AJSLP

Review Article

The Association Between Parental Mean Length of Utterance and Language Outcomes in Children With Disabilities: A Correlational Meta-Analysis

Micheal Sandbank[a] and Paul Yoder[b]

Purpose: The purpose of this correlational meta-analysis was to examine the association between parental utterance length and language outcomes in children with disabilities and whether this association varies according to other child characteristics, such as age and disability type. This association can serve as a starting point for language intervention practices for children with disabilities.
Method: We conducted a systematic search of 42 electronic databases to identify relevant studies. Twelve studies reporting on a total of 13 populations (including 257 participants) were identified. A random-effects model was used to estimate a combined effect size across all studies as well as separate effect sizes across studies in each disability category.
Results: The combined effect size across all studies suggests a weak positive association between parental input length and child language outcomes. However, subgroup analyses within disability categories suggest that this association may differ for children with autism. Results of 4 studies including 47 children with autism show that parental input length is strongly associated with positive language outcomes in this population.
Conclusions: Present evidence suggests that clinicians should reconsider intervention practices that prescribe shorter, grammatically incomplete utterances, particularly when working with children with autism.

The manner in which parents talk to their children is important. The apparent complexity of language acquisition and the ease with which children who are typically developing acquire vocabulary and syntax without explicit instructions has led several researchers to theorize about the underlying mechanisms that facilitate language acquisition in young children. A wealth of evidence suggests that certain speech exhibited by adults when speaking to children (sometimes referred to as *motherese*, hereafter referred to as *child-directed speech*) serves as a vital aid to children learning language (Kuhl et al., 1997; Snow, 1972; Thiessen, Hill, & Saffran, 2005; Werker et al., 2007). Child-directed speech is universally demonstrated by adults speaking to young children (Grieser & Kuhl, 1988). It is theorized to operate as a filter of human speech, making important features of language more salient and processable (Grieser & Kuhl, 1988; Thiessen et al., 2005; Werker et al., 2007). As a result, the attributes of child-directed speech are of great interest to researchers because they shed light on the process of child language acquisition. This knowledge can serve as a starting point for intervention when a child's language is delayed or impaired.

Investigations have shown that child-directed speech is different from speech directed to adults in that it is consistently characterized by higher pitch, slower rate of delivery, longer pauses, and expanded intonation contours (Ferguson, 1964; Grieser & Kuhl, 1988; Sherrod, Crawley, Petersen, & Bennett, 1978). In addition, child-directed speech is marked by shorter utterances that are semantically and syntactically simpler than speech spoken to adults (Snow, 1972). Although a large body of research describes the properties of child-directed speech, less is known regarding whether any single characteristic of child-directed speech plays a key role in promoting language production. This gap in knowledge is especially pertinent to the debate regarding one aspect of child-directed speech: grammaticality.

[a]The University of Texas at Austin
[b]Vanderbilt University, Nashville, TN
Correspondence to Micheal Sandbank: michealpaigesandbank@gmail.com

Editor: Krista Wilkinson
Associate Editor: Carol Miller
Received January 21, 2015
Revision received June 26, 2015
Accepted September 1, 2015
DOI: 10.1044/2015_AJSLP-15-0003

Disclosure: The authors have declared that no competing interests existed at the time of publication.

The extent to which the grammaticality of child-directed speech influences language processing is unknown (van Kleeck et al., 2010). Children's early expressive language is often typified as "telegraphic," or like a telegram, in that it consists only of core content words that convey semantic meaning (Brown, 1973). Telegraphic speech is stripped of morphemes that primarily serve grammatical functions, such as prepositions, conjunctions, and auxiliary verbs. Child production of telegraphic speech is a normal part of early language development, but experts disagree as to whether adult use of telegraphic speech facilitates child language acquisition (van Kleeck et al., 2010).

Some evidence suggests that parental telegraphic speech may play a role in promoting child language development. For example, parental input is naturally telegraphic to some extent, in so far as it is marked by shorter utterances and syntactical simplicity (Snow & Ferguson, 1977). In theory, simplified parental input limits ancillary information while emphasizing the most essential elements of language. Various language interventions that use telegraphic speech as part of an intervention package have been demonstrated as effective for children with language disabilities (Dawson et al., 2010; Kaiser, Hancock, & Nietfeld, 2000). For example, the Early Start Denver Model (Rogers & Dawson, 2010) recommends that caregivers of children with autism spectrum disorder follow the "one-up" rule, which prescribes adding one word to the number of words used in a child's spontaneous production. Examples of adult responses given in the manual include telegraphic phrases such as "Want ball?" and "Pop bubbles."[1] However, it is possible that other aspects of the intervention beyond telegraphic speech were responsible for the observed treatment effect.

On the other hand, some experts insist that grammatical input is an important aspect of language learning, arguing that it provides important linguistic cues that are useful to children with language impairments (van Kleeck et al., 2010). There is robust evidence that proves this is the case for children that are typically developing. For example, children who are typically developing use function words and inflections to identify the grammatical function and meaning of novel words (Behrend, Harris, & Cartwright, 1995; Golinkoff, Hirsh-Pasek, & Schweisguth, 2001; Höhle & Weissenborn, 2003). Indeed, longer parental utterances (which likely feature more grammatical content) are associated with longer child utterances in children who are typically developing (Barnes, Gutfreund, Satterly, & Wells, 1983; Moerk, 1975). Moreover, longer parental utterances are predictive of later vocabulary in children who are typically developing (Hoff & Naigles, 2002). Thus there is support for the hypothesis that longer and more grammatically complex utterances provide children with a wealth of information that they can use to develop more robust language.

The nature of this debate has particular relevance to clinical practice for treating children with language impairments. Although children who are typically developing will likely go on to develop robust language even with linguistic models of varied grammaticality, the same cannot be said for children with language impairments or delays. It is possible that a certain type of input with a certain level of grammaticality better facilitates language acquisition in children with language impairments. The evidence base addressing this issue has been considered in a previous review. Van Kleeck and colleagues (2010) reviewed intervention research that compared the use of telegraphic input to grammatical input for children with language impairments, and only three intervention studies met the criteria for review, all of which were published prior to 1980. Analyses of their results suggested comprehension outcomes did not differ on the basis of type of input. One small study ($N = 10$) suggested a small effect of telegraphic input on language production. Because intervention evidence was severely limited, van Kleeck and colleagues turned to processing studies, which examined responses to telegraphic and grammatical input using experimental tasks in children who were typically developing as well as those with language impairments or delays. The results overwhelmingly favored grammatical input in studies of children who were typically developing, but were mixed in studies of children with language impairments. Bredin-Oja and Fey (2014) recently examined the effects of telegraphic and grammatically complete language models on grammatical morphemes used by five children with language impairments. Two children did not use grammatical morphemes in either condition, but three children produced more grammatical morphemes when presented with grammatically complete prompts. Thus the evidence base favoring either approach as an intervention is inconclusive, and this is illustrated by the array of different expert opinions (Van Kleeck et al., 2010).

