. Table S1 in the Supplementary Materials #2 online shows that there was considerable unanimity among these SLPs in their rankings. We used the modal ranking as the Communication Score for each combination of Mode and Understandability scores, so that the response *Child does not do this* had the lowest ranked score (0) and *Speech only: Always understand* was awarded the highest ranked score (15). Then the Overall Communication Score (OCS) for each child was calculated as the mean of the 31 Communication Scores, not including items left blank.

2.2 Participants

Two groups of children and their parents were recruited for this study, which was approved by the Institutional Review Board at Kansas State University, which is located in a small city in an otherwise rural area of the American Midwest. The first group included 54 typically developing children including three girls and three boys in each 6-month age interval between 2;0 and 6;5 (2;0-2;5, 2;6-2;11, 3;0-3;5, 3;6-3;11, 4;0-4;5, 4;6-4;11, 5;0-5;5, 5;6-5;11, and 6;0-6;5). Fifty mothers and four fathers participated. The researchers contacted local preschools to distribute information about the study via paper fliers and emails, and notifications were posted on the University website. Parents contacted the researchers and provided informed consent for their child and themselves to participate. They were told that the child would receive \$15 at the end of the single research session. For selection purposes the child was required to be in one of the specified age ranges, be a monolingual English speaker, pass a hearing screening, perform at age level or above with respect to speech sound development on the *Diagnostic Evaluation of Articulation and Phonology (DEAP)* screening test (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002), and could not be receiving speech-language services. The TD children also met standards for utterance length and complexity via Mean Length of Utterance in morphemes (MLU). (See below for linguistic analysis of conversational samples to determine MLU, Type/Token Ratio, and Percent of Intelligible Utterances.) The child had to have either MLU within -1.5 standard deviations (SD) for the child's age (Miller & Chapman, 1981), or alternatively, have MLU between -1.5 SD and -2.0 SD for the child's age and have a measure of vocabulary diversity via Type/Token Ratio (TTR) equal to or greater than .40. The MLU for children aged six years was evaluated against the norms for five-year-olds because norms for six-year-olds were not available. We did not collect information about family socioeconomic status or ethnicity.

Ultimately, 54 children were selected from an initial group of 65 children referred by their parents. Of the 11 children who did not meet selection criteria, four did not pass the speech sound screening, one did not pass the hearing screening, one was bilingual, one was receiving speech-language services, and two were outside the age range. Two children failed to reach the MLU standard for their age group.

The second group of participants consisted of 34 children who were receiving services for SLD and their parents. These children included four two-year-olds (2F, 2M), twelve three-year-olds (3F, 9M), eight four-year-olds (3F, 5M), seven five-year-olds (2F, 5M), and three six-year-olds (2F, 1M). Among the 34 parents, 32 were mothers and two were fathers. To locate SLD participants, the authors contacted SLPs from regional public-school districts and their associated early intervention programs, a private practice, and a university clinic. The SLPs determined which children on their caseload met the following selection criteria: Receiving intervention services, between the ages of 2;0 and 6;8, monolingual, hearing within typical limits (if testable), and no known organically based communication disorders (e.g., cleft palate). The information provided to the parents indicated that their child would be seen for two sessions about 3-4 months apart and that the child would receive \$50 at the end of the second session. The parents were also told that the child's SLP would be asked for information about the child's areas of treatment. Parents responded by sending the signed consent form in a self-addressed stamped envelope (SASE) provided by researchers. Forty-one parents initially indicated interest in the study; however, five could not be reached for scheduling and two bilingual children did not meet the inclusion criteria. Three of the children could not be scheduled for the second visit because their parents could not be reached.

The referring SLPs indicated whether the child had an ASD diagnosis, and they reported the number of objectives they had for the children in four areas: expressive language, receptive language, phonology, and pragmatics. There were eight children receiving treatment for ASD, seven children receiving treatment only for phonology, and 19 children receiving treatment for various combinations of treatment areas, but always including expressive language (Language Plus).

2.3 Procedures

For both the TD and SLD children, each child was seen in the parent's preferred setting (i.e., in the home, at the University Speech and Hearing Center, or at the child's school). The first and third authors conducted all the sessions. For both groups, the first activity of the session was the hearing screening, unless the parent indicated that the child passed a hearing screening within the previous eight months, and the parent had no current concern about hearing. All TD children passed the hearing screening. Among the children with SLD, one child had a known unilateral hearing loss. Another child could not be conditioned to using behavioral responses to signals presented via a portable audiometer. He was brought into the university clinic for sound-field screening with Visually Reinforced Head Turn. The hearing of three children with ASD could not be screened using behavioral measures, and their parents reported that the child's service provider had also been unable to screen hearing. However, these parents indicated no concerns about hearing, and the investigators concurred, based on their interactions with the child.

For the TD children, the investigator administered the *Diagnostic Evaluation of Articulation and Phonology* screener (Dodd et al., 2002) and then engaged the child in a video-recorded conversation centered on a standard set of toys: a barn and animals, Mr. and Mrs. Potato Head™, a Pinpressions toy with small plastic toys to generate a variety of shapes in the field of pins, and two wordless storybooks. A Canon Vixia HF10 video camera with a camera-mounted microphone (Røde Directional Video Condenser Microphone model N3594) was situated within three-to-four feet of the child's face, with the tabletop visible as well. During the conversational sample, a second researcher tallied the number of Communication units (C-units; defined as independent clauses with all modifiers) produced by the child to make sure that there were at least 50 for analysis, when possible. The video-recordings were later downloaded to a computer and stored with a case number for subsequent analysis. During the conversational sample, the parent usually stayed in the room or nearby and filled out the *CPUCQ*, with the experimenters responding to any questions or concerns. In a few cases, the parent completed the *CPUCQ* after the investigators left, in which case they were provided with a SASE in which to send it to the study office. Additionally, some parents were randomly selected to complete another *CPUCQ* for reliability purposes one to three weeks after the assessment visit and mail it to the investigators in a SASE.

In the sessions with children who had SLD, after the hearing screening, the researcher reviewed the results of the *Ages and Stages Questionnaire (ASQ)*: Bricker & Squires, 1999), which had been sent to the parents in advance, and the researcher also administered the *Preschool Language Scale-5 Screener (PLS-5 Screener)*: Zimmerman et al., 2012). Then one of the researchers engaged the child in conversation around the same toys used with the TD children to obtain a conversation sample, using the same videorecording equipment, with a second researcher counting C-units and the parent typically filling out the *CPUCQ* at the same time. Conversational samples were not available for five of the 34 SLD children because three children with ASD were nonverbal during the visit and also by parental report, one child was very poorly intelligible, and one child's conversational sample was not recorded due to technical difficulties.

Thirty-one of the children with SLD were seen for a second visit three to four months after the first visit, during which they were receiving intervention from their usual provider. The parent again filled out the *CPUCQ* during this visit, and a conversational sample was recorded. A random sample of the parents who did not complete a reliability questionnaire after the first visit filled out another copy of the *CPUCQ* one to three weeks after the second visit and returned it in a SASE.

2.3.1 Scoring and Data Entry

The *DEAP* screener for the TD children and the *PLS-5 Screener* and the *ASQ* for the SLD children were scored by the investigators according to the respective test manuals. The conversational samples were glossed by student research assistants who were trained and monitored in transcribing samples, in determining the corpus to be analyzed, and in applying the coding conventions used in the *Systematic Analysis of Language Transcripts (SALT)*: Miller et al., 2011). Language measures for each sample included MLU (a measure of utterance length and complexity), TTR (a measure of vocabulary diversity), and Percent of Intelligible Utterances (PIU; a measure of intelligibility). Each transcript was vetted by another student research assistant for accuracy while viewing the video recording, and it was also reviewed by one of the investigators for accuracy of coding. For each transcript,

the corpus to be analyzed was the “Middle 50,” that is, a contiguous set of 50 C-units taken from the middle of the sample. This procedure allowed for a brief warm-up period for the child at the beginning of the conversation. The Middle 50 also included any unintelligible utterances that occurred in the Middle 50, although *SALT* uses only the intelligible utterances to calculate MLU. If the child was not using many C-units, then we took a contiguous sample that included 50 C-units and/or multi-word utterances, and if even that criterion could not be met, then intelligible single-word utterances were included to bring the count to 50.

