

Research Article

Relations Between Teacher Talk Characteristics and Child Language in Spoken-Language Deaf and Hard-of-Hearing Classrooms

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Purpose: The aim of this study was to examine relations between teachers' conversational techniques and language gains made by their deaf and hard-of-hearing students. Specifically, we considered teachers' reformulations of child utterances, language elicitations, explicit vocabulary and syntax instruction, and wait time.

Method: This was an observational, longitudinal study that examined the characteristics of teacher talk in 25 kindergarten through second-grade classrooms of 68 deaf and hard-of-hearing children who used spoken English. Standardized assessments provided measures of child vocabulary and morphosyntax in the fall and spring of a school year.

Characteristics of teacher talk were coded from classroom video recordings during the winter of that year.

Results: Hierarchical linear modeling indicated that reformulating child statements and explicitly teaching vocabulary were significant predictors of child vocabulary gains across a school year. Explicitly teaching vocabulary also significantly predicted gains in morphosyntax abilities. There were wide individual differences in the teachers' use of these conversational techniques.

Conclusion: Reformulation and explicit vocabulary instruction may be areas where training can help teachers improve, and improvements in the teachers' talk may benefit their students.

The path to language mastery tends to be a long, slow one for many deaf and hard-of-hearing (DHH) children (Blamey, 2003). Differences between DHH children's language development and the language development of hearing peers are present on a variety of measures, including language comprehension, general expressive language scores, and vocabulary (Cruz, Quittner, Marker, DesJardin, & CDaCI Investigative Team, 2013; Webb, Lederberg, Branum-Martin, & Connor, 2015). However, there is a range of outcomes in the language development of DHH children. Research suggests that language outcomes are related to age of identification and intervention, degree of hearing loss, and parental engagement and input (Coppens, Tellings, van der Veld, Schreuder, & Verhoeven, 2012; DesJardin & Eisenberg, 2007; Easterbrooks, Lederberg, & Connor, 2010; Geers, 2002; Lederberg, Schick, & Spencer,

2013). Less is known about the effect of educational factors on language outcomes.

Research with hearing children indicates that how teachers talk with their students influences child language growth (Cabell, Justice, McGinty, DeCoster, & Forston, 2015; Cabell et al., 2011; M. L. Rowe, 2012; Ruston & Schwanenflugel, 2010). Professionals have also suggested that teachers of DHH students can influence their students' language development, but there is little empirical work that supports this claim (Luckner & Cooke, 2010). The goal of this study was to examine what characteristics of teacher talk might facilitate DHH students' spoken language development in kindergarten through second-grade classrooms.

Adult Conversation Practices That Support Hearing Children's Language

There is strong evidence that features of adult language input matter for child language development. This finding has been established with parents and their children (Hoff-Ginsberg, 1986; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002; M. L. Rowe, Leech, & Cabrera, 2016), early childhood educators and their students (Dickinson & Porche, 2011; Girolametto, Weitzman, & Greenberg, 2003;

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Editor-in-Chief: Sean Redmond

Editor: GERALYN TIMLER

Received December 21, 2017

Revision received June 4, 2018

Accepted July 15, 2018

https://doi.org/10.1044/2018_JSLHR-L-17-0475

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

Justice, Mashburn, Pence, & Wiggins, 2008), and grade school teachers and their students (e.g., Gámez & Lesaux, 2015; Tobin, 1986). The current study examined teacher talk in DHH classrooms along five dimensions: repetition of child utterances, language elicitation, explicit vocabulary instruction, explicit grammar instruction, and the provision of wait time after asking questions. These dimensions were chosen based on research that indicates the positive effect of these characteristics of teacher talk on hearing children's language learning, as well as their frequent inclusion in recommendations to teachers on how to facilitate their students' language learning (Massey, 2004; Wasik & Jacobi-Vessels, 2017; Whorrall & Cabell, 2016). These practices are frequently included in interventions designed to improve the language of young hearing children by changing the conversational practices of their preschool teachers (Cabell et al., 2011; Justice et al., 2008), usually in combination with other practices and particular language and literacy curricula. These studies have found that children in intervention groups experienced stronger vocabulary gains over the course of the school year than children in control groups (Justice et al., 2008; Piasta et al., 2012; Wasik, Bond, & Hindman, 2006; Wasik & Hindman, 2011).

Three of the behaviors examined in this article have been studied extensively through interactive storybook reading interventions. Interactive storybook reading (also called dialogic reading; Whitehurst et al., 1988) encourages adults to ask children open-ended questions, expand children's utterances, and teach novel vocabulary by using child-friendly definitions during storybook reading. Interventions that train preschool and early elementary (K–2) teachers in interactive book reading result in greater child vocabulary gains compared to controls (e.g., Lonigan & Whitehurst, 1998; Mol, Bus, & de Jong, 2009; Wasik & Bond, 2001). The wide-scale replication of interactive storybook reading interventions and the strength of the study designs (i.e., the large number of randomized controlled trials) provide strong evidence that three of the supportive behaviors examined in this study are effective in improving language outcomes even in group settings (Mol et al., 2009). However, they only provide evidence for the effectiveness of all three behaviors used together in a single activity. The current study examined the effect of each individual behavior in a wider range of activities.

The above research suggests that changing the way teachers talk to children along multiple dimensions facilitates hearing children's language. There is also research that has examined the effect of individual dimensions on child language outcomes.

Reformulation

The repetition and expansion of children's statements in various forms is one of the most well-established and often-used techniques for improving language development, and researchers often draw distinctions among different ways of repeating and improving child statements. The remainder of this article will use "imitation" to refer to a verbatim repetition of a child statement, whereas

"reformulation"¹ will mean an adult statement, which includes a child utterance but adds or substitutes semantic or syntactic detail, corrects syntax, or changes the voice. Although imitation may be facilitative for preverbal children, it does not seem to be facilitative for older children (DesJardin, 2006). In contrast, reformulation may be beneficial for children at all ages. As Saxton (1997, 2005) argues, reformulations provide an immediate contrast between the child's language and a slightly more sophisticated or adultlike form of language. Furthermore, reformulations tend to be highly comprehensible and interesting to children because they have significant overlap with language the child has just produced. Randomized controlled trials indicate that reformulation is an effective method of improving expressive syntax in young, typically developing children (Nelson, Camarata, Welsh, Butkovsky, & Camarata, 1996; Saxton, 1997). In addition, Ruston and Schwanenflugel (2010) posit that vocabulary recasting (i.e., reformulations that include more sophisticated vocabulary) can improve children's vocabulary.