Objectives

This review article examines the effect of the grammaticality of parental input on language outcomes in children with disabilities by using a proxy measure of the extent of grammatical input: mean length of utterance (MLU). This measure reflects the average number of morphemes used per utterance in a speech sample. Although MLU does not directly measure the grammatical complexity of an utterance, there is much evidence to suggest that these two aspects of language development are closely related in children who are typically developing and some evidence to support this relation in children with language impairments or delays. The MLU of the speaker has been shown to be positively associated with various indexes of grammatical complexity in children, including the number and diversity of grammatical categories (Newport, Gleitman, & Gleitman, 1977; Shipley, Smith, & Gleitman, 1969), the emergence of semantic–syntactic relationships (Bloom, Lightbown, Hood, & Bowerman, 1975), and the acquisition

[1]Sentence examples are from Rogers & Dawson, 2010. Copyright © 2010 Guilford Press. Reprinted with permission from Guilford Press (one-time, non-exclusive, in English only).

of grammatical morphemes (de Villiers & de Villiers, 1973). In addition, Scarborough, Rescorla, Tager-Flusberg, Fowler, and Sudhalter (1991) showed that MLU was closely related to an index of syntactic and morphological proficiency (the Index of Productive Syntax) in children who were typically developing as well as in children with language impairments. This association was especially high for children who were typically developing with MLU below 3.0 ($r > .9$) and children with language impairments who exhibited MLU below 3 ($r > .8$). Even in children who were typically developing and whose MLU exceeded 3.0, this relation was still significant and strong ($r > .5$). Although the relation between these two aspects of language development has largely been demonstrated in children rather than adults, there is still reason to expect that it holds in child-directed speech because parents tend to restrict their utterance length when speaking to young children (Snow, 1972). Thus there is sufficient evidence to support the use of MLU as a proxy measure of grammatical complexity.

To date no meta-analytic investigations have examined the relation between parental utterance length and child language outcomes for children with disabilities. Understanding the population-estimated relation between these two outcomes may shed light on the extent of their importance. The presence of a strong correlation between these two outcomes would justify further research examining causality regardless of whether the length of parental input affects language outcomes in children with disabilities. Confirmation of such causality would have wide implications for clinical practice, providing an evidence base that justifies the deliberate use of more grammatical or more telegraphic speech in intervention settings. Therefore, we investigated the relation between parental MLU and language outcomes in children with developmental disabilities using studies that reported correlations or data from which correlations could be estimated. Correlational evidence is not causal, and the directionality of the relation cannot be assumed: A strong correlation could be evidence that parent input influences child language outcomes or that aspects of child language influence parent input. Still, correlational evidence is useful for illuminating potentially causal relations when intervention evidence is lacking, and it can set the stage for subsequent investigations that can establish causality. In addition, we examined the extent to which this relation varied according to mental age, chronological age, and disability type of participants.

Methods

Eligibility Criteria

Participants

Eligible studies were required to include two populations of participants. The first population type was children age 12 years and younger with a reported diagnosis of a developmental disability that is known to delay language development. Relevant diagnoses included autism, Down syndrome, intellectual disability (formerly termed *mental retardation*), cerebral palsy, specific language impairment, and pervasive developmental disorder–not otherwise specified. Studies that included participants with multiple disability types or those with comorbid diagnoses were also included. Studies were excluded if their participants were being raised in a bilingual environment or had a diagnosis of traumatic brain injury, hearing impairment, stuttering disorder, or visual impairment. These exclusions were necessary because these types of impairments are thought to differently affect child language development and its potential relation to parental input. The second population type was at least one parent or primary caregiver for each of the children included in the study. Studies were excluded if they reported parents to be deaf or bilingual. These exclusions were necessary because these characteristics are known to affect the length of parental input. The status of the parent as biologically related to the child was not considered.

Outcomes

Included studies reported on at least two outcomes: (a) a measure of parental utterance length and (b) a measure of child language outcomes. Acceptable measures of parental input were restricted to MLU and variations thereof (e.g., MLU morphemes, MLU for spontaneous utterances, parent-to-child MLU ratio). Acceptable measures of child language were any standardized, parent-report, or observational measure of any aspect of language development. Outcomes were not required to be measured concurrently or collected from a specific type of measurement context.

Study Design

Any empirical studies that reported correlation coefficients between acceptable parent input and child language outcomes were included. Studies were also included if they reported data from which correlations could be estimated, such as raw scores for both outcomes or means and standard deviations for subgroups representing dichotomized outcomes. Acceptable correlations were concurrent or predictive. Studies were not excluded if they investigated the effects of an intervention on parental input or language outcomes so long as they reported data that permitted estimation of preintervention correlation coefficients for all participants. Studies were not required to include control or comparison groups.

Type of Publication

All types of available data were eligible for inclusion in this meta-analysis. These include dissertations and theses, conference reports, peer-reviewed articles, and data sets published in databanks. There were no restrictions regarding date of publication. Studies were excluded if they were not published in English. However, data from a French-speaking population were analyzed by the author and included. This exception was made because no translation was required for the analysis.

Information Sources

To identify and retrieve all published data that met the eligibility criteria specified, we searched 39 databases simultaneously using the ProQuest electronic search engine (http://www.proquest.com). The final search of the ProQuest database was conducted on August 13, 2014. In addition, to ensure that the sources adequately examined unpublished studies, we searched the British Education Index and Australian Education Index. Backward searching of studies identified as eligible was used to identify any literature that was not collected through our electronic searches. Two authors were contacted because potentially relevant data were referenced in their studies, but the information included in the manuscript was insufficient to permit the estimation of effect sizes, and only one author replied. In addition, all 130 corpora of the Child Language Data Exchange System (MacWhinney, 2000) were examined for relevant unpublished data sets.

Search

Our search strategy included four sets of search terms that represented the following four constructs: parent, language, disability, and utterance length. Root words with multiple forms were identified with wildcard characters so that all variants of the root could be identified (e.g., autis* to locate autism and autistic). Relevant search terms were linked within each category by the Boolean operator “OR” and across categories using the operator “AND.” A set of search terms indicating exclusionary criteria was linked to preceding sets via the operator “NOT.” The exact syntax used for all electronic searches is as follows:

> all(parent* OR caregiver* OR maternal OR paternal OR “parental input” OR “parent-child communicat*” OR “father-child communicat*” OR “paternal input” OR “maternal input”) AND all(Language OR “language development” OR “language acquisition” OR linguistic OR communicat* OR verbal OR vocabulary OR “mean length of utterance” OR “MLU” OR “language age” OR speech OR words) AND all(disability OR disable* OR autis* OR asperges* OR delay* OR disorder* OR develop* OR “Intellectual Disability” OR “intellectually disabled” OR “mental retardation” OR “mentally retarded” OR “mental delay” OR “mentally delayed” OR impair* OR “Down syndrome” OR “cerebral palsy” OR “specific language impairment” OR “SLI”) AND all(“MLU” OR “mean length of utterance” OR “utterance length” OR utterance OR “number of different words”) NOT all(“deaf” OR “hearing impaired” OR “hearing impairment” OR “stuttering” OR injur* OR cochlear OR vis* OR bilingual).