The data from *CPUCQ* questionnaires were entered into spreadsheets, including the child’s Mode of communication, the Understandability rating, and any parental comments for each pragmatic situation. To facilitate the finding of data entry errors, each set of data was entered into two separate files by different research assistants. Then one of the investigators reviewed the two versions and resolved any differences. If the parent made no choice for a particular item, or if the parent made a choice from only one of the two scales (other than *Child does not do this*), that item was counted as a non-response. For each pragmatic situation, a Communication Score was automatically derived from a look-up table, based on the combination of Mode and Understandability ratings selected by the parent. The child’s OCS was determined by averaging the CS across all 31 pragmatic situations, except for No Response items.

2.3.2 Reliability of *CPUCQ*

Internal consistency of the *CPUCQ* was assessed by comparing parent responses in the first half of the questionnaire to the responses in the second half for the 54 TD children. Split-half reliability was also computed separately for the 34 SLD children. To assess test-retest reliability we randomly selected respondents who were asked to fill out the *CPUCQ* one to three weeks after the visit and return it to the investigators in a SASE.

2.3.3 Statistical Procedures

Parametric statistical tests were used to analyze the TD data, including two-way ANOVAs, *t*-tests, and Pearson correlations. Nonparametric statistical tests were applied to the SLD data because the 34 SLD children had not been systematically sampled across the age range of interest. For this reason, there were no direct comparisons of the SLD data to the TD data using statistical procedures, although the relevant data are provided in tables and figures.

3. Results

3.1 Results of Language-Based Measures for the TD and SLD Groups

Based on the *PLS-Screener* and the *ASQ*, the SLD x scored more poorly than the TD populations on which these measures were standardized. Only 11 of the 34 SLD participants (32.4%) had passing scores on either the *ASQ* Communication subscale or the *PLS-5 Screener* Main Scale or both.

We hypothesized that certain measures of language performance would differentiate between SLD children and TD children. Table 1 summarizes *SALT* measures for the TD and SLD children (including size of the analysis set in terms of number of utterances, MLU, TTR, and PIU), together with *CPUCQ* Overall Communication Scores (OCS), which will be discussed later. The data are shown for full years of age in order to avoid small cell sizes in the SLD group wherever possible. For the SLD children, standard deviations (SDs) for some measures are relatively large, no doubt due to the heterogeneous nature of the SLD group. Table 1 shows that with respect to both MLU and PIU, the TD children had numerically higher values than the SLD children in most of the age groups. With respect to TTR, a measure of vocabulary diversity, there was no reason to expect TTR to differ between the TD and the SLD children, although the SLD group had a range that was numerically a bit higher than that of the TD group (i.e., a TTR range of .39 - .46 for the TD group and .44 - .52 for the SLD group).

Table 1. Mean Values of Various Measures from the Systematic Analysis of Language Transcripts (Miller et al. 2011), and from the CPUCQ with Standard Deviations in Parentheses, for Children with Typical Development (TD) and Children with Speech-Language Disorder (SLD)

| Age Group | Study Group | Systematic Analysis of Language Transcripts | | | | CPUCQ |
|-----------------|----------------------------|---|------------------|-------------------------------------|------------------------------------|-----------------------------|
| | | Size of Analysis Set | Type/Token Ratio | Mean Length of Utterance, Morphemes | Percent of Intelligible Utterances | Overall Communication Score |
| Two-year-olds | TD n = 12 | 60.6 (9.24) | 0.39 (0.045) | 2.6 (0.81) | 91.9 (5.10) | 12.0 (1.07) |
| | SLD n = 4 | 55.5 (25.68) | 0.48 (0.22) | 1.3 (0.14) | 58.8 (29.8) | 4.8 (0.58) |
| Three-year-olds | TD n = 12 | 70.2 (9.96) | 0.41 (0.051) | 3.8 (0.64) | 92.0 (4.24) | 12.6 (1.06) |
| | SLD n = 12 ^a | 64.9 (13.44) | 0.44 (0.43) | 2.4 (0.45) | 81.5 (6.75) | 9.6 (2.50) |
| Four-year-olds | TD n = 12 | 68.6 (7.73) | 0.44 (0.051) | 3.9 (0.64) | 94.7 (4.33) | 13.3 (0.86) |
| | SLD n = 9 ^b | 51.8 (11.20) | 0.52 (0.086) | 2.8 (1.03) | 81.2 (17.51) | 8.8 (2.92) |
| Five-year-olds | TD n = 12 | 62.5 (9.66) | 0.46 (0.044) | 3.9 (0.38) | 96.2 (4.34) | 13.9 (0.72) |
| | SLD n = 8 | 70.1 (10.074) | 0.44 (0.024) | 3.9 (0.46) | 89.2 (5.67) | 10.9 (1.1) |
| Six-year-olds | TD n = 6 | 61.3 (6.83) | 0.44 (0.040) | 4.6 (0.49) | 98.2 (2.40) | 13.5 (0.85) |
| | SLD n = 3 ^c | 56.5 (7.78) | 0.52 (0.106) | 3.5 (1.26) | 97.8 (3.18) | 7.7 (5.46) |

^aTwo of these children did not provide SALT data.

^bTwo of these children did not provide SALT data.

^cOne of these children did not provide SALT data.

3.2 Results of the CPUCQ for TD and SLD Children

3.2.1 Mode of Communication and Understandability Ratings

Tables 2 and 3 are summary tables for Mode of communication and Understandability ratings, respectively. (Table S2 in the Supplementary Material #2 online provides the same data broken down by full-year age group.) Table 2 shows that parents of children with SLD chose *Speech plus gesture* at rates comparable to their TD peer parents, but they differed primarily by selecting *Speech only* less often and *Child does not do this* far more often than the parents of TD children. The SLD group exhibited a developmental trend toward later onset of employing the *Speech only* mode. Table 3 suggests that children with SLD were consistently rated as less understandable than their TD peers. The parents of the TD children selected *Usually understand* or *Always understand* more than 90% of the time. The SLD children differed in that for most of the age groups, parents chose *Sometimes understand* and *Usually understand* for the majority of responses, although for the two-year-olds, almost a quarter of the responses were *Rarely understand*.

Table 2. Modes of Communication on the *Caregiver/Parent Understanding-the-Child Questionnaire* Selected by Parents of Children with Typical Development (TD) and Children with Speech-Language Disorders (SLD)

| PARTICIPANT GROUP | <i>Does not do this</i> | <i>Gesture only</i> | <i>Speech plus gesture</i> | <i>Speech only</i> | Row totals |
|--------------------------|--------------------------------|----------------------------|-----------------------------------|---------------------------|-------------------|
| TD <i>n</i> = 54 | 9 (0.5%) | 1 (0.06%) | 760 (45.9%) | 884 (53.4%) | 1654 |
| SLD <i>n</i> = 34 | 156 (15.2%) | 18 (1.7%) | 466 (45.3%) | 387 (37.6%) | 1029 |

Note. Data are the frequency of responses in each Mode category along with percentages of the row total. The data in this table do not reflect 20 No Response items for the TD children (1.3% of the total) or 25 No Response items for the SLD children (2.1% of the total).

Table 3. Ratings of Understandability on the *Caregiver/Parent Understanding-the-Child Questionnaire* Selected by Parents of Children with Typical Development (TD) and Children with Speech-Language Disorders (SLD)

| PARTICIPANT GROUP | <i>Never understand</i> | <i>Rarely understand</i> | <i>Sometimes understand</i> | <i>Usually understand</i> | <i>Always understand</i> | Row totals |
|--------------------------|--------------------------------|---------------------------------|------------------------------------|----------------------------------|---------------------------------|-------------------|
| TD <i>n</i> = 54 | 1 (0.1%) | 7 (0.4%) | 115 (7.0%) | 550 (33.4%) | 972 (59.1%) | 1645 |
| SLD <i>n</i> = 34 | 5 (0.6%) | 63 (7.2%) | 268 (30.8%) | 368 (42.2%) | 173 (19.8%) | 871 |

Note. The data in this table do not reflect 20 No Response items for the TD children (1.3% of their total) or 25 No Response items for the SLD children (2.1% of their total). These data do not include *Does not do this* in the totals because in that case, there is no understandability rating.