Language Elicitations

Use of language elicitions (i.e., questions and other statements that request dialogue, such as "Tell me more") in the classroom is frequently studied as a mechanism for language development because language elicitation creates a dialogue between teacher and student. Language elicitions are often considered as belonging to one of two categories: closed and open-ended. Closed language elicitions can be answered with a single word or short list of highly constrained possible answers. Conversely, open-ended elicitions are typically defined as questions that have more than one possible response or that require a multiword response. Open-ended elicitions are more likely to result in longer, more linguistically complex answers from students than closed elicitions (de Rivera, Girolametto, Greenberg, & Weitzman, 2005; Lee & Kinzie, 2012; Lee, Kinzie, & Whitaker, 2012; M. L. Rowe et al., 2016; Wood & Wood, 1983). These extended responses give children more practice-generating complex language and using the sophisticated vocabulary that they encounter in the classroom (Dickinson, Hofer, Barnes, & Grifenhagen, 2014), leading to better linguistic competence over time. Observational studies indicate that teachers' use of open-ended questions correlates with preschool children's language gains (Cabell et al., 2011; Wasik et al., 2006).

Explicit Vocabulary Instruction

Explicitly providing child-friendly definitions of novel words is another practice that is commonly recommended

¹Other researchers have chosen to call this behavior "negative evidence," "recasting," "expansion," and "expatiation," among other terms (e.g., Cruz et al., 2013; DesJardin & Eisenberg, 2007; Justice et al., 2008; Saxton, 1997; Smith, Warren, Yoder, & Feurer, 2004). Following the lead of Fey, Krulik, Loeb, and Proctor-Williams (1999), we have chosen to call all of these closely related behaviors "reformulations."

(e.g., Wasik & Jacobi-Vessels, 2017; Whitehurst et al., 1988; Whorral & Cabell, 2016). Child-friendly definitions help children to build a “tight web of knowledge” (Whorral & Cabell, 2016, p. 338) that connects new words to their existing knowledge. Research with hearing children shows that vocabulary interventions that include explicit definitions of words tend to be effective in improving language outcomes (McKeown & Beck, 2014; Weizman & Snow, 2001) and are more effective for improving vocabulary than interventions that rely on exposure alone (Marulis & Neuman, 2010, 2013; Stahl & Fairbanks, 1986). Because vocabulary and syntax are closely linked (Dixon & Marchman, 2007; Fisher, Hall, Rakowitz, & Gleitman, 1994; Gleitman & Gleitman, 1992), explicit vocabulary instruction may also support children’s acquisition of morphosyntax.

Explicit Grammar Instruction

Opinions on explicit syntax instruction for young students tend to be mixed and somewhat contentious. Many educators consider explicit grammar instruction to be futile and unengaging, particularly in the classrooms of younger learners (Eberhardt, 2013). Others suggest that students who struggle with syntax may have an even greater difficulty in comprehending and producing the complex syntax that is often required for schooling and that these children require explicit syntax teaching (Scott & Balthazar, 2013). With the exception of Foorman et al. (2006), who noted little time devoted to explicit grammar instruction in urban classrooms of early elementary school children, there is a paucity of research about explicit grammar instruction. Because of this paucity, we chose to examine the amount of explicit grammar instruction present in teacher talk, but no hypotheses were formed about its relation to child language outcomes.

Wait Time

Providing wait time, a pause of about 3 s after asking a question, may give students time to think about their answer and produce higher-quality language (M. B. Rowe, 1986). A multitude of research in upper-elementary and middle-school classrooms has established that longer teacher wait times lead to a plethora of positive outcomes and, most notably for this study, to longer student responses (Fagan, Hassler, & Szabo, 1981; M. B. Rowe, 1974; Tobin, 1986). This suggests wait time may also be beneficial for students’ language development, because students will have more practice generating complex language.

Language-Supporting Interactions With DHH Children

To our knowledge, there is very little research that has examined the effect of teacher talk on language outcomes of DHH children. In a review of vocabulary research with DHH students, Luckner and Cooke (2010) found no research that examined the relations between teacher talk and child language outcomes and only one study that examined the effect of a teacher-implemented intervention on

vocabulary. Paatsch, Blamey, Sarant, and Bow (2006) found that a teacher-provided intervention that included explicit vocabulary training (defining words and using them in context) was associated with vocabulary learning. In addition, Trussell and her colleagues (Trussell, Dunagan, Kane, & Cascioli, 2017; Trussell & Easterbrooks, 2014) found that DHH children learned vocabulary embedded within classroom interactive storybook reading. The interactive storybook reading included open-ended language elicitation and definitions of words. Similarly, Bobzien et al. (2017) found that targeted instruction of vocabulary words in meaningful contexts helped DHH preschoolers learn specific words, and Lund and Douglas (2016) found that DHH preschoolers learn more target words when teachers provide direct instruction that includes explicit definitions than when teachers simply expose children to new words. Although these studies suggest that these techniques were effective in teaching DHH children novel vocabulary, they did not measure long-term vocabulary gains or gains on standardized tests. In addition, only the studies about explicit vocabulary instruction examined the influence of an individual technique on vocabulary or morphosyntax gains.

There is more research that examines characteristics of parental talk with DHH children, and it supports our hypothesis that the same characteristics of adult talk will be beneficial for DHH children’s language development. For example, parents’ use of interactive book reading is beneficial for DHH children (Aram, Most, & Mayafit, 2006; Fung, Chow, & McBride-Chang, 2005). In addition, DesJardin and colleagues have extended the literature to parent–child conversations in settings other than book reading. They found that, for DHH children of up to 4 years old, parents’ use of language supporting behaviors (including reformulation and open-ended language elicitation, among other behaviors) is positively related to child language skills (DesJardin et al., 2014, 2017) and that parents’ use of these behaviors is associated with greater language gains over 3 years for preschool children (Cruz et al., 2013).