Study Selection

Studies were screened at the abstract level for relevance. Citations were removed from the pool of potentially eligible studies if abstracts did not specifically state that participants were disabled, disordered, or clinically impaired. Citations also were removed if abstracts referred to specially excluded populations (i.e., deaf, visually impaired, bilingual). Single-case designs and qualitative studies were also excluded at the abstract level. After initial abstract-level elimination, the remaining studies were accessed online, retrieved from interlibrary loan or microfilm storage, and examined at the full-text level. Elimination was then conducted through sequenced searching for eligibility criteria. Studies were examined for participant characteristics, a measure of parental utterance length, a measure of child language, and inclusion of correlational data (or data that could be used to estimate correlations in their absence). Studies that contained all four of these information components were included in the review.

Variables

The final set of included studies and data sets were coded for a number of study characteristics. These included the year of publication, type of publication, number of child participants, caregiver type (mother or father), and metric of utterance length. Because utterance length is an observational measure, its calculation method often varies across studies. Although it is most often referred to as the MLU, which averages the number of words per utterance, it may also be indexed as the MLU in morphemes (MLUm), the mean length of spontaneous utterances in words (MLUs), or the ratio of parent utterance length to child utterance length (aMLU/cMLU). Child characteristics that were recorded from each report included the type of disability, mean age of participants at study entry, measure of child language, any measure of cognition (IQ or mental age), and mean cognitive score at study entry.

Summary Measures

The product–moment correlation coefficient was used to index the size of the relation between parental input and child language. This effect size was chosen because many studies already report bivariate relations between continuous variables using this metric (Lipsey & Wilson, 2001). Each effect size was coded as reported for each study or estimated in its absence using means and standard deviations or raw scores for each participant. The correlation coefficient was estimated only when means and standard deviations for one outcome were reported for subgroups that represented a dichotomization of the other outcome of interest (for details regarding the estimation process, see Borenstein, Hedges, Higgins, & Rothstein, 2011). If multiple measures of the same construct (e.g., multiple measures of child language) were reported, then the first reported effect size was coded. This convention was chosen a priori to avoid biasing results toward larger effect sizes and to enable replication of the synthesis process. Choosing the first reported effect size, rather than choosing one at random, ensures that the search can be replicated in the future.

Analytic Strategies

Data were managed by the first author using an Excel spreadsheet (Microsoft, Redmond, WA). Estimates of effect size were transformed using Fisher Z_r-transform to avoid inaccurate standard errors resulting from the non-normal sampling distribution of the product–moment correlation coefficient (Lipsey & Wilson, 2001). The resulting transformed correlation coefficients were synthesized using a random-effects model to estimate the mean effect size. The random-effects model conservatively assumes that variance observed in effect estimates is partially due to sampling error and partially due to other unidentified sources. Use of the model mandates identification of the random-effects variance component, which is then added to the variance estimates for each effect size. The resulting variances are then used to compute the inverse variance weights for each effect estimate. Thus in a random-effects model, inverse variance weights reflect both the sample size and the random-effects variance, resulting in wider confidence intervals (Lipsey & Wilson, 2001). Use of this model is recommended when the included studies cannot be assumed to be functionally equivalent (e.g., when conducted by a range of authors across a wide span of time) and when the goal of the analysis is to generalize to a wide range of scenarios (Borenstein et al., 2011).

In addition to estimating the random-effects mean correlation coefficient, we examined other parameters of the random-effects analysis, including the estimate of between-study variance (τ^2), the weighted squared deviation (Q) and its test of significance, and the ratio of true heterogeneity to observed variation (I^2). These indexes are used to gauge the likelihood that variance in effect size between studies is nonrandom and attributable to an unexamined moderator. To explore possible explanations for nonrandom heterogeneity in effect estimates, we conducted a random-effects disability subgroup analysis and examined the extent to which age moderated the effect of parental input on child language. Publication bias was examined via a trim-and-fill analysis and an Egger test for bias. All analyses were conducted with *R* statistical software (R Core Team, 2013) using the metafor package (Veichtbauer, 2010).

Results

Study Selection

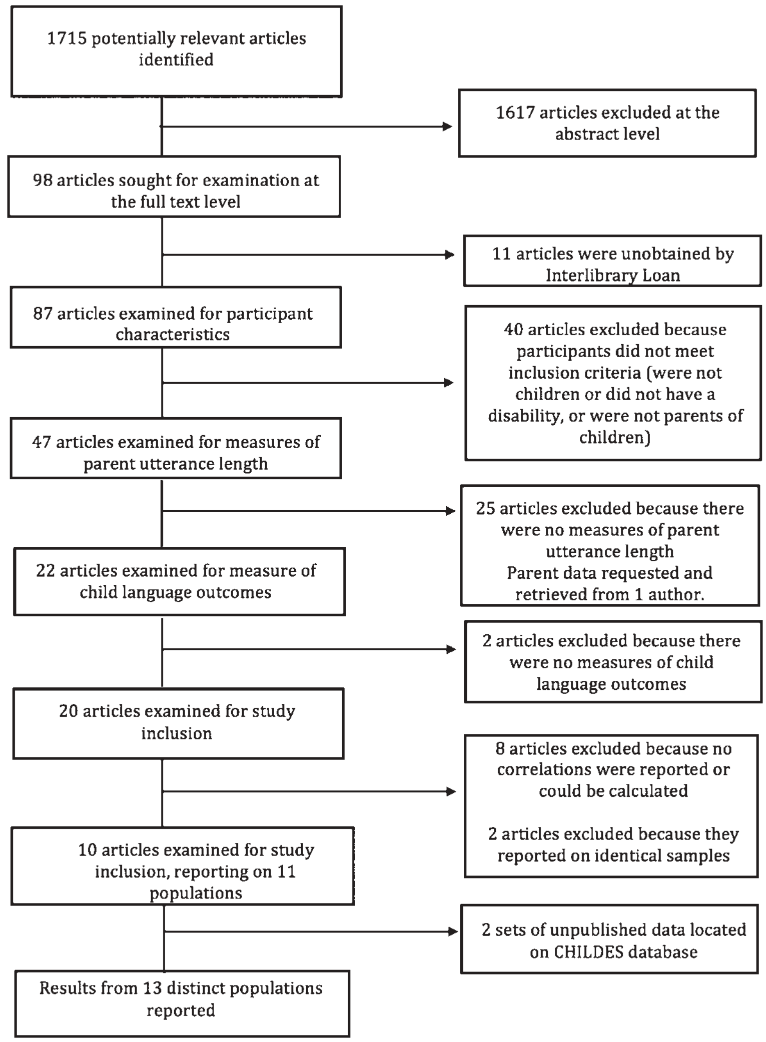
The search of combined databases using the ProQuest search engine yielded a total of 1,446 references. Of these, 1,023 were from scholarly journals, 285 were dissertations or theses, 63 were reports, 47 were books, and 28 were other sources. Our searches of the Australian Education Index and the British Education Index yielded 269 results, bringing the total number of screened studies to 1,715. Of these, 1,617 were excluded at the abstract level, leaving 98 to be examined at the full-text level. Of these articles, 11 were not retrieved via interlibrary loan as a result of issues with date or location of publication (citations were old or difficult to retrieve from other countries). However, given that approximately 10% of the studies screened at the full-text level were eligible for inclusion, it is likely that only one of these studies might have qualified for inclusion in this analysis. Two data sets were retrieved from the Child Language Data Exchange System database and analyzed (MacWhinney, 2000). Reported results reflect data from a total of 13 distinct populations. Figure 1 illustrates the screening process for identified studies.