3.2.2 The OCS Results

Figure 2 shows the mean OCS for the TD children by their half-year age groups, with bars showing two SDs below the mean. Also shown are data points for individual SLD children, with different icons used for the three subgroups (phonology only, ASD, and language plus). (Mean data for the SLD children are available in Table 1.) Figure 2 shows that the SLD children had OCS along virtually the entire range of OCS under the curve for the TD children.

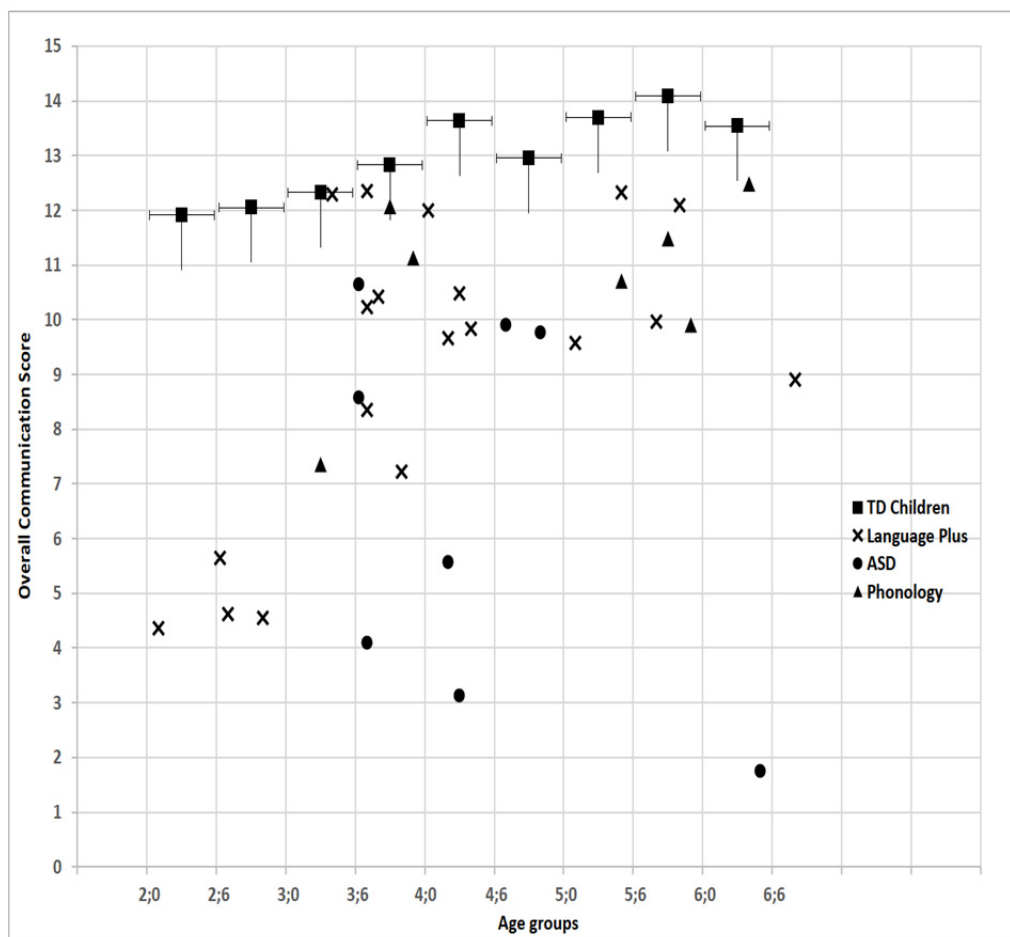


Figure 2. *CPUCQ* Overall Communication Scores (OCS) on the Caregiver/Parent Understanding the Child Questionnaire for Individual Children with SLD in Three Diagnostic Subgroups. Also Shown are the Mean OCS and -2 SD for TD Children in Each Half-year Age Group

3.2.2.1 Change in OCS over the Age Range 2–6 Years

For the TD children shown in Figure 2, it is clear that the mean OCS were already relatively high for the youngest TD children and that the scores gradually increased to the oldest age group (6;0-6;5). In a two-way ANOVA with age group and sex as the factors, significant differences in OCS were found for the TD age groups, $F(8,36) = 3.928$, $p = .002$, but not for sex, $F(1,36) = 0.597$, $p = .445$, and there was no significant interaction between age group and sex, $F(8,36) = 0.610$, $p = .763$. The Levene test suggested that the variances were equivalent across the age groups, $F(17,36) = 1.762$, $p = .075$. The significant finding for age groups was associated with partial *eta* squared of .466, which is considered a large effect size.

With respect to the SLD children, we did not hypothesize a strong relationship with age because it was likely that a severely involved older SLD child would have an OCS that was similar to the OCS of much younger children. Figure 2 appears to show such a pattern, notably for several children in the ASD subgroup. As expected, the correlation between a given child's OCS and age (in months) did not reach statistical significance for the 34 SLD children (Spearman $\rho = .286$, $p = .102$). We did not test for differences between boys and girls because of disparities in numbers (12 girls and 22 boys) and ages.

3.2.2.2 Relationship between OCS and MLU

Table 1 included both *SALT* data and the *CPUCQ* OCS for both the TD and the SLD children. For the TD children, the correlation between OCS and MLU was significant, with Pearson $r(52) = .402$, $p = .003$. This result was not

surprising given that the participants had been chosen on the basis of the MLU that was appropriate for their age group. Equally notable is the fact that when the effect of age group was partialled out, the size of the correlation between OCS and MLU dropped markedly and no longer reached statistical significance, $r(52) = 0.017, p = 0.903$. This finding was undoubtedly due to the fact that age group was significantly correlated with both the CPUCQ OCS, $r(52) = 0.592, p = .001$, and with MLU, $r(52) = 0.663, p = .001$.

We hypothesized that OCS for the SLD children would correlate strongly with MLU because both OCS and MLU were measures involving the use of language in a communication-impaired population. Table 1 showed these data by full-year age group. This hypothesis was confirmed for the 29 SLD children who provided both OCS and MLU (Spearman $\rho = .591, p = .001$). Age of the children was likely not a confounding variable because there was no significant correlation between OCS and age.

3.2.2.3 Relationship between OCS and PIU

Because the CPUCQ incorporated measures of understandability, we predicted that the OCS would correlate significantly with PIU, an intelligibility measure, as shown in Table 1. Based on scores for individual children, the correlation between OCS and PIU for the TD children did not reach significance, Pearson $r(52) = .202, p = 0.143$. This result no doubt occurred because for both variables, scores were relatively high even among the youngest TD children, with a mean OCS of 11.85 at age 2;0-2;5 and a corresponding PIU of 90.5%, compared to mean OCS of 13.55 and PIU of 97.2% at age 6;0-6;5. However, with respect to the SLD group, the hypothesis of a relationship between OCS and PIU was confirmed via a significant correlation between OCS and PIU for the 29 children for whom both data points were available (Spearman $\rho = .444, n = 29, p = .016$).

3.2.2.4 OCS in the SLD Group

We can make some cautious statements about the SLD children based on visual information in Figure 2. First, only a few SLD children had an OCS that overlapped the ranges shown for the TD children. Many of the SLD children had much lower OCS, with the youngest children and some of the children with ASD having very low OCS. Finally, the ASD group appeared to be bimodal, with four children scoring below OCS = 6 and four scoring above OCS = 8.

3.3 CPUCQ Reliability and Item Difficulty

3.3.1 Internal Reliability of CPUCQ

We performed split-half reliability for the CPUCQ used with TD children. Item #1 “Child asks you for more,” was not included because it had not been randomly assigned, unlike the other 30 items. The mean Communication Score for items #2-16 was 12.80 ($SD = 1.444$), while for items #17-31, it was 12.94 ($SD = 1.473$). The correlation between the two halves was significant, $r(52) = .899, p < .001$. A t -test for related pairs showed no significant difference between the two halves, $t(53) = 1.529, p = .132$.

Split-half reliability of the CPUCQ for the SLD children was calculated similarly using the data from Visit 1. The distribution of CS for items 2-16 ($M = 8.86, SD = 3.071, Mdn = 9.7$) did not differ from that of items 17-31 ($M = 8.79, SD = 3.246, Mdn = 9.7$), based on the Wilcoxon signed rank test for paired samples in a large group with two instances of tied scores ($z = -0.654, n = 32, p = .516$). The correlation between the two halves was strongly positive (Spearman $\rho = 0.875, n = 34, p = .001$).