DesJardin and colleagues have also looked at the independent effect of parents’ use of reformulations and language elicitation with their young DHH children. DesJardin (2006) found that mothers’ use of certain types of reformulations (i.e., restating child verbalizations in a question format) correlated with better child language whereas use of verbatim imitation of child utterances correlated with weaker child language. In addition, she found that the rate of maternal use of open-ended language elicitation positively correlated with child language. In addition, Encinas and Plante (2016) have shown that specific types of reformulations (i.e., restating a grammatically incorrect child verbalization with corrected grammar) appear beneficial for facilitating morphosyntax for young children with cochlear implants when used in one-on-one settings with clinicians.

Only one study to date has considered the relation between individual behaviors for facilitating language development and DHH children’s growth in language over

time. DesJardin, Ambrose, and Eisenberg (2009) found that mothers' use of certain reformulations (i.e., repeating child verbalizations in the form of a question) during the first observation (when children were between 2 and 6 years old) was positively related to children's oral and reading vocabulary 3 years later and that mothers' use of open-ended questions during the first observation positively predicted children's reading comprehension 3 years later.

The Importance of Explicit Vocabulary and Grammar Instruction for DHH Children

One of the reasons that young DHH children are delayed in language acquisition may be that they encounter unique barriers to learning language from naturalistic input. Young DHH children struggle with learning new words implicitly in the way that young hearing children learn (Lederberg, Prezbindowski, & Spencer, 2000; Lederberg & Spencer, 2009), and their syntax delays may be related to difficulty in hearing essential morphemes (Moeller & Tomblin, 2015). However, there is some research that suggests that explicit instruction can facilitate language development, particularly for vocabulary (Lund & Douglas, 2016; Paatsch et al., 2006; Trussell et al., 2017).

This Study

Many studies have considered types of teacher talk that can support language development for young hearing children in preschools and day care, and a few have examined conversational techniques parents may use to support DHH children's language development. However, there is little information about teacher talk behaviors in the classrooms of young DHH students and how teacher talk relates to gains in DHH students' language skills. This study is also among the first to consider the extent to which conversational language support practices, which are frequently studied in preschools and day cares, predict language skill development of elementary school students. This is an important extension of the literature, because group size and activity context affect the quality of adult input (Dickinson et al., 2014; Dickinson & Smith, 1991; Kontos & Keyes, 1999; Turnbull, Anthony, Justice, & Bowles, 2009). The demanding instructional goals in elementary school classrooms may reduce the quality of adult input and its effectiveness.

This study used assessment scores and video observations collected by the Center on Literacy and Deafness (CLAD), a multistate, interdisciplinary research team studying language and literacy for young DHH children (Easterbrooks et al., 2010). Data were collected from two cohorts of children during the 2011–2012 and 2012–2013 school years. The CLAD sample included classrooms that used a variety of different modalities for communication. For this study, we restricted our sample to classrooms that use spoken English exclusively, because the features of teacher talk that influence language development may differ for different modalities.

We used fall and spring language scores (expressive vocabulary and morphosyntax) to examine gains across the school year. We measured teacher talk during winter of the school year, in between the fall and spring assessments. We selected winter observations because they are the most stable indicators of teacher behavior (Stuhlman, Hamre, Downer, & Pianta, 2018). We also wanted to separate the timing of the observation from our measure of child language to establish temporal precedence (Huttenlocher et al., 2002).

Research Questions

This study examined two questions:

1. What are the characteristics of teacher talk in the kindergarten through second grade, spoken language classrooms of DHH children?
2. To what extent does teacher talk relate to gains in DHH students' vocabulary and morphosyntax across a school year?

Method

Participants

Children were eligible for the CLAD study if they (a) were in kindergarten, first grade, or second grade; (b) had an individualized education plan because of a hearing loss; and (c) had no additional severe disabilities according to their teachers. To be eligible for the current study, students also needed to be present during the selected period for observation (winter) and be in classrooms that used spoken language without sign support. This resulted in a sample of 68 children in 25 classrooms from four states and one Canadian province.

Most classes were small, self-contained classrooms with an average of four students, but there were also classrooms where one DHH child was mainstreamed with an average of 19 students in the classroom. Table 1 presents the characteristics of the classrooms.

Approximately 48% of the children were boys. Forty-seven percent had been identified as having a hearing loss before 6 months of age, 18% were identified before 2 years, 16% before 3 years, and 12% at some time between 3 years of age and the beginning of the study, with 7% missing data; 62% used a cochlear implant and 38% used hearing aids; and 5% had a DHH parent. Of the children who used hearing aids, 17% had mild hearing loss, 75% had moderate hearing loss, and 8% had severe hearing loss (levels of hearing loss were based on unaided better ear pure-tone average; 8% missing data). According to parent report, all of the children who used hearing aids used them nearly all the time. At the time of fall testing, the average child age was 6 years 8 months, with a standard deviation of 13 months. Forty-six percent of the sample was in kindergarten, 36.5% was in first grade, and 17.5% was in second grade. Approximately 43% of the students received Language Arts instruction in a classroom with mixed grade levels. All students' parents reported that they primarily use spoken language

Table 1. Classroom characteristics.