Study Characteristics

Table 1 summarizes the characteristics of the 13 included study populations (from 12 studies), which reported on a total of 257 children. All of the studies were conducted in North America and published after 1978. Three of the eligible studies were dissertations, one was a conference report, two were unpublished data sets, and six were published in peer-reviewed scholarly journals. Hamilton (1985) reported on two distinct but eligible populations. As a result, effect sizes for these subgroups were recorded separately. Of the 13 populations reported, five were composed exclusively of children with Down syndrome, two of children with specific language impairment, four of children with autism, and one of a child with intellectual disabilities. The largest study reported on a sample composed of children with multiple developmental disabilities, including Down syndrome, cerebral palsy, and intellectual disability. The mean age in months of child participants across all studies was 52.46 (SD = 21.11). Of the eligible reports, 10 specified that parental input data were collected from mothers of included children, whereas two (Barker, 2007; Burgess, Audet, & Harjusola-Webb, 2013) referred to included caregivers as "parents." The primary measure of parental utterance length was MLU (in words): 10 of the studies tracked parent language outcomes using MLU (Burgess et al., 2013; Grelle, 2013; Hamilton, 1985; Hooshyar, 1985; Hwang & Windsor, 1999; Kaiser, Hemmeter, Blair, & Rourke, 1987; Konstantareas, Mandel, Homatidis, 1988; Nadig, 2012; Rondal, 1978; Tingley, Gleason, Hooshyar, 1994). In contrast, Barker (2007) reported using the MLUm, and Cunningham, Siegel, Van der Spuy, Clark, and Bow (1985) reported using a ratio of the maternal MLU divided by the child MLU (aMLU/cMLU).

Regarding the child language outcomes, Cunningham et al. (1985) and Konstantareas et al. (1988) reported expressive language scores from the Reynell Developmental Language Scales (Reynell, 1977). Barker (2007) reported regression results for multiple language outcomes. The standardized beta weight that indexed the relation between parental input and the Sequenced Inventory of Communication Development–Revised (Hedrick, Prather, & Tobin, 1984) was coded as the effect size for this report because it was listed first. Burgess et al. (2013) reported raw data for several acceptable measures of language, so data from the first measure listed (Expressive Communication subscale from the Vineland-II Adaptive Behavior Scales; Sparrow, Balla, & Cicchetti, 2005) was used to calculate a correlation. Hwang and Windsor (1999) reported the MLU for

Figure 1. Study screening process.



spontaneous child utterances in words (MLUs). Child outcomes from the remaining reports and analyzed data sets were reflected as the MLU in words. All effect sizes were concurrent rather than predictive.

Cognitive scores were reported for only six of the included populations. Language ages were accepted as a proxy measure for cognitive ability when intelligence quotient scores or mental ages were not reported. For each of the studies that reported it, the mean mental or language age was exceeded by the mean chronological age by at least 19 months, indicating significant cognitive deficits. Table 1 presents information regarding cognitive measures and the mean scores for participants in each study.

Main Results

A forest plot reflecting the results of a random-effects analysis of observed effect sizes is presented in Figure 2. The overall random-effects mean correlation coefficient was .23, 95% confidence interval (CI) [−0.02, 0.46]. Because the CI surrounding this mean effect includes zero, there is insufficient evidence to definitively state that the length of parental utterance is positively associated with child language outcomes in children with disabilities as a whole. However, because more than 90% of the CI includes positive values, we can cautiously speculate that the true value of this association is positive. However, it is possible that the combined effect size reflects heterogeneous study populations more than it reflects a true effect, and examination of various indexes of homogeneity of effects suggests that this was the case.

The analysis of homogeneity of effects revealed that nonrandom heterogeneity was present in our sample of effect size estimates. There was a significant estimate of weighted squared deviations of effect sizes, $Q(10) = 35.82$, $p < .001$. This allowed us to reject the null hypothesis that all studies estimated a common effect size and led us to calculate the variance of the true effect sizes. Our estimate

Table 1. Study demographics.

Study	Pub type	Disability	Age in months	Cognitive Measure	Cognitive Score	Caregiver type	Parent language measure	Child language measure	*n*
		Participant characteristics							
Barker (2007)	D	COM	29.47	Mullen ELC	59.02	Parent	MLUm	SICD Exp	60
Burgess, Audet, & Harjusola-Webb (2013)	PA	AUT	54.7	Vineland Expressive Language Age	24.3 months	Parent	MLU	Vineland Expressive	10
Cunningham, Siegel, Van der Spuy, Clark, & Bow (1985)	PA	SLI	47	Leiter IQ	108	Mother	aMLU/cMLU	Reynell Exp	47
Grelle (2013)	D	AUT	28	NR	NR	Mother	MLU	MLU	5
Hamilton (1985)	D	DS	34	NR	NR	Mother	MLU	MLU	12
		SLI	33.8	NR	NR	Mother	MLU	MLU	12
Hooshyar (1985)	UD	DS	64.48	Vineland Mental Age	44.35 months	Mother	MLU	MLU	31
Hwang & Windsor (1999)	PA	DS	52	NR	NR	Mother	MLU	MLUs	8
Kaiser, Hemmeter, Blair, & Rourke (1987)	CP	ID	35.37	NR	NR	Mother	MLU	MLU	4
Konstantareas, Mandel, & Homatidis (1988)	PA	AUT	91.25	Reynell Language Age	51 months	Mother	MLU	Reynell Exp	12
Nadig (2012)	UD	AUT	60	NR	NR	Mother	MLU	MLU	20
Rondal (1978)	PA	DS	90	NR	NR	Mother	MLU	MLU	21
Tingley, Gleason, & Hooshyar (1994)	PA	DS	62	Vineland Mental Age	43 months	Mother	MLU	MLU	15