3.3.2 Test-Retest Reliability

We examined test-retest reliability by choosing parents at random to complete a second CPUCQ form, which they returned by mail one to three weeks after the session. Fifteen parents of TD children (28% of the total) returned the questionnaires. The test/retest correlation was high, $r(13) = .9325, p = .001$. The mean of the original OCS for these children was 13.25 ($SD = 1.270$) and the mean of the retest scores was 13.28 ($SD = 1.261$), and there was no significant difference between the two related means, $t(14) = 0.622, p = .544$.

Test/retest reliability for the SLD children was similarly assessed by asking parents to fill out the CPUCQ again after one to three weeks and return it in a SASE. Some of the parents provided reliability copies after Visit 1, while parents of different children provided reliability copies after Visit 2, for a total of 10 reliability questionnaires (15% of the total of 65 questionnaires from Visits 1 and 2). The OCS determined during the visits ($M = 9.84, SD = 2.638, Mdn = 10.5$) was compared to the reliability OCS ($M = 9.89, SD = 3.184, Mdn = 10.8$). The difference between the medians did not reach significance in a Wilcoxon signed rank test for paired samples ($z = -0.051, n = 10, p = 0.960$). The test/retest correlation was strongly positive (Spearman $\rho = 0.900, n = 10, p = .001$).

3.3.3 Item Difficulty

Item difficulty on the *CPUCQ* for each group was determined by averaging the Communication Scores across the group for each item. The Supplementary Materials #2 online show Table ID1, in which the items are ranked in order of difficulty for the TD group, and Table ID2, in which the items are ranked for the SLD group. The Supplementary Materials #2 also contain an analysis of the use of gesture for the ten easiest and ten most difficult items in the TD and the SLD groups.

For the TD children, the item with the highest mean CS (“Child says ‘Thank you’”) was ranked 1 (least difficult), and the item with the lowest mean CS (“The child attempts to tell (you) a joke”) was ranked 31 (most difficult). Examination of these scores suggested that the pragmatic situations covered a range of performance, with mean CS of 14.75 at the “least difficult” end and mean CS of 10.4 at the “most difficult” end. For the SLD group, the ranks of *CPUCQ* items were similar to the TD ranks, but the range of Communication Scores was much larger. For the SLD children, the easiest items had average CS between 11 and 13, while the most difficult had average CS between 4 and 7.

3.4 *CPUCQ* Post-testing for SLD Children after a Period of Intervention

Parents of 31 of the 34 SLD children completed the *CPUCQ* after a period of three to four months of intervention in order to determine if the *CPUCQ* was sensitive to change in performance. The mean period of intervention was about 3.6 months ($M = 15.1$ weeks, $SD = 2.65$ weeks), and it corresponded to the late-winter-through-spring portion of the academic year. The mean improvement in OCS at Visit 2 was 0.84 ($SD = 1.288$), with a median improvement of 1.032 in OCS. This difference was significant, based on the Wilcoxon Signed Rank Test for paired samples, $z = 3.214$, $p = .001$, $\eta^2 = 0.347$.

4. Discussion

The purpose of this study was to explore the use of a parent questionnaire (the *CPUCQ*) to assess a child’s intelligibility in a variety of typical situations. The present study shows that TD children are readily understood by at least one parent by the age of two years, with about 80% of the parents’ ratings being *Usually understand* (rating of 4) or *Always understand* (rating of 5). The changes that take place in TD children at older ages show that the children use the *Speech only* mode more often than the *Speech plus gesture* mode, and they are understood somewhat more often. These findings corroborate McLeod’s (2020) statement that “There is emerging evidence across languages that typically developing young children are ‘usually’ to ‘always’ intelligible...” (p. 14), using a similar rating scale.

In contrast to the TD children, parents of SLD children did not readily understand their children. The two most frequent understandability ratings were *Usually understand* and *Sometimes understand*, except for the two-year-olds for whom about 75% of ratings were in the *Sometimes understand* and *Rarely understand* categories. These data are in broad agreement with those presented by McLeod (2020) for children with speech/language concerns, who had ratings in the *Sometimes* and *Usually* categories. An important finding with respect to the SLD children is the large number of situations (about 15% of the total) in which parents reported that their children did not attempt to communicate. Most of these instances occurred among the two-, three-, and four-year-old children, and most occurred in the more difficult communication situations (see Tables S2 and S5 in the Supplementary Materials #2 online). It is possible, of course, that the children may have attempted to communicate, but the parents did not recognize the attempts.

Children with SLD like those in the present study are likely to have many fewer communication-expanding conversational experiences with their parents than TD children because their parents often fail to understand them. If parents do not understand their child, they are not going to be able to provide the contingent models, expansions, and other linguistic and pragmatic inputs that help the child grow as a communicator (e.g., McCormick, et al., 2020). Even parents who appear highly motivated to understand their child, such as those in Hurt’s 1991 study who were constantly checking that they understood what the child said, spend substantial amounts of time in the checking process. This is time that might otherwise be used to provide more typical communication-enhancing input to the child.

4.1 *The Role of the Pragmatic Situation in Situational Intelligibility*

The *ICS* has been widely adopted (McLeod, 2020) because it formalized a variable known to be important in the study of intelligibility, namely the influence of the conversational partner’s familiarity with the child. In the present study, we attempt to expand the study of conversational interactions to account for the nature of the speaking task for the child. It is unsurprising that in certain speaking situations, most children are highly likely to be understood, while in other situations children face difficulty in making themselves understood, especially those with SLD.

Thus the SLD children may sometimes be deprived of communication-enhancing responses from their parents or caregivers.

4.2 The Role of Gesture

The present study found that it is unusual for a child in the two-to-six-year age range to use *Gesture only* in communicating with parents, with the exception being two-year-old SLD children in about 10% of responses. It is also clear that the balance between *Speech plus gesture* and *Speech only* tends to shift somewhat toward *Speech only* in the older groups, whether TD or SLD. An important issue in interpreting these findings is what the term *gesture* meant to the parents who participated in the study. The *CPUCQ* provides the following information: “The word *gesture* refers to actions such as pointing, or shaking the head, and also to using baby signs. Not all children use gestures” (Figure 1). However, some parents’ comments provided insight into their views of what constituted gesture. Thirty parents (56%) of TD children and 21 parents (62%) of SLD children chose to comment at least once. Preliminary analyses of the comments of parents of TD children show that when the parents chose *Speech plus gesture*, they mentioned conventional gestures such as head and hand movements most often, with prominent use of pointing (Baus et al., 2021). However, the parents also included general body language as gesture (e.g., touches/grabs listener, demonstrates, acting/animated/dramatic, as well as large motor responses). Based on these comments, it is possible that many of the parents had an expansive view of gesture. If confirmed, this preliminary finding may explain why the present study shows gesture accompanying at least 40% of speech acts by TD children through age 6;5, while much of the literature on gesture suggests that children combine speech with gesture in the transition to multiword speech, and thereafter, speech alone strongly predominates. In several such studies (e.g., Goldin-Meadow, 2020), the gestures under study appear to be more symbolic or iconic (e.g., squeezing the hand shut, or pointing to two matching objects in succession) than the broader range referenced in parent comments on the *CPUCQ*.

4.3 Importance of the *CPUCQ* Overall Communication Score

The composite Communication Score for each *CPUCQ* situation can be thought of as a measure of how well the child communicates a message using the modalities available to the child. The parent is familiar with the modalities used by the child and with the pragmatic situation because of sharing the child’s everyday life and activities. The summary situational intelligibility score, the OCS, is the score best suited to comparing groups of children such as the TD and SLD groups in the present study. The OCS assists the clinician in accounting for the child’s communication abilities and planning intervention.

An additional feature of the *CPUCQ* is that it is possible to determine OCS for children for whom language sampling and *SALT* analysis are not possible, as was the case for three nonverbal and one unintelligible child in the SLD group. Moreover, of the intelligibility assessments that are available to assess children’s speech, none are actually standardized for English-speaking children as young as age two.