Participating students	Total students ^a	Classroom type	Grade levels	Activity types
2	3	DHH only	K	Reading comprehension, storybook reading
5	5	DHH only	K–1	Vocabulary instruction, journaling
4	6	DHH only	K–2	Discussion of wordless picture book
4	6	DHH only	K	Storybook reading, reading comprehension
2	2	DHH only	1	Informational book reading, prewriting activity
4	4	DHH only	K–1	Group writing activity
4	5	DHH only	K	Informational book reading, reading comprehension
3	6	DHH only	K	Group writing activity, general language practice
3	3	DHH only	1–2	Reading comprehension
5	5	DHH only	K	Storybook reading, general language practice
2	2	DHH only	K–1	Informational book reading, prewriting activity
2	2	DHH only	1–2	Storybook reading, general language practice
3	5	DHH only	2	Storybook reading, reading comprehension
4	4	DHH only	1–2	Reading comprehension
3	4	DHH only	1	Group writing activity
4	8	DHH only	K	Journaling, storybook reading
6	6	DHH only	K–1	Storybook reading, vocabulary instruction, general language practice
1	18	Mainstream	1	Poetry reading, vocabulary instruction, storybook reading
1	21	Mainstream	2	Informational book reading, reading comprehension
1	22	Mainstream	2	Reading comprehension, storybook reading
1	20	Mainstream	1	Vocabulary instruction, informational book reading
1	22	Mainstream	K	Storybook reading and reading comprehension
1	15	Mainstream	1	Storybook reading
1	6	Mainstream	2	Informational book reading, prewriting activity
1	29	Mainstream	K	Reading comprehension, prewriting activity

Note. DHH = deaf and hard of hearing.

^a“Total students” refers to total students present during the 20-min observation. Some children may receive Language Arts instruction with a small DHH-only group and attend a mainstream class for other parts of the day.

with no sign support at home, except for one parent who did not respond. Approximately 37% of participants were White, 16% were Black, 10% were Asian, 18% were Hispanic or Latino, and 18% were other or no response.

All primary teachers ($N = 25$) were women and had at least a 4-year degree. Nineteen teachers returned a questionnaire with additional information about their education and certification. Fifteen had master’s degrees. Ten teachers had degrees specific to deaf education. The remaining teachers had degrees in elementary education ($n = 4$), special education ($n = 1$), early childhood ($n = 1$), child development ($n = 1$), and communication disorders ($n = 1$). Eighteen of the 19 teachers reported that they were certified teachers. One teacher did not respond to the certification question but reported that she had a master’s degree in deaf education. One teacher had listening and spoken language certification. Four of the classrooms had two adults in the room during the observation period, and no data were available about the second adult’s education or certification. For three of the classrooms, the second adult was a paraprofessional who only spoke a few times. In one case, the second adult was a coteacher who spoke nearly as much as the primary teacher.

Procedure

Schools recruited for the CLAD study included schools for the Deaf, mainstream classrooms, self-contained

classrooms, and a variety of different school types. A high proportion of the classrooms included only DHH students. Recruiting schools or classrooms with many eligible children allowed CLAD to include the maximum number of participants while minimizing the cost of data collection. As part of the CLAD study, kindergarten through second-grade DHH children took a large battery of language and literacy assessments in the fall and spring of a single school year. Testing for an individual child was usually completed within a single week. Fall testing occurred in September (approximately 45% of participants), October (47%), and November (7%). Spring testing occurred in March (11%), April (53%), and May (36%). Assessors tested children one at a time in a small, quiet room in the child’s school. To prevent testing fatigue, children were tested for short periods on several (usually consecutive) days. An observer also video-recorded Language Arts instruction three times—a single day per classroom in the fall, winter, and spring. This study used only the winter classroom observations, which were completed in January (approximately 35% of participants), February (55%), and March (9%). None of the winter observations overlapped with the spring assessments; most participants (88%) had 7 weeks or more between the winter observation and spring assessments, and the minimum gap was 3 weeks (3% of participants).

The institutional review board of all universities involved in this project approved of the study, as did all of

the schools from which data were collected. Parent notification, rather than parent consent, occurred in the majority of schools. Data were collected from the vast majority of students who met eligibility criteria.

Standardized Child Language Measures

Vocabulary

The Expressive One-Word Picture Vocabulary Test—Fourth Edition (EOWPVT-4; Martin & Brownell, 2011) is a test of expressive vocabulary normed for ages 2 through adulthood. The test requires children to look at a series of pictures and give a one-word name for each picture. Because children varied widely in age, we used the standard scores derived from the hearing norming sample. Standard scores for this test have a mean of 100 and a standard deviation of 15. According to the test manual, the EOWPVT-4 has an average internal consistency of .95 across age groups when measured by Cronbach's alpha and a test-retest reliability of .98 for raw scores (Martin & Brownell, 2011). Internal consistency reliability for the entire CLAD sample on the EOWPVT-4 was .97, as measured by Cronbach's alpha. Testing reliability scores of .90 or higher are the most desirable (Anastasi & Urbina, 1997).

Morphosyntax

The Clinical Evaluation of Language Fundamentals—Fourth Edition Word Structure subtest (CELF-4-WS; Semel, Wiig, & Secord, 2003a) assesses knowledge of English morphological rules with a sentence completion task. For example, the child sees a picture of a single book and a picture of several books. The examiner says, "This is a book. Here are some...." Scaled scores have a mean of 10 and a standard deviation of 3. Scores are based on a norming sample of 5- to 8-year-old hearing children. For the norming sample, the Word Structure subtest has an average internal consistency of .84 and a test-retest reliability of .81 (Semel, Wig, & Secord, 2003b). Internal consistency reliability of the CELF-4-WS for the entire CLAD sample was a Cronbach's alpha of .93.

Coding Procedures

Researchers coded teacher talk observed during the winter observation in three passes. The first pass was to select the time segment to code, the second pass was to transcribe the interactions, and the third pass was to code the characteristics of teacher talk. All coding was performed by the first author, a doctoral student with extensive experience in observational coding under the supervision of the second author. The first author trained another doctoral student in the coding scheme using classroom observations from fall and spring until the two coders reached acceptable levels of agreement. The second doctoral student then independently coded 20% of the winter observations, randomly selected ($n = 5$ of the 25 classrooms) for all three passes to establish reliability.