Note. Pub type = publication type; D = dissertation; COM = combined disabilities; ELC = early learning composite; MLUm = mean length of utterance in morphemes; SICD Exp = Expressive Language Score from the Sequenced Inventory of Communicative Development; PA = peer-reviewed article; AUT = autism; MLU = mean length of utterance; SLI = specific language impairment; aMLU/cMLU = adult MLU divided by child MLU; Reynell Exp = Expressive Language subscore from the Reynell Developmental Language Scales; NR = not reported; DS = Down syndrome; CP = conference paper; ID = intellectual disability; UD = unpublished data; MLUs = mean length of spontaneous utterances.

of between-studies variance (τ^2) was 0.12. The total amount of this variability due to true heterogeneity, as opposed to sampling error, was reflected by the I^2 estimate of 65.98%. In other words, nearly 70% of the observed variance reflected real differences in effect sizes. This served as a rationale for conducting a moderator analysis to identify the source of heterogeneity.

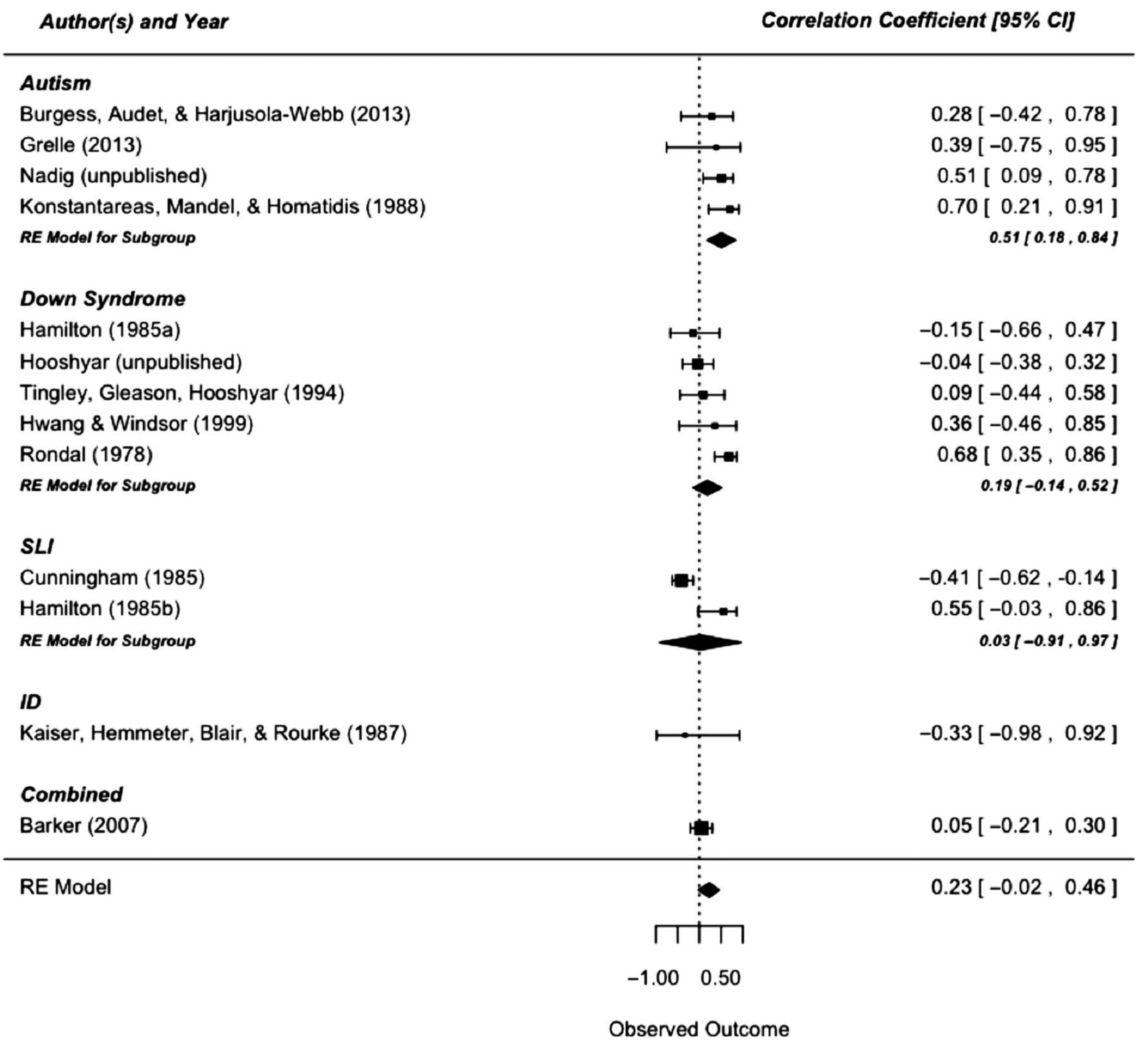
Moderator Analysis

The extent to which the relation between parental input length and child language was moderated by cognitive ability was not estimable given that fewer than half of the studies reported participant cognition and given that those studies used varied and incomparable scales. However, there is evidence in extant literature that maternal MLU is correlated with child MLU and child age (Barnes et al., 1983; Moerk, 1975). Therefore, we conducted a random meta-regression using the random-effects model to examine the extent to which chronological age moderated the relation between parental input and language outcomes in children with disabilities. Results indicated that the slope of the relation between chronological age and the effect size of parental MLU and child language was not statistically different from zero ($\beta = .01$, $p = .08$). Thus we were unable to explain the presence of greater than expected variance by adding age as a predictor.

Subgroup Analysis

To examine the question of whether the relation between parental input length and child language differed across differently disabled populations, we conducted a random-effects subgroup analysis by disability type. The random-effects mean correlations for the studies of children with Down syndrome, specific language impairment, and autism were, respectively, .19, 95% CI [−.14, .52]; .03, 95% CI [−.91, .97]; and .51, 95% CI [.18, .84]. Combined effect sizes within subgroups are also presented in Figure 2. Although all subgroup estimated mean effects were positive (indicating the possibility of a positive relation between parental length of utterance and child language outcomes), only the effect size associated with the four investigations of children with autism was significant. These four studies included a total of 47 participants with autism. Effect sizes for studies of children with autism ranged from .28 to .70. Thus all four effect-size estimates for this disability category were positive, two of which were strong and significantly positive. Our confidence in the results is limited by the small number of studies populating each disability category, but they provide emerging evidence that the association between parental input length and child language outcomes is positive and particularly important for children with autism. The clinical significance of these associations is elaborated on further in the discussion.

Figure 2. Forest plot of correlation coefficients.