4.4 Potential Clinical Use of the *CPUCQ*

The *CPUCQ* may have clinical utility beyond the obviously normative uses. Because this questionnaire is intended to reflect typical communication situations, SLPs may find it helpful in counseling parents and in therapeutic planning. For example, the parents’ experience in filling out the *CPUCQ* may alert them to the importance of gesture for their child’s effective communication, and the SLP can help them pay more attention to their child’s gestures, especially if this improves intelligibility. When it comes to treatment planning, the pragmatic situations in the *CPUCQ* may provide a hierarchy of difficulty for the child, and the SLP can help the child become more intelligible, for example, by using more gestures, or by breaking a complex communication into a series of shorter utterances (which are more likely to be understood).

4.5 Limitations of the Study and Implications for Future Research with the *CPUCQ*

The TD and SLD groups we studied were far smaller than needed to standardize an assessment instrument, nor did they include a range of children of different socioeconomic status and from different socio-cultural groups. This limitation means that any findings cannot readily be applied to the general TD and SLD populations. Nevertheless, the initial analysis suggests that the *CPUCQ* possesses construct validity as a measure because of its origins in the research literature about pragmatic situations in which developing children need to communicate and because of input from SLPs in early childhood settings. The questionnaire also derives construct validity from the relationship between OCS and age, with OCS increasing in older age groups (at least for TD children). In addition, both the Mode scale and the Understandability scale show change in usage over the age range for both TD and SLD children. Validity is also implied by the fact that there is a clear range of difficulty across the 31 situations presented in the questionnaire. Yet another element of construct validity is that the *CPUCQ* should differentiate

SLD children from TD children. It appears that many children with SLD have lower OCS than TD children, but a limitation of the study is that this possibility is based on visual rather than statistical evidence (Figure 2).

One additional limitation of this study is that the SLD children were selected and subsequently grouped on the basis of their SLPs' reported treatment categories, without information about severity. As a result, one child could have been close to dismissal from treatment, while another might be in the early stages of treatment. Nevertheless, another finding relative to construct validity is that for the SLD children, the *CPUCQ* appears to show positive change in OCS over a three- to four-month period of intervention. Future studies with SLD children and the *CPUCQ* will need additional documentation of the communication needs of these children.

One final consideration relates to criterion validity of the *CPUCQ*. Criterion validity derives from the relationship between OCS and MLU for both the TD and the SLD children (MLU also correlates with age for TD children). In addition, the OCS correlates significantly with the intelligibility measure PIU for the SLD children. The internal reliability of the *CPUCQ* appears to be acceptable for both TD and SLD groups, as does test-retest reliability. These findings need to be verified in future research.

5. Conclusion

The *CPUCQ* is a novel assessment of situational intelligibility that documents how well parents and caregivers understand their young children in a variety of typical communication situations. The preliminary information derived from the *CPUCQ* appears to have clinical utility for practitioners working with young children in the areas of communication development and disorders. These initial data suggest that larger samples of both TD children and children with SLD with diverse SES representation are warranted.

6. Acknowledgements

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Competing Interest Statement

The authors have no conflicts of interest to disclose.

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Appendix**Supplementary Materials #1**

**Burnett, Pelczarski, and Smit: Exploring Assessment of Situational Intelligibility in Children
with and without Speech-Language Disorders**

Caregiver/Parent Understanding-the Child Questionnaire

Investigators: Ann Smit, Debra Burnett, and Kristin Pelczarski
Kansas State University

You are invited to assist researchers at Kansas State University to develop a way to measure how understandable a preschooler's speech is to people in his or her environment.

This is a study to determine how a child's ability to be understood changes over time. Your comments are welcome, and space is provided for them.

Child's Initials: _____ Child's Birthdate: _____ Child's Sex: **M** **F**

Today's Date: _____

Please indicate your relationship to this child, e.g. mother, father, grandparent, child care provider, teacher, etc.:

Do you have concerns about your child's speech or language development? **Yes** **No** (Please circle)

If Yes, please explain: _____

Is your child in speech or language therapy at present? **Yes** **No** (Please circle)

If Yes, please explain: _____

Please use the following categories to indicate how your child communicates in each situation:

- **Speech only**
- **Speech plus gesture**
- **Gesture only**
- **Child does not do this**

Please use the following scale to rate how well the listener understands this child in each situation below:

| | | | | | |
|-------------------------|-------------------------|--------------------------|-----------------------------|---------------------------|--------------------------|
| UNDERSTANDABILITY SCALE | 1 | 2 | 3 | 4 | 5 |
| | Never understand | Rarely understand | Sometimes understand | Usually understand | Always understand |

| UNDERSTANDABILITY SCALE | 1 | 2 | 3 | 4 | 5 |
|-------------------------|------------------|-------------------|----------------------|--------------------|-------------------|
| | Never understand | Rarely understand | Sometimes understand | Usually understand | Always understand |

| SITUATION Note 1: The word <i>gesture</i> refers to actions such as pointing, or shaking the head, and also to using baby signs. Not all children use gestures. Note 2: If the child uses vocalizations, such as grunts, that help to convey meaning, you should consider them speech. However, please note thenature of the vocalizations in the Comments area for each item. | HOW How does the child usually indicate this? Please circle or mark one option. | UNDERSTANDABILITY Use the scale above to indicate how well you understand the child. Circle the appropriate number. |
|---|---|---|
| 1. The child asks you for more. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 2. The child tells you about food likes and dislikes. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 3. The child tells about a recent activity or event not known or not experienced by the listener (you). <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 4. The child talks to a person who is not familiar, e.g. a store clerk. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 5. The child tells you about internal state, for example, being hungry or thirsty, needing to potty, or hurting. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |

| UNDERSTANDABILITY SCALE | | 1 | 2 | 3 | 4 | 5 |
|---|--|-------------------|-------------------|----------------------|--------------------|-------------------|
| | | Never understand | Rarely understand | Sometimes understand | Usually understand | Always understand |
| Situation | How | Understandability | | | | |
| 6. The child talks on phone to a relative or family friend. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 | 2 | 3 | 4 | 5 |
| 7. The child tells about a recent activity or event that is known or experienced by the listener (you). <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 | 2 | 3 | 4 | 5 |
| 8. The child explains (to you) what's wrong, for example, why he/she is crying. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 | 2 | 3 | 4 | 5 |
| 9. The child says "thank you" (to you). <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 | 2 | 3 | 4 | 5 |
| 10. The child says his/her own name or names of siblings, toys, or pets to an unfamiliar person. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 | 2 | 3 | 4 | 5 |
| 11. The child protests (to you) when asked to do something, for example, to get ready for bed. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 | 2 | 3 | 4 | 5 |

UNDERSTANDABILITY SCALE 1 2 3 4 5
 Never Rarely Sometimes Usually Always
 understand understand understand understand understand

| Situation | How | Understandability |
|--|--|-----------------------|
| 12. The child talks to the teacher or caregiver. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 13. The child explains (to you) how to do something, or describes a current activity, for example, building with blocks. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 14. The child calls your attention to something on a page or to something that is happening. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 15. The child refuses something that is offered, for example, a toy or more food. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 16. The child calls a person, for example, from another room. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only The child does not do this | 1 2 3 4 5 |
| 17. The child asks you a wh-question (where, who, how, when, what), for example, "Where go?" or "Where are you going?" <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |

UNDERSTANDABILITY SCALE 1 2 3 4 5
 Never Rarely Sometimes Usually Always
 understand understand understand understand understand

| Situation | How | Understandability |
|---|--|-------------------|
| 18. The child tells you or another familiar person to do something. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 19. The child names an object, an action, or a picture in a storybook (for you). <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 20. The child directs your attention to an object, book, activity, etc. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 21. The child tells you a brief story that is made-up or one he/she has heard. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 22. The child requests an object (from you) that is NOT present in the context or situation. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 23. The child attempts to tell (you) a joke. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |

UNDERSTANDABILITY SCALE 1 2 3 4 5
 Never Rarely Sometimes Usually Always
 understand understand understand understand understand

| Situation | How | Understandability |
|---|--|-----------------------|
| 24. The child makes a comment (to you), for example, about a picture in a storybook. <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 25. The child indicates that he or she is all done, for example, with a snack. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 26. The child asks (you) a Yes/No question, for example, "Want this?" or "Do you want this?" <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 27. The child requests an object that is present in the context or situation (from you). <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 28. The child talks on the phone to a parent or sibling. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 29. The child uses polite forms to make requests (of you), e.g. "Can/may I?" <i>Comment?</i> | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |

UNDERSTANDABILITY SCALE 1 2 3 4 5
 Never Rarely Sometimes Usually Always
 understand understand understand understand understand

| Situation | How | Understandability |
|---|--|---|
| 30. The child tries to tell a play partner what to do. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> Comment? | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |
| 31. The child says names of siblings, toys, or pets to unfamiliar person. <i>(Please use the scale to indicate how that person appears to understand the child.)</i> Comment? | Speech only Speech plus gesture Gesture only Child does not do this | 1 2 3 4 5 |

Additional Questions

32. How often do you find yourself translating or talking for your child to another person? (Please circle)

1 = Never 2 = Rarely 3 = Sometimes 4 = Usually 5 = Always

33. Has your child been taught any "baby sign"? Yes No

- A. Please give an example:
- B. How did your child learn baby sign?
- C. How long has your child used baby sign?