First Pass

The coders identified the first 20 min of the winter observation, which met three criteria. The first criterion was that instruction was focused on the meaning of texts or language. Coders decided about the focus of instruction using a coding scheme based on the work of Connor and colleagues (Connor, Morrison, et al., 2009; Connor, Piasta, et al., 2009). This scheme differentiates meaning-based instruction (such as reading comprehension activities, vocabulary instruction, composition instruction, or general language practice) from code-focused instruction (such as phonological awareness, spelling, or decoding instruction). We selected to code only meaning-based activities because they would provide the richest source of the teacher talk variables we were examining. More information about the types of activities observed in each classroom is available in Table 1. The most common meaning-based activities included book reading, reading comprehension activities, and prewriting activities (see Connor, Morrison, et al., 2009, for more in-depth definition of these activities). Although the 20 min that were selected for analyses were focused on a number of different reading activities, they all provided a context where teachers and children interacted in activities that focused on the active extraction and construction of meaning from text and speech (Connor, Morrison, et al., 2009).

The next criterion for the selection of the 20-min observation was that the largest number of participating children possible were present, and the third was that the lesson was led by the teacher who spent the most time teaching. Interrater reliability for the first pass of coding was 98.5% agreement.

Second Pass

Coders transcribed all teacher and child talk in the 20-min meaning-based segment. The transcriptions were broken into conversational turns. Conversational turns were defined as speech that was bounded at the beginning and end by another person's speech or at least 2 s of silence. Transcription reliability was based on agreement for conversational turns. This process yielded 86% agreement on teacher turns and 83% agreement on child turns. Individual videos ranged from 79% to 92% agreement for teacher turns and 79% to 92% agreement for child turns.

We transcribed and coded all teacher talk that the participant children likely heard. This occurred in two contexts. The majority of teacher talk took place during group instruction. In this context, we transcribed all teacher talk. Our assumption was that the participants would have heard all the teacher's utterances, even if a particular utterance was directed to a nonparticipant. In contrast, when classes broke into smaller groups and the teacher worked with a single group at a time, we only transcribed teacher talk when the teacher was working with a group that included one or more participating students. The teacher talk in this article therefore represents all the language that participating students were exposed to, although portions of it may have been directed to a nonparticipating child.

The majority of classrooms had only a single teacher present during the Language Arts period, but four classrooms had two adults present and interacting with the children. In these cases, the language of both adults was transcribed without differentiating between speakers because we were interested in the total adult language input children experienced.

Third Pass

We coded teacher talk along five categories: repetition, language elicitation, explicit vocabulary instruction, explicit grammar instruction, and wait time. For the first four categories, if the turn did not contain any code for that category, it received a null code. Each category was mutually exclusive and exhaustive for a conversational turn, meaning that each teacher conversational turn received a code from the repetition, language elicitation, explicit vocabulary instruction, and explicit grammar instruction categories. Only turns that received a code for language elicitation (either open-ended or closed) received a code for wait time. For example, a single teacher conversational turn might be coded as containing a reformulation, an open-ended language elicitation, a null code for explicit vocabulary instruction, a null code for explicit grammar instruction, and a code for allowing wait time. Each category is defined here (see Table 2 for a summary and Appendix A for excerpts from coded transcripts).

Repetition category. The repetition category included imitation and reformulation. Imitation was coded when a child's statement was repeated verbatim, in whole or in part. Imitation was coded even if the repetition included a change in intonation (e.g., if the teacher added a questioning intonation to the statement).

Reformulation was coded when the teacher repeated a child's utterance with words that added syntactic or semantic information but did not change the essential meaning of the utterance. This included behaviors other researchers have called expansion, expatiation, and conversational or syntactic recasting (Cleave, Becker, Curran, Van Horne, & Fey, 2015; DesJardin & Eisenberg, 2007; Justice et al., 2008; Mackey & Philip, 1998). If a turn included both imitation and reformulation, we coded reformulation.

Language elicitation category. Language elicitation referred to a teacher turn that requested a verbal response from students. Often language elicitation took the form of a question. However, some questions did not require a verbal response ("Can you come sit over here?") and were therefore not language eliciting. Conversely, some imperatives and statements did request a verbal response ("Tell me more," "I'd love to hear more about your weekend") and were language eliciting. We did not consider requests to read or repeat something verbatim as language elicitations, because they did not require the child to generate new language.

Table 2. Summary of coding scheme.

Category	Code	Description
Repetition	Imitation	A teacher repeats verbatim a preceding child utterance. The teacher must repeat two or more words but does not have to repeat the entire utterance. For example, a child says "I went to a pool party this weekend!" and the teacher says, "A pool party?"
	Reformulation	A teacher repeats a child's preceding utterance but adds syntactic or semantic information without changing the essential meaning of the sentence or reformulates the sentence to change the pronouns. For example, the child says "We played at recess," and the teacher says, "You played at recess?" or "You played on the playground at recess?" but not "You had a lot of fun playing, didn't you?"
Language elicitation	Closed elicitation	The teacher elicits constrained language, for example, by asking a question that can be answered by one word ("What's your favorite color?"), issuing a labeling request ("Tell me what this is."), or presenting a forced choice ("Do you want goldfish or animal crackers today?").
	Open-ended elicitation	The teacher elicits unconstrained language, for example, by asking a question that requires more than one word to answer ("How did you know that?") or requesting complex information ("Tell me more about your vacation.").
Explicit vocabulary instruction		A teacher takes a conversational turn that contains explicit vocabulary instruction, such as giving a definition of a word, affirming or clarifying a child's definition, describing how or when a word might be used, or giving an example of a word used in context if a nearby turn included an explicit definition.
Explicit grammar instruction		The teacher takes a conversational turn that contains explicit grammar instruction, such as explaining when to use pronouns, when to add "s" to the end of words, subject-verb agreement, or word order.
Wait time	Wait time allowed	After a teacher's language elicitation, there are 3 s or more of silence.
	Wait time interrupted by teacher	If the teacher's turn included a language elicitation, a teacher interruption was coded if the teacher spoke again within 3 s of the last question in the turn. Calling on a specific child after asking a question to the class was not counted as an interruption.
	Immediate child response	If the teacher's turn ends in a language elicitation and a child speaks less than 3 s after the question ends, immediate child response is coded.