Additional Analyses

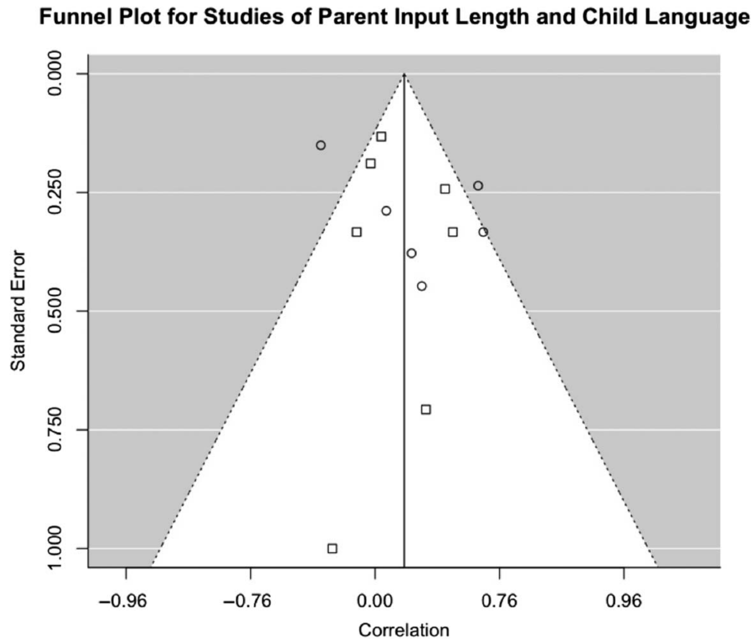
Figure 3 presents a funnel plot reflecting a trim-and-fill analysis, which we used to examine the effect of publication bias. No studies were filled in the plot, suggesting that publication bias did not lead to overestimation or underestimation of effects. In addition, an Egger test for small study effects was not significant (z = .66, p =.50). These results suggest that the estimate of mean effect was not significantly swayed by outliers or publication bias.

Discussion

Summary of Evidence

The objective of this meta-analysis was to examine the relation between one aspect of parental input (length) and language outcomes for children with disabilities. Establishing the presence of a relation between these two outcomes is a precedent step in the determination of cause—whether variation in one outcome causes variation in another (Cook & Campbell, 1979). It should be noted that the presence of a relation does not provide information regarding the direction of an effect. It is plausible that aspects of parent input are influenced by aspects of child language and not the other way around. If parents of children with disabilities modify their utterance length to match or slightly exceed that of utterances exhibited by their children, then a positive relation between the two outcomes of interest would be observed. However, it is also possible that these outcomes are positively related because child language is influenced by aspects of parent input, including length and grammaticality. Two theories suggest this is the case, and these theories serve as the basis for contradictory intervention practices for language impairment. One theory argues that shorter utterances reduce language information to only what is salient, aiding greater uptake of information and fostering greater language learning in children with disabilities (Willer, 1974). Another theory argues that longer

Figure 3. Funnel plot illustrating correlational effect sizes plotted against their standard errors. Circles represent effect sizes from peer-reviewed published articles, and squares represent those taken from all other types of data.



utterances provide more language information, which children might use to acquire language rules (Bedore & Leonard, 1995; Fey, Long, & Finestack, 2003). The latter theory is discussed less often than the former. Because language interventionists and special education researchers are often tasked with providing recommendations for parental language input, it is important to estimate the magnitude of the association of these variables in children with disabilities as a preliminary step in assessing the validity of these theories. The results of the present review suggest that for children with developmental disabilities other than autism, this association is weakly positive at best. The random-effects mean correlation coefficient was small (.23) and the 95% CI included zero. The clinical implications of this weak relation, which may have a true value of zero, are limited.

However, results of the subgroup analysis that examined the association within disability type suggest that this relation may be positive for children with autism. Positive correlations between parent input length and child language outcomes were reported or calculated for all four studies of children with autism. Although two of the effect sizes in this subgroup had CIs that included zero, the mean effect size of this association for children with autism was strong (.51) and significantly different from zero. Although more investigations are needed to confirm this association, these results suggest that children with autism may benefit from hearing longer parental utterances.

We can speculate as to why this association is stronger for children with autism than for children with other disabilities. Parents of young children who are typically developing adapt many aspects of their language to the ability levels of their children, but this adaptation declines as children age and acquire language (Moerk, 1975; Shipley et al., 1969; Slobin, 1968). This parental fine-tuning may be cued in part by a child's emerging language and in part by the child's social response to parental input (i.e., the extent to which they provide physical cues that they are engaged in the interaction). Although parents of children who are typically developing may stop adapting their language as their children age, parents of children with other disabilities may continue to fine-tune, even as their children age, naturally cued to do so by their low language level and strong social responsiveness. However, this social responsiveness is lacking in children with autism. For example, children with autism are less able to coordinate their eye gaze with speaking partners and object referents (Mundy, Sigman, Ungerer, & Sherman, 1986). In a typical interaction, coordinated eye gaze can serve as an indication that a child is attending to a parent's verbal cues, even in the absence of a verbal response. Without these physical cues, parents of children with autism may decrease their attempts to adapt their language to the level of their child. As children with autism age, this decrease in parental fine-tuning would give way to an increasing exposure to longer utterances. However, if children with autism are, in fact, tacitly processing this input, then an increase in linguistically robust utterances will benefit their language growth. Although this explanation is speculative, it is interesting to note that the largest correlations between utterance length and language outcomes were from studies that featured older children with autism, with average ages of 60 and 91 months (Konstantareas et al., 1988; Nadig, 2012).

Clinical Implications

In light of the current results, what directions should be given to clinicians? There is little evidence to suggest that longer and grammatically complete utterances negatively affect language outcomes for most children with disabilities. Moreover, it is possible that children with autism benefit from input that is longer than is usually afforded by telegraphic speech. Multiple investigations have shown that children use cues embedded in grammatically complete input to parse speech and identify the meanings and functions of words (Bedore & Leonard, 1995; Behrend et al., 1995; Golinkoff et al., 2001) long before they themselves produce grammatically complete speech. Thus it is merited to recommend the use of grammatically complete speech when speaking to young children with disabilities. However, even in light of evidence from this and other investigations, we can speculate that there is a limit to this relationship. Longer is not necessarily better because children are not likely to understand sentences that far exceed their processing capacity. Unfortunately, at present we do not have a foolproof way to estimate a child's processing capacity. Thus caregivers and interventionists who use grammatically complete sentences when speaking to children but avoid extremely lengthy utterances are likely to maximize the probability that children will process their input. Making key words salient by changing pitch, tempo, and intonation in a way that is typical of child-directed speech is likely to improve the processability of input (Ferguson, 1964). In addition, referencing items currently in the child's focus will also aid noun learning (Akhtar, Dunam, & Dunam, 1991; Carpenter, Nagell, & Tomasello, 1998). Last, providing linguistic and nonlinguistic responses to children's communication attempts encourages future communication attempts from the child and provides words for the child's presumed meaning (Tamis-LeMonda, Bornstein, Baumwell, & Damast, 1996). Thus there is a broad evidence base supporting grammatically complete utterances that provide salient information about the focus of a child's attention and using the attributes of child-directed speech to make language easier to process. This should serve as a starting point for intervention when language is delayed.