34. Any additional comments that you want to share are welcome.

Supplementary Materials #2

Burnett, Pelczarski, and Smit: Exploring Assessment of Situational Intelligibility in Children with and without Speech-Language Disorders

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- 1 Results of Judges' Ranking of Combinations of Mode and Understandability Ratings**
- 2 Children's Use of Mode of Communication and Understandability Ratings**
- 3 Determining Item Difficulty on the CPUCQ**
- 4 Use of Gesture in Easy and Difficult Situations**

1. Results of Judges' Ranking of Combinations of Mode and Understandability Ratings

The goal of this procedure was to produce a single Communication Score for each combination of Mode of communication and Understandability rating. Each of five judges was given slips of paper, with each combination printed on one slip. They were asked to rank the combinations by how well the child communicates by putting the slips of paper in order from zero to 15. The results are shown in Table S1.

Table S1. Rankings of CPUCQ Mode and Understandability combinations assigned by five SLPs

| <i>Mode + Understandability Combination</i> | Mean ranking | Modal ranking |
|---|--------------|---------------|
| <i>Speech only + Always understand</i> | 15.0 | 15 |
| <i>Speech plus gesture + Always understand</i> | 13.8 | 14 |
| <i>Gesture-only + Always understand</i> | 12.8 | 13 |
| <i>Speech only + Usually understand</i> | 12.2 | 12 |
| <i>Speech plus gesture + Usually understand</i> | 11.0 | 11 |
| <i>Gesture only + Usually understand</i> | 10.2 | 10 |
| <i>Speech only + Sometimes understand</i> | 8.8 | 9 |
| <i>Speech plus gesture + Sometimes understand</i> | 8.0 | 8 |
| <i>Gesture only + Sometimes understand</i> | 7.2 | 7 |
| <i>Speech only + Rarely understand</i> | 5.8 | 6 |
| <i>Speech plus gesture + Rarely understand</i> | 5.0 | 5 |
| <i>Gesture only + Rarely understand</i> | 4.2 | 4 |
| <i>Speech only + Never understand</i> | 2.8 | 3 |
| <i>Speech plus gesture + Never understand</i> | 2.0 | 2 |
| <i>Gesture only + Never understand</i> | 1.2 | 1 |
| <i>Child does not do this</i> | 0.0 | 0 |

2. Children's Use of Mode of Communication and Understandability Ratings

The text of the paper provides the summary data in Tables 2 and 3. The table below shows the same data broken down by age separately for typically developing (TD) children and children with speech-language disorder (SLD).

Table S2. Modes of Communication and Ratings of Understandability for TD and SLD Children by Full-year Age Groups, Shown as the Percentage of Responses

| TWO-YEAR-OLDS | | | | | | | |
|------------------------------------|---------|---------------------------------------|------|------------------------------------|---------|---------------------------------------|------|
| TD Children n = 12 | | | | SLD Children n = 4 | | | |
| Mode of Communication ^a | | Understandability Rating ^b | | Mode of Communication ^a | | Understandability Rating ^b | |
| <i>Speech only</i> | 46.8 | <i>Always</i> | 39.7 | <i>Speech only</i> | 9.2 | <i>Always</i> | 1.3 |
| <i>Gesture plus speech</i> | 51.0 | <i>Usually</i> | 44.1 | <i>Gesture plus speech</i> | 46.2 | <i>Usually</i> | 19.2 |
| <i>Gesture only</i> | 0.3 | <i>Some-times</i> | 15.9 | <i>Gesture only</i> | 10.1 | <i>Some-times</i> | 41.0 |
| <i>Does not do this</i> | 1.9 | <i>Rarely</i> | 0.3 | <i>Does not do this</i> | 34.5 | <i>Rarely</i> | 33.3 |
| NR | count=7 | <i>Never</i> | 0.0 | NR | count=5 | <i>Never</i> | 5.1 |
| THREE-YEAR-OLDS | | | | | | | |
| TD children n = 12 | | | | SLD children n = 12 | | | |
| Mode of Communication ^a | | Understandability Rating ^b | | Mode of Communication ^a | | Understandability Rating ^b | |
| <i>Speech only</i> | 45.8 | <i>Always</i> | 50.4 | <i>Speech only</i> | 35.7 | <i>Always</i> | 27.6 |
| <i>Gesture plus speech</i> | 54.2 | <i>Usually</i> | 37.9 | <i>Gesture plus speech</i> | 49.9 | <i>Usually</i> | 39.2 |
| <i>Gesture only</i> | 0.0 | <i>Some-times</i> | 9.8 | <i>Gesture only</i> | 0.5 | <i>Some-times</i> | 28.2 |
| <i>Does not do this</i> | 0.0 | <i>Rarely</i> | 1.6 | <i>Does not do this</i> | 13.9 | <i>Rarely</i> | 4.7 |
| NR | count=5 | <i>Never</i> | 0.3 | NR | count=5 | <i>Never</i> | 0.3 |
| FOUR-YEAR-OLDS | | | | | | | |
| TD children n = 12 | | | | SLD children n = 8 | | | |
| Mode of Communication ^a | | Understandability Rating ^b | | Mode of Communication ^a | | Understandability Rating ^b | |
| <i>Speech only</i> | 59.4 | <i>Always</i> | 62.2 | <i>Speech only</i> | 36.4 | <i>Always</i> | 19.6 |
| <i>Gesture plus speech</i> | 40.1 | <i>Usually</i> | 34.1 | <i>Gesture plus speech</i> | 43.8 | <i>Usually</i> | 45.2 |
| <i>Gesture only</i> | 0.0 | <i>Some-times</i> | 3.8 | <i>Gesture only</i> | 1.7 | <i>Some-times</i> | 29.8 |
| <i>Does not do this</i> | 0.5 | <i>Rarely</i> | 0 | <i>Does not do this</i> | 18.2 | <i>Rarely</i> | 5.0 |
| NR | count=0 | <i>Never</i> | 0 | NR | count=6 | <i>Never</i> | 0 |

| FIVE-YEAR-OLDS | | | | | | | |
|------------------------------------|---------|---------------------------------------|------|------------------------------------|---------|---------------------------------------|------|
| TD children n = 12 | | | | SLD children n = 12 | | | |
| Mode of Communication ^a | | Understandability Rating ^b | | Mode of Communication ^a | | Understandability Rating ^b | |
| <i>Speech only+666+3011</i> | 59.7 | <i>Always</i> | 79.2 | <i>Speech only</i> | 54.4 | <i>Always</i> | 14.8 |
| <i>Gesture plus speech</i> | 40.3 | <i>Usually</i> | 19.7 | <i>Gesture plus speech</i> | 45.6 | <i>Usually</i> | 53.7 |
| <i>Gesture only</i> | 0.0 | <i>Some-times</i> | 1.1 | <i>Gesture only</i> | 0 | <i>Some-times</i> | 27.3 |
| <i>Does not do this</i> | 0.0 | <i>Rarely</i> | 0 | <i>Does not do this</i> | 0 | <i>Rarely</i> | 4.2 |
| NR | count=7 | <i>Never</i> | 0 | NR | count=0 | <i>Never</i> | 0 |
| SIX-YEAR-OLDS | | | | | | | |
| TD children n = 6 | | | | SLD children n = 3 | | | |
| Mode of Communication ^a | | Understandability Rating ^b | | Mode of Communication ^a | | Understandability Rating ^b | |
| <i>Speech only</i> | 57.3 | <i>Always</i> | 68.1 | <i>Speech only</i> | 55.6 | <i>Always</i> | 19.7 |
| <i>Gesture plus speech</i> | 42.7 | <i>Usually</i> | 29.7 | <i>Gesture plus speech</i> | 33.3 | <i>Usually</i> | 33.3 |
| <i>Gesture only</i> | 0.0 | <i>Some-times</i> | 2.2 | <i>Gesture only</i> | 0 | <i>Some-times</i> | 42.4 |
| <i>Does not do this</i> | 0.0 | <i>Rarely</i> | 0 | <i>Does not do this</i> | 1.4 | <i>Rarely</i> | 4.5 |
| NR | count=1 | <i>Never</i> | 0 | NR | count=7 | <i>Never</i> | 0 |

^a The Non-Responses (NR) are not included in the totals for percentage scores for Mode of Communication.