We distinguished between closed and open-ended language elicitation based on the length of response the elicitation was likely to prompt. An elicitation that could be answered with one word (such as a yes/no question or a labeling request) was closed, whereas elicitations that required a multiword response were open-ended. Forced-choice questions (“Do you want animal crackers or goldfish for snack?”) were always closed, regardless of how many words the choices contained. Teachers sometimes asked multiple questions in a single turn or repeated a question many times before allowing a child to answer (see Appendix B, Excerpts 1 and 5 for examples of multiple questions in a single turn). Only the last language elicitation in a turn received a language elicitation code.

Explicit vocabulary instruction category. Explicit vocabulary instruction was defined as any teacher conversational turn that included a definition of a vocabulary word or included a recently defined word used in context (see Appendix A, Excerpt 4 for an example of when using a word in context was coded as vocabulary instruction). This included both incidental explicit instruction, such as when a teacher briefly paused during story reading to discuss the meaning of a word, and intentional explicit instruction, such as when the class reviewed a list of weekly vocabulary words. Explicit vocabulary instruction may have been planned ahead of time by the teacher or occurred spontaneously within a lesson.

Explicit grammar instruction category. Explicit grammar instruction applied to conversational turns that included an explanation of why a particular grammatical construct should be used. Corrections or statements with no explanations about why or when that rule should be used were not explicit instruction. For example, if a child said “I have three dog” and the teacher merely corrected with no explanation, such as “Put an ‘s’ at the end of dog,” this was not explicit instruction. However, “Put an ‘s’ at the end of dog because there is more than one” would have been explicit instruction (see Appendix A, Excerpt 3 for another example of grammar instruction).

Wait time category. Following the recommendations of Rowe (1986), we defined wait time as a pause of 3 s or more that occurred between a teacher’s language elicitation and the next conversational turn. We included two additional codes (immediate child response and teacher interruption) in the wait time category to indicate what happened when there was no wait time. Immediate child response referred to instances when there was no wait time because children responded immediately. Teacher interruptions of wait time referred to any time a teacher interrupted the wait time after a language elicitation. Most teacher interruptions occurred when teachers asked a question but continued talking without a pause or immediately providing hints or answers to their own questions.

Only teacher turns that contained language elicitation (either open-ended or closed) received a wait time code. If a turn was coded for language elicitation, it also received a code of either wait time allowed, immediate child response, or teacher interruption of wait time. Wait time began only when the last language elicitation ended.

Reliability. We used ComKappa (Bakeman & Robinson, 2012) to calculate Cohen’s kappa statistics for third-pass reliability, following the procedure recommended by Bakeman and Gottman (1997). Cohen’s kappa calculates reliability for mutually exclusive and exhaustive categories and (unlike percent agreement for individual codes) corrects for chance agreement. The average ranged from .85 to .77, which is considered good or excellent agreement (Bakeman & Gottman, 1997; Fleiss, 1981). Specifically, agreement for the repetition category was .85, language elicitation was .84, wait time was .77, and explicit vocabulary instruction was .77. There were extremely few instances of explicit grammar instruction in the videos used for reliability; one coder noted two, and the other noted four. We reported frequency of grammar instruction in descriptive statistics but not in any further analyses because it was impossible to measure reliability for this code.

Analytic Strategy

We used HLM7 (Raudenbush et al., 2011) for the hierarchical linear modeling (HLM) analyses. HLM7 uses maximum likelihood estimation for missing data. We used IBM SPSS, Version 22 (IBM, 2013) for all other analyses. The use of HLM allowed us to examine teacher-level predictors of child-level outcomes while still making use of all the data (i.e., not aggregating data at the class level and examining only means). In addition, HLM does not require normal distributions of predictors or outcomes, only the normal distribution of residuals (Raudenbush & Bryk, 2002). This was helpful, because a few of our predictors had significantly nonnormal distributions.

Characteristics of Teacher Talk

To answer the first research question (“What are the characteristics of teacher talk in the kindergarten through second grade, spoken language classrooms of DHH children?”), we report descriptive statistics for all teacher talk codes (mean, standard deviation, minimum, and maximum) in Table 3. We next correlated teacher talk variables to determine if the amount teachers used these behaviors co-occurred, because these practices are commonly recommended to teachers. All correlations are reported in Table 4.

Prediction of Gains in Child Language

The second question posed in this study was, “To what extent does teacher talk predict gains in DHH students’ vocabulary and morphosyntax across a school year?” First, we examined correlations between teacher talk variables with the mean fall and spring vocabulary and morphosyntax scores for each classroom. This allowed us to establish if teacher talk variables varied with initial child language abilities. Next, we conducted partial correlations indicating whether there were relationships between single teacher talk behaviors and classroom-aggregated child spring scores after controlling for fall scores. Finally, we conducted two

Table 3. Occurrence of teacher talk.

Behavior	<i>n</i>	Mean	<i>SD</i>	Median	Mode	Min	Max
Total teacher turns	25	144.6	35.3	144	132	72	223
Imitations	25	1.6	1.5	1	0	0	5
Reformulations	25	13.2	8.1	12	12	1	36
Closed language elicitation	25	34.9	13.3	32	31	15	70
Open-ended language elicitation	25	20.0	14.4	16	31	3	69
Vocabulary instruction	25	4.9	5.3	2	1	0	16
Grammar instruction	25	.2	.5	0	0	0	2
Wait time allowed	25	3.7	3.0	3	2	0	12
Teacher interruption of wait time	25	6.1	4.2	6	6	0	17
Immediate child response	25	44.9	20.3	38	33	17	113

Note. All scores are reported as a raw number of times the behavior occurred during a 20-min observation. All codes could occur in any teacher turn, except for the three wait time codes. These could occur only following a turn that included a language elicitation (closed or open).

HLM analyses to examine the multivariate relationships among teacher talk variables and individual child language gains. HLM is a form of regression that allows individual observations to be nested within a related context, which is what happens when the language development of multiple children is influenced by the same teacher (Raudenbush & Bryk, 2002). We chose HLM because it allowed us to retain the maximum statistical power by not aggregating children's language scores by classroom. One analysis used spring vocabulary scores as the outcome, and the other one used spring morphosyntax scores as the outcome.