Strengths

This study had several strengths. First, this was the first meta-analysis that examined this relation in children with disabilities. Second, the systematic search strategy included published and unpublished studies. Third, the meta-analysis was conducted using a random-effects model, which is recommended for its generality and realistic assumptions about study variability (Mosteller & Colditz, 1996). Fourth, multiple third variables were examined as potential explanations for effect size heterogeneity. Last, additional analyses suggested that the results were unaffected by publication bias.

Limitations

Some factors limit our confidence in the findings of this review. First, no reliability was conducted regarding the selection of included studies. In addition, only 13 effect sizes were included in the estimation of mean effect. As a result, this review was insufficiently powered to detect the significance of a small mean correlation. Last, the nature of this meta-analysis (correlational) permitted only detection of a linear relation. Thus it is possible that a nonlinear association exists between these two outcomes, but it cannot be detected with these methods.

Future Investigations

There are many ways that future investigations should examine the relation between parental input length and language outcomes in children with disabilities. First, although several studies have investigated this issue in populations typically developing and at risk, very few studies have sought to characterize parental input directed to children with disabilities in terms of utterance length and grammaticality. Thus more work should be done to paint a detailed picture of parental input to children with disabilities as well as the extent to which it varies by disability population and age. To this end, investigations involving language interventions could report preintervention correlations between parent MLU and child language outcomes to clarify the relation. Because it is also likely that this relation varies by disability type, investigations that include multiple disability types in the study sample should report separate correlations for each disability type, especially if the sample includes children with autism. Language interventionists might experimentally examine whether length and grammaticality of adult input affect language outcomes for children with disabilities by randomly assigning children to separate intervention conditions. These conditions could systematically vary utterance length and inclusion of grammatical morphemes to rigorously test whether they have a causal effect on child language outcomes.

Conclusions

It is important to determine the extent to which parental input affects child language outcomes, especially for children with disabilities. Knowledge of the dynamic interactions between parents and language-learning children might facilitate new insights regarding the mechanisms of language acquisition, permitting researchers to develop new intervention techniques that test the extent to which such mechanisms are causal. At present, numerous language intervention packages that have been demonstrated as effective for children with language disabilities recommend parental and clinician use of shortened speech. These include Enhanced Milieu Teaching (Hancock & Kaiser, 2006), the Early Start Denver Model (Rogers & Dawson, 2010), and the Hanen Program for Parents (Pepper, Weitzman, &

McDade, 2004). The results of this review and that of van Kleeck et al. (2010) confirm that there is insufficient evidence to support such a recommendation. Moreover, the results of the subgroup analysis conducted for this review suggest that such a practice could be detrimental for children with autism. As a result, interventionists should reconsider whether this attribute of these treatments is a critical and necessary part of treatment fidelity.

Acknowledgments

This article was supported by the Office of Special Education Programs (OSEP) training grant #H325D100034A, awarded to Ann Kaiser.

References

References marked with an asterisk indicate studies included in the meta-analysis.

Akhtar, N., Dunam, F., & Dunam, P. J. (1991). Directive interactions and early vocabulary development: The role of joint attentional focus. *Journal of Child Language, 18,* 41–50.

***Barker, R. M.** (2007). *Predicting oral language development in toddlers with significant developmental disabilities: The role of child and parent communication characteristics* (Thesis). Georgia State University, Atlanta.

Barnes, S., Gutfreund, M., Satterly, D., & Wells, G. (1983). Characteristics of adult speech which predict children's language development. *Journal of Child Language, 10,* 65–84.

Bedore, L. M., & Leonard, L. B. (1995). Prosodic and syntactic bootstrapping and their clinical applications: A tutorial. *American Journal of Speech-Language Pathology, 4*, 66–72.

Behrend, D. A., Harris, L. L., & Cartwright, K. B. (1995). Morphological cues to verb meaning: Verb inflections and the initial mapping of verb meanings. *Journal of Child Language, 22,* 89–106.

Bloom, L., Lightbown, P., Hood, L., & Bowerman, M. (1975). *Structure and variation in child language* (Vol. 40). Chicago, IL: University of Chicago Press.

Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2011). *Introduction to meta-analysis*. Hoboken, NJ: Wiley.

Bredin-Oja, S., & Fey, M. (2014). Children's responses to telegraphic and grammatically complete prompts to imitate. *American Journal of Speech-Language Pathology, 23,* 15–26.

Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.

***Burgess, S., Audet, L., & Harjusola-Webb, S.** (2013). Quantitative and qualitative characteristics of the school and home language environments of preschool-aged children with ASD. *Journal of Communication Disorders, 46,* 428–439.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of Society for Research in Child Development, 63*(4), i–174.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis for field settings*. Skokie, IL: Rand McNally.

***Cunningham, C. E., Siegel, L. S., Van der Spuy, H. I. J., Clark, M. L., & Bow, S. J.** (1985). The behavioral and linguistic interactions of specifically language-delayed and normal boys with their mothers. *Child Development, 56,* 1389–1403.

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., . . . Varley, J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. *Pediatrics, 125,* 17–23.

de Villiers, J. G., & de Villiers, P. A. (1973). A cross-sectional study of the acquisition of grammatical morphemes in child speech. *Journal of Psycholinguistic Research, 2,* 267–278.

Ferguson, C. A. (1964). Baby talk in six languages. *American Anthropologist, 66,* 103–114.

Fey, M. E., Long, S. H., & Finestack, L. H. (2003). Ten principles of grammar facilitation for children with specific language impairments. *American Journal of Speech-Language Pathology, 12,* 3–15.

Golinkoff, R. M., Hirsh-Pasek, K., & Schweisguth, M. A. (2001). A reappraisal of young children's knowledge of grammatical morphemes. In J. Weissenborn & B. Höhle (Eds.), *Approaches to bootstrapping: Phonological, lexical, syntactic and neurophysiological aspects of early language acquisition* (pp. 167–188). Philadelphia, PA: John Benjamins.

***Grelle, L.** (2013). *Mothers' conversational patterns: A comparison between typically developing children and young children with autism spectrum disorders* (Unpublished master's thesis). University of Missouri–Columbia, Columbia, MO.

Grieser, D. L., & Kuhl, P. K. (1988). Maternal speech to infants in a tonal language: Support for universal prosodic features in motherese. *Developmental Psychology, 24,* 14–20.

***Hamilton, G. J.** (1985). *Characteristics of maternal speech to different groups of children* (Unpublished doctoral dissertation). Peabody College for Teachers of Vanderbilt University, Nashville, TN.