^b Neither the NRs nor the *Does not do this* responses are included in the totals for percentage scores of Understandability Ratings.

3. Determining Item Difficulty on the CPUCQ

Item difficulty for a test is usually determined by the number of participants who “Pass” an item, a procedure appropriate for plus/minus scoring. However, we had a multidimensional scoring system, and for this reason we took the mean CS for each situation across the entire group, and then we ranked those means. Table S3 shows the ranking for the TD children. The situation with the highest mean CS (“Child says ‘Thank you’”) was ranked 1 (least difficult), and the situation with the lowest mean CS (“The child attempts to tell (you) a joke”) was ranked 31 (most difficult). Examination of these scores suggested that the pragmatic situations covered a range of performance, with mean CS of 14.75 at the “least difficult” end and mean CS of 10.4 at the “most difficult” end. The remaining 29 situations were relatively evenly spread across the range between these extremes. Interestingly, the situation that the authors expected would have the highest mean CS, “Child asks you for more,” was actually the third highest; however, it was the only one of the least difficult situations that all respondents completed. Additionally, we had included two situations on the CPUCQ that described the child drawing the respondent’s attention to something (i.e., item 14 and item 20), and as expected, they had similar difficulty—13.07 and 13.20, respectively.

Table S3. For TD Children, Mean Communication Score for Each CPUCQ Question Averaged over All Participants and Ranked from 1 (Easiest) to 31 (Most Difficult)

| Rank | Question number | Pragmatic Situation | Mean Communication Score | Number of Non-Responses |
|------|-----------------|--|--------------------------|-------------------------|
| 1 | Q9 | The child says, “thank you” (to you). | 14.75 | 1 |
| 2 | Q25 | The child indicates that he or she is all done, for example, with a snack. | 14.38 | 1 |
| 3 | Q1 | The child asks you for more. | 14.33 | 0 |
| 4 | Q17 | The child asks you a Wh-question (where, who, how, when, what), for example, “Where go?” or “Where are you going?” | 14.09 | 1 |
| 5 | Q2 | The child tells you about food likes and dislikes. | 14.02 | 0 |
| 6 | Q5 | The child tells you about internal state, for example, being hungry or thirsty, needing to potty, or hurting. | 13.98 | 1 |
| 7 | Q26 | The child asks (you) a Yes/No question, for example, “Want this?” or “Do you want this?” | 13.93 | 0 |
| 8 | Q11 | The child protests (to you) when asked to do something, for example, to get ready for bed. | 13.91 | 1 |
| 9 | Q16 | The child calls a person, for example, from another room. | 13.89 | 0 |
| 10 | Q15 | The child refuses something that is offered, for example, a toy or more food. | 13.87 | 0 |
| 11 | Q27 | The child requests an object that is present in the context or situation (from you). | 13.85 | 0 |
| 12 | Q31 | The child says names of siblings, toys, or pets to a familiar person. | 13.72 | 0 |
| 13 | Q19 | The child names an object, an action, or a picture in a storybook (for you). | 13.35 | 0 |
| 14 | Q7 | The child tells about a recent activity or event that is known or experienced by the listener (you). | 13.31 | 2 |
| 15.5 | Q24 | The child makes a comment (to you), for example, about a picture in a storybook. | 13.26 | 0 |
| 15.5 | Q18 | The child tells you or another familiar person to do something. | 13.26 | 0 |

| | | | | |
|----|-----|--|-------|---|
| 17 | Q29 | The child uses polite forms to make requests (of you), e.g. "Can/may I?" | 13.22 | 0 |
| 18 | Q20 | The child directs your attention to an object, book, activity, etc. | 13.20 | 0 |
| 19 | Q14 | The child calls your attention to something on a page or to something that is happening. | 13.07 | 0 |
| 20 | Q22 | The child requests an object (from you) that is NOT present in the context or situation. | 12.72 | 0 |
| 21 | Q12 | The child talks to the teacher or caregiver. | 12.72 | 1 |
| 22 | Q13 | The child explains (to you) how to do something, or describes a current activity, for example, building with blocks. | 12.65 | 0 |
| 23 | Q30 | The child tries to tell a play partner what to do. | 12.11 | 0 |
| 24 | Q10 | The child says his/her own name or names of siblings, toys, or pets to an unfamiliar person. | 12.10 | 2 |
| 25 | Q21 | The child tells you a brief story that is made-up or one he/she has heard. | 11.87 | 0 |
| 26 | Q3 | The child tells about a recent activity or event not known or not experienced by the listener (you). | 11.81 | 1 |
| 27 | Q8 | The child explains (to you) what's wrong, for example, why he/she is crying. | 11.66 | 4 |
| 28 | Q28 | The child talks on the phone to a parent or sibling. | 11.40 | 1 |
| 29 | Q6 | The child talks on the phone to a relative or family friend. | 10.81 | 1 |
| 30 | Q4 | The child talks to a person who is not familiar, e.g. a store clerk. | 10.79 | 1 |
| 31 | Q23 | The child attempts to tell (you) a joke. | 10.67 | 2 |

For the SLD children, the item difficulty list (as shown in Table S4) was derived in the same way as for the TD children, using the data from the first visit. The list of the 31 pragmatic situations was arranged from easiest (low ranking, high CS) to most difficult (high ranking, low CS). There are many similarities to the comparable list for the TD children. Both groups had relatively high scores in such situations as saying "thank you," asking for more, and indicating "all done." There were also similarities at the more difficult end of the scale with situations such as telling a joke or talking to a store clerk, but there were some notable differences between the two populations as well. For example, the easiest questions for the TD children had average CS between 14 and 15, and the most difficult had average CS between 10 and 11. The range was much larger for the SLD group, for whom the easiest questions had average CS between 11 and 13, while the most difficult had average CS between 4 and 7.

Table S4. For SLD Children, Mean Communication Score for Each *CPUCQ* Question Averaged over All Participants and Ranked from 1 (Easiest) to 31 (Most Difficult)

| Rank | Question number | Pragmatic Situation | Mean Communication Score | Number of Non-Responses |
|------|-----------------|--|--------------------------|-------------------------|
| 1 | Q9 | The child says “thank you” (to you). | 12.82 | 1 |
| 2 | Q1 | The child asks you for more. | 11.79 | 0 |
| 3 | Q25 | The child indicates that he or she is all done, for example, with a snack. | 11.81 | 2 |
| 4 | Q15 | The child refuses something that is offered, for example, a toy or more food. | 11.48 | 1 |
| 5 | Q27 | The child requests an object that is present in the context or situation (from you). | 11.21 | 1 |
| 6 | Q20 | The child directs your attention to an object, book, activity, etc. | 11.15 | 1 |
| 7 | Q19 | The child names an object, an action, or a picture in a storybook (for you). | 10.85 | 1 |
| 8 | Q5 | The child tells you about internal state, for example, being hungry or thirsty, needing to potty, or hurting. | 10.69 | 2 |
| 9 | Q11 | The child protests (to you) when asked to do something, for example, to get ready for bed. | 10.63 | 2 |
| 10 | Q16 | The child calls a person, for example, from another room. | 10.27 | 1 |
| 11 | Q18 | The child tells you or another familiar person to do something. | 10.06 | 1 |
| 12 | Q2 | The child tells you about food likes and dislikes. | 9.97 | 2 |
| 13 | Q24 | The child makes a comment (to you), for example, about a picture in a storybook. | 9.71 | 0 |
| 14 | Q17 | The child asks you a wh-question (where, who, how, when, what), for example, “Where go?” or “Where are you going?” | 9.53 | 0 |
| 15 | Q14 | The child calls your attention to something on a page or to something that is happening. | 9.52 | 1 |
| 16 | Q31 | The child says names of siblings, toys, or pets to a familiar person. | 9.50 | 0 |
| 17 | Q12 | The child talks to the teacher or caregiver. | 9.26 | 0 |
| 18 | Q22 | The child requests an object (from you) that is NOT present in the context or situation. | 9.21 | 0 |
| 19 | Q7 | The child tells about a recent activity or event that is known or experienced by the listener (you). | 8.09 | 1 |
| 20 | Q13 | The child explains (to you) how to do something, or describes a current activity, for example, building with blocks. | 8.06 | 0 |
| 21 | Q26 | The child asks (you) a Yes/No question, for example, “Want this?” or “Do you want this?” | 7.91 | 1 |
| 22 | Q10 | The child says his/her own name or names of siblings, toys, or pets to an unfamiliar person. | 7.56 | 2 |