Both models contained fall scores to control for child language skill at the beginning of the school year. We entered children's fall score in the first step and then added three teacher talk variables (open-ended questions, reformulations, and explicit vocabulary instruction) in the second step to examine R^2 change. Only a few children had missing data, most of it due to absence on the day of assessments. For vocabulary assessments, six children were missing fall scores, one child was missing spring scores, and two children were missing both fall and spring scores. For morphosyntax, one class (three participating children) was too old to receive a scaled score and was not included in the morphosyntax analysis at all. From the remaining classrooms,

two children were missing fall scores, and one child was missing spring scores.

For both language outcomes, we first specified an unconditional model with the child language score in spring as the outcome variable. The baseline model determined how much variation there was among students between individual clusters (i.e., the intraclass correlation [ICC]; ICC = .34 for the vocabulary scores and ICC = .16 for the morphosyntax scores). These substantial ICCs justified our decision to use HLM instead of examining child language scores as though they were entirely independent. Next, we ran additional models that added fall scores and tested the significance of the three teacher talk behaviors that predicted the most variability in child outcomes: explicit vocabulary instruction, reformulation, and open-ended language elicitation. We chose to add only three teacher talk predictors to preserve parsimony because our sample size was relatively small for an HLM analysis. We chose not to examine interaction terms for moderators of the associations between spring language scores and teacher talk predictors for the same reason. As an example, the final vocabulary model is described next. In Level 1 of this model (Equation 1), an individual child (i) in a particular classroom (j) has a spring vocabulary score (Y), and it is modeled as a function of the

Table 4. Zero-order correlations for standardized child language scores and teacher talk.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Fall EOWPVT	1	.86**	.67**	.76**	.26	.24	-.20	.30	-.02	.00
(2) Spring EOWPVT		1	.63**	.77**	.28	.48*	-.07	.45*	.18	-.16
(3) Fall CELF-4-WS			1	.86**	.65**	.03	-.18	.32	-.20	.21
(4) Spring CELF-4-WS				1	.47*	.30	-.24	.31	.21	.19
(5) Imitation					1	.21	-.09	.34	-.35	.34
(6) Reformulation						1	.42*	.63*	.03	-.41
(7) Closed LE							1	.08	-.12	-.17
(8) Open-ended LE								1	.11	-.03
(9) Explicit vocabulary instruction									1	-.10
(10) Wait time allowed										1

Note. EOWPVT = Expressive One-Word Picture Vocabulary Test—Fourth Edition; CELF-4-WS = Clinical Evaluation of Language Fundamentals—Fourth Edition Word Structure subtest; LE = language elicitation.

* $p < .05$. ** $p < .01$.

intercept (the estimated mean spring score for the child's classroom, β_{0j}) after adjusting for the child's fall score (β_{1j}) and the error term associated with the estimated mean (r_{ij}).

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\text{fallscore}) + r_{ij} \quad (1)$$

At Level 2, the adjusted mean spring score for children in a particular classroom (β_{0j}) is modeled as a function of the grand mean spring score (γ_{00}), the classroom's vocabulary instruction rate (γ_{01}), the classroom's reformulation rate (γ_{02}), the classroom's open-ended language elicitation rate (γ_{03}), and the error term associated with the classroom's estimated mean (u_{0j}). γ_{10} represented the slope associated with the fall language score.

$$\begin{aligned} \beta_{0j} &= \gamma_{00} + \gamma_{01}(\text{vocabulary instruction}) \\ &\quad + \gamma_{02}(\text{reformulation}) + \gamma_{03}(\text{open ended LE}) + u_{0j} \\ \beta_{1j} &= \gamma_{10} \end{aligned} \quad (2)$$

All of the teacher talk variables and the variables at Level 1 were centered around the grand mean, and we chose to use restricted maximum likelihood because of the small number of Level 2 units (classrooms). The same process was repeated for the analysis of vocabulary scores. We checked for violations of the assumptions of HLM with both the unconditional models and the final models by examining the distribution and relations of residuals. There was no cause for concern regarding the vocabulary models, but the morphosyntax models presented some issues that are further discussed in the results section.

Results

Child Score Descriptive Statistics

On average, the children in this sample were about 1 *SD* behind the norms for their hearing peers on expressive vocabulary (EOWPVT-4) and about 2 *SDs* behind the mean for productive morphosyntax (CELF-4-WS). Means and standard deviations for both assessments are reported in Table 5. Because the partial correlation analysis required

classroom-aggregated language scores, means of classroom-aggregated scores are also presented in Table 5.

Characteristics of Teacher Talk

The first research question for this study was, "What are the characteristics of teacher talk in the kindergarten through second grade, spoken language classrooms of DHH children?"

Frequency

Table 3 summarizes descriptive statistics for teachers' use of various behaviors, and a figure depicting the counts of each behavior by teacher is available in Appendix B. Except where noted, the frequency of each behavior approximated a normal distribution.

Imitation was rare; no teachers imitated more than five times, and eight teachers did not imitate child statements at all. Reformulation occurred fairly frequently, with a mean of 13 reformulations during a 20-min observation. However, there were great individual differences among teachers in how often they reformulated. Two teachers reformulated a child statement only once or twice in the 20-min observation, whereas three teachers reformulated more than once per minute.

Closed language elicitation was by far the most frequent behavior, with an average of about 35 closed elicitations, nearly two per minute. Open-ended elicitations were also fairly frequent, with an average of one per minute. However, four teachers had fewer than 10 open-ended language elicitations during the entire observation, four teachers used between 30 and 35, and two teachers used more than 40, resulting in a nonnormal distribution. When both closed and open-ended language elicitations are considered together, language elicitation occurred an average of nearly three times per minute.

Explicit vocabulary instruction, on average, occurred five times during the 20-min observation or once every 4 min. The distribution for explicit vocabulary instruction was also uneven. Two teachers fell exactly at the mean, with five turns containing explicit vocabulary instruction, but no teachers had four, six, seven, or eight instances of vocabulary instruction. Four teachers used explicit vocabulary instruction in 10 or more conversational turns (i.e.,

Table 5. Descriptive statistics for child language scores.