Hancock, T. B., & Kaiser, A. P. (2006). Enhanced milieu teaching. In R. J. McCauley & M. E. Fey (Eds.). *Treatment of language disorders in children* (pp. 203–236). Baltimore, MD: Brookes.

Hedrick, D. L., Prather, E. M., & Tobin, A. R. (1984). *Sequenced inventory of communication development*. Seattle, WA: University of Washington Press.

Hoff, E., & Naigles, L. (2002). How children use input to acquire a lexicon. *Child Development, 73,* 418–433.

Höhle, B., & Weissenborn, J. (2003). German-learning infants' ability to detect unstressed closed-class elements in continuous speech. *Developmental Science, 6,* 122–127.

***Hooshyar, N.** (1985). Language interaction between mothers and their nonhandicapped children, mothers and their Down children, and mothers and their language-impaired children. Unpublished raw data.

***Hwang, M., & Windsor, J.** (1999). Imitation in the spontaneous language of children with and without Down syndrome. *Clinical Linguistics & Phonetics, 13,* 323–334.

***Kaiser, A., Hemmeter, M. L., Blair, G., & Rourke, M.** (1987). *Imitation by normal and developmentally delayed children in mother-child transactions*. Paper presented at the annual meeting of the Society for Research on Child Development, Baltimore, MD.

Kaiser, A. P., Hancock, T. B., & Nietfeld, J. P. (2000). The effects of parent-implemented enhanced milieu teaching on the social communication of children who have autism. *Early Education and Development, 11,* 423–446.

***Konstantareas, M. M., Mandel, L., & Homatidis, S.** (1988). The language patterns mothers and fathers employ with their autistic boys and girls. *Applied Psycholinguistics, 9,* 403–414.

Kuhl, P. K., Andruski, J. E., Chistovich, I. A., Chistovich, L. A., Kozhevnikova, E. V., Ryskina, V. L., . . . Lacerda, F. (1997, August 1). Cross-language analysis of phonetic units in language addressed to infants. *Science, 277,* 684–686.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.

MacWhinney, B. (2000). *The CHILDES Project: Tools for analyzing talk* (3rd ed.). Mahwah, NJ: Erlbaum.

Moerk, E. L. (1975). Verbal interactions between children and their mothers during the preschool years. *Developmental Psychology, 11,* 788–794.

Mosteller, F., & Colditz, G. A. (1996). Understanding research synthesis (meta-analysis). *Annual Review of Public Health, 17,* 1–23.

Mundy, P., Sigman, M., Ungerer, J., & Sherman, T. (1986). Defining the social deficits of autism: The contribution of nonverbal communication measures. *Journal of Child Psychology and Psychiatry, 27,* 657–669.

***Nadig, A.** (2012). Montreal parent-child interaction corpus: Children with autism spectrum disorders or typical development. Unpublished raw data.

Newport, E., Gleitman, H., & Gleitman, L. R. (1977). Mother, Id rather do it myself: Some effects and non-effects of maternal speech style. In C. E. Snow & C. A. Ferguson (Eds.), *Talking to children: Language input and acquisition* (pp. 109–149). New York, NY: Cambridge University Press.

Pepper, J., Weitzman, E., & McDade, A. (2004). *Making Hanen happen: It Takes Two to Talk—The Hanen Program for Parents: Leader's guide for certified speech-language pathologists*. Toronto, Ontario, Canada: The Hanen Center.

R Core Team. (2013). R: A language and environment for statistical computing [Computer software]. Vienna, Austria: R Foundation for Statistical Computing. Available from http://www.R-project.org/

Reynell, J. (1977). *Reynell Developmental Language Scales–Revised*. Windsor, UK: NFER.

Rogers, S. J., & Dawson, G. (2010). *Early Start Denver Model for Young Children with Autism: Promoting language, learning, and engagement*. New York, NY: Guilford Press.

***Rondal, J. A.** (1978). Patterns of correlations for various language measures in mother-child interactions for normal and Down's syndrome children. *Language and Speech, 21,* 242–252.

Scarborough, H. S., Rescorla, L., Tager-Flusberg, H., Fowler, A. E., & Sudhalter, V. (1991). The relation of utterance length to grammatical complexity in normal and language-disordered groups. *Applied Psycholinguistics, 12,* 23–45.

Sherrod, K. B., Crawley, S., Petersen, G., & Bennett, P. (1978). Maternal language to prelinguistic infants: Semantic aspects. *Infant Behavior & Development, 1,* 335–345.

Shipley, E. F., Smith, C. S., & Gleitman, L. R. (1969). A study in the acquisition of language: Free responses to commands. *Language, 45,* 322–342.

Slobin, D. I. (1968). Imitation and grammatical development in children. In N. S. Endler, L. R. Boulter, & H. Osser (Eds.), *Contemporary issues in developmental psychology* (pp. 437–443). New York, NY: Holt, Rinehart & Winston.

Snow, C. E. (1972). Mothers' speech to children learning language. *Child Development, 43,* 549–565.

Snow, C. E., & Ferguson, C. A. (Eds.). (1977). *Talking to children: Language input and acquisition: Papers from a conference sponsored by the Committee on Sociolinguistics of the Social Science Research Council (USA)*. New York, NY: Cambridge University Press.

Sparrow, S. S., Balla, D. A., & Cicchetti, D. V. (2005). *Vineland-II Adaptive Behavior Scales*. Crowley, TX: AGS Publishing.

Tamis-LeMonda, C., Bornstein, M., Baumwell, L., & Damast, M. (1996). Responsive parenting in the second year: Specific influences on children's language and play. *Early Development and Parenting, 5,* 173–183.

Thiessen, E. D., Hill, E. A., & Saffran, J. R. (2005). Infant-directed speech facilitates word segmentation. *Infancy, 7,* 53–71.

***Tingley, E. C., Gleason, J. B., & Hooshyar, N.** (1994). Mothers' lexicon of internal state words in speech to children with Down syndrome and to nonhandicapped children at mealtime. *Journal of Communication Disorders, 27,* 135–155.

van Kleeck, A., Schwarz, A. L., Fey, M., Kaiser, A., Miller, J., & Weitzman, E. (2010). Should we use telegraphic or grammatical input in the early stages of language development with children who have language impairments? A meta-analysis of the research and expert opinion. *American Journal of Speech-Language Pathology, 19,* 3–21.

Veichtbauer, W. (2010). Conducting meta-analysis in R with the metafor package. *Journal of Statistical Software, 36(3),* 1–48.

Werker, J. F., Pons, F., Dietrich, C., Kajikawa, S., Fais, L., & Amano, S. (2007). Infant-directed speech supports phonetic category learning in English and Japanese. *Cognition, 103,* 147–162.

Willer, B. (1974). Reduced versus nonreduced models in language training of MR children. *Journal of Communication Disorders, 7,* 343–355.