| | | | | |
|----|-----|--|------|---|
| 23 | Q30 | The child tries to tell a play partner what to do. | 7.47 | 2 |
| 24 | Q29 | The child uses polite forms to make requests (of you), e.g. "Can/may I?" | 7.44 | 0 |
| 25 | Q8 | The child explains (to you) what's wrong, for example, why he/she is crying. | 7.35 | 0 |
| 26 | Q28 | The child talks on the phone to a parent or sibling. | 7.29 | 0 |
| 27 | Q3 | The child tells about a recent activity or event not known or not experienced by the listener (you). | 6.35 | 0 |
| 28 | Q6 | The child talks on phone to a relative or family friend. | 6.24 | 0 |
| 29 | Q4 | The child talks to a person who is not familiar, e.g. a store clerk. | 6.12 | 0 |
| 30 | Q23 | The child attempts to tell (you) a joke. | 5.88 | 1 |
| 31 | Q21 | The child tells you a brief story that is made-up or one he/she has heard. | 4.35 | 0 |

4. Use of Gesture in Easy and Difficult Situations

In order to determine if children used different ways to communicate in "easy" situations than they did in "difficult" situations, we looked at the distribution of responses for the ten easiest situations and the most difficult situations, shown in Table S5. These analyses are based on the Item Difficulty tables S3 and S4. For their ten easiest situations, the TD children used *Speech only* about 60% of the time, and *Speech plus gesture* about 40% of the time, which resulted in their parents marking *Always understand* about 85% of the time and *Usually understand* the rest of the time. In contrast, the TD children used *Speech only* and *Speech plus gesture* about equally often for the ten most difficult situations. Their parents understood them much less often, choosing *Always understand* about 30% of the time, *Usually understand* about 50% of the time and *Sometimes understand* about 20% of the time. In other words, it appears that the children occasionally added gesture for the difficult situations, but their communication was nevertheless more difficult for their parents to understand.

Table S5. The Ten Easiest and the Ten Most Difficult Situations for the TD and SLD Children with Frequencies Shown as Percentages of the Total

| TD Children | | | | | | | |
|----------------------------|------|--------------------------|------|-----------------------------------|------|--------------------------|------|
| The Ten Easiest Situations | | | | The Ten Most Difficult Situations | | | |
| Mode of Communication | | Understandability Rating | | Mode of Communication | | Understandability Rating | |
| Speech only | 60.4 | Always understand | 84.3 | Speech only | 49.4 | Always understand | 29.4 |
| Speech plus gesture | 38.7 | Usually understand | 14.8 | Speech plus gesture | 46.8 | Usually understand | 48.1 |
| Gesture only | 0 | Sometimes understand | 0.7 | Gesture only | 0.2 | Sometimes understand | 19.1 |
| | | Rarely understand | 0 | | | Rarely understand | 1.3 |
| | | Never understand | 0 | | | Never understand | 0.2 |
| Does not do this | 0 | | 0 | Does not do this | 1.3 | | 1.3 |
| No response | 0.7 | | 0.7 | No response | 2.2 | | 2.2 |

| SLD Children | | | | | | | |
|----------------------------|------|--------------------------|------|-----------------------------------|------|--------------------------|------|
| The Ten Easiest Situations | | | | The Ten Most Difficult Situations | | | |
| Mode | | Understandability Rating | | Mode | | Understandability Rating | |
| Speech only | 37.9 | Always understand | 29.1 | Speech only | 38.2 | Always understand | 3.2 |
| Speech plus gesture | 52.6 | Usually understand | 40.9 | Speech plus gesture | 32.6 | Usually understand | 20.9 |
| Gesture only | 2.9 | Sometimes understand | 17.9 | Gesture only | 0.6 | Sometimes understand | 34.7 |
| | | Rarely understand | 1.8 | | | Rarely understand | 11.5 |
| | | Never understand | 0.3 | | | Never understand | 1.2 |
| Does not do this | 2.9 | | 2.9 | Does not do this | 27.1 | | 27.1 |
| No response | 3.5 | | 3.5 | No response | 1.4 | | 1.4 |

The patterns of communication with “easy” and “difficult” situations were different for the SLD children because of the role played by the *Child does not do this* response. For their ten easiest situations, the SLD children relied extensively on *Gesture plus speech* (about 53% of the time) and *Speech only* (about 38% of the time). This resulted in parental ratings of *Always understand* (30% of the time), *Usually understand* (40% of the time), and *Sometimes understand* (about 18% of the time). In contrast, for the ten most difficult situations, about 27% of the time parents of SLD children checked *Child does not do this*. The remaining communication attempts for difficult situations were *Speech plus gesture* (about 33%) and *Speech only* (about 38%). Parents revealed how problematic it was to understand their children in the ten most difficult situations by choosing *Always understand* only about 3% percent of the time, *Usually understand* about 21% of the time, *Sometimes understand* about 35% of the time, and *Rarely understand* about 12% of the time. In other words, for the ten easiest situations, the SLD children relied heavily on *Speech plus gesture* and *Speech only*, resulting in their parents often understanding them. However, with respect to the more difficult communication situations, a quarter of them were never attempted. The children who did attempt the difficult situations relied on speech with and without gesture, although these efforts had negative effects on the ratings of parental understanding compared to their communication in the ten easiest situations.

Discussion

One of the issues relating to gesture use is whether use of gesture improves the child’s ability to be understood in the moment. Much of the literature on gesture appears to focus on the role that iconic or meaningful gesture plays in the child’s language development and as a predictor of future development (e.g. Thal & Tobias, 1994; Goldin-Meadow, 2020). In addition, research by Goldin-Meadow and colleagues (LeBarton et al., 2015; Novak et al., 2015) has emphasized the role of gesture in children’s learning of new words and of new math concepts. However, it is unclear whether use of gesture helps the child to be understood in a conversational interaction, an issue that may not have been addressed directly in research. Implicit in the many studies that look at children’s gestures is that the parents understand the gestures, along with any speech that accompanies them (e.g. Goldin-Meadow et al., 2007).

The question of whether using the types of gesture reported in the present study helps children to be understood is generally beyond the scope of the present study. However, there are hints about the answer to this question in the data about the ten easiest situations and the ten most difficult situations for the TD children and for the SLD children. For their ten most difficult situations, the TD children somewhat increased their use of *Speech plus gesture* compared to the ten easiest situations, but their understandability ratings decreased. That is, the additional use of gesture may not have helped them in the most difficult communication tasks. For the SLD children, their understandability ratings dropped markedly in the ten most difficult situations compared to the ten easiest, and their use of *Speech plus gesture* also decreased (from about 53% to 32%). Thus it is possible that adding gesture to speech helps the SLD children in the easiest situations but not the more difficult ones. However, the picture relating to the most difficult situations is complicated by the large number of situations in which a child did not attempt to communicate at all. This means that the group of children providing data in the most difficult situations is missing data points from some of the children who provide data points on the easiest situations.

An important point about the comparisons between the easiest and the most difficult situations for both groups of children is that several of the most difficult ones require the child to formulate longer and more complex utterances than for the easiest situations, for example, in order to tell a joke. Simply using more gesture is not likely to result in intelligible communication in these situations. Thus a cautious answer to the question of whether adding gesture to speech helps the child to be understood is that it may depend on the characteristics of the group and the difficulty of the communication task.

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