Test	Time	Disaggregated scores				Aggregated by classroom			
		<i>n</i>	Mean	<i>SD</i>	Min–max	<i>n</i>	Mean	<i>SD</i>	Min–max
Vocabulary	Fall	59	84.61	12.05	57–115	25	83.67	9.83	57–115
	Spring	65	86.45	12.16	61–117	25	84.35	10.36	61–117
Morphosyntax	Fall	63	2.84	2.41	1–8	25	2.73	1.86	1–8
	Spring	63	3.75	2.86	1–11	24	3.55	2.15	1–11

Note. In the spring, one classroom had no children who were young enough for standard scores on the morphosyntax assessment. This classroom was excluded entirely from all correlation analyses.

at least once every 2 min), whereas four teachers never used explicit vocabulary instruction. Thus, although not bimodal, the distribution was highly nonnormal. Explicit grammar instruction occurred extremely rarely, twice in one classroom and once in three other classrooms.

In the average classroom, wait time occurred after only 8% of language elicitation turns. In most instances, this was because children responded immediately. For 81% of teacher language elicitations, students replied in under 3 s. In cases where students did not respond in under 3 s, teachers allowed a pause only 38% of the time (i.e., after 8% of all language elicitations). When students did not respond immediately, teachers interrupted the wait time with hints, answers to their own questions, or other comments such as behavior management directives 62% of the time (i.e., after 11% of all language elicitations). In an average classroom, this would represent 55 total language elicitations, 45 of which were answered by children in under 3 s. Four language elicitations would have at least a 3-s pause afterward, and six language elicitations would have no wait time because the teacher interrupted herself.

Relations Among Scores

Zero-order correlations of language and teacher talk variables are presented in Table 4. Children's language skills were highly correlated with each other. The strongest correlations were those between the scores on the same language tests from fall to spring ($r = .86$), indicating that children's language skills were stable across the school year.

There were only a few moderate correlations between the teacher talk variables. Reformulation was correlated with both closed language elicitation and open-ended language elicitation, but no other teacher talk variables were correlated with one another.

Teacher Talk and Children's Spoken Language Abilities

Zero-Order Correlations

Teachers' use of imitation correlated with their students' fall morphosyntax scores, but this was the only correlation between fall scores and teacher talk. Spring vocabulary scores were correlated with both reformulation and open-ended language elicitation.

Partial Correlations

We next measured which characteristics of teacher talk were related to classroom gains in vocabulary and morphosyntax using partial correlations. For partial correlations, we used classroom average language scores. As shown in Table 6, after controlling for fall vocabulary scores, reformulation was significantly correlated with spring vocabulary, $r(23) = .55, p = .005$. Partial correlations between spring vocabulary scores and both open-ended language elicitation, $r(23) = .40, p = .056$, and explicit vocabulary instruction, $r(23) = .39, p = .061$, approached significance.

After controlling for fall morphosyntax scores, only explicit vocabulary instruction was significantly correlated with spring morphosyntax scores, $r(22) = .69, p < .001$.

HLM Analysis

We next examined language gains using HLM. HLM results for both the vocabulary and morphosyntax models are reported in Table 7. The full model revealed that, after accounting for children's vocabulary scores in the fall, higher teacher rates of reformulation and vocabulary instruction were significant predictors of better spring child vocabulary. Open-ended language elicitations were not significantly related to gains.

The models with morphosyntax scores as an outcome revealed that, after accounting for children's fall scores, only teacher explicit vocabulary instruction was a significant predictor of spring scores. This must be interpreted with caution because the morphosyntax models presented a few assumption violations, namely nonnormal distribution of Level 2 residuals and a significant correlation between Level 1 and Level 2 residuals ($r = .438, p < .001$).

Discussion

This study is the first to examine teacher talk in the classrooms of young DHH students and its relation to children's language gains. We included 25 classrooms in four states and one Canadian province. The schools varied along a number of dimensions, including type of school, geographic location, and inclusion of hearing children. Therefore, our results were not constrained by one geographic context or one type of curriculum. Our results suggest that certain aspects of the way teachers talk to the children may contribute to children's language learning. Specifically, teachers' use of reformulations and explicit vocabulary instruction were related to gains in child language across a school year.

As Huttenlocher et al. (2002) point out, establishing the direction of effect between adult talk and child language is difficult, especially because of its potential bidirectional nature. However, a longitudinal design can provide evidence by establishing temporal precedence. We found that teacher talk was not related to initial vocabulary and morphosyntax scores. This suggests that teachers were not using reformulations and explicit vocabulary instruction in response to child language functioning. Rather, these characteristics were related to the gains children made from fall to spring, providing evidence that teacher talk influenced children's language learning.

The mean rate for teacher reformulation was a little more than once per 2 min, and 14% of teacher turns contained reformulation. Previous research has shown the efficacy of reformulations either in one-on-one settings (e.g., Camarata, Nelson, & Camarata, 1994; DesJardin, 2006) or in a classroom in combination with other behaviors and curricula (e.g., Cabell et al., 2011). This study is one of the first to demonstrate teacher reformulations are related to vocabulary gains even in group settings. The wide range in

Table 6. Partial correlations of teacher talk and language scores.

Teacher talk	Correlations of spring vocabulary scores after controlling for fall vocabulary scores		Correlations of spring morphosyntax scores after controlling for fall morphosyntax scores	
	Correlation	Significance	Correlation	Significance
Imitations	.12	.59	-.31	.15
Reformulations	.55	.005	.20	.36
Closed LE	.21	.34	-.09	.68
Open-ended LE	.40	.056	.08	.71
Wait time allowed	-.31	.14	.03	.89
Explicit vocabulary instruction	.39	.061	.69	< .001

Note. LE = language elicitation.

rates of reformulation indicates that this is an area where many teachers can improve.

The mean rate of explicit vocabulary instruction occurred about once every 4 min or in about 3% of teacher conversational turns. However, there were remarkable differences in vocabulary instruction among classrooms. Most classrooms ($n = 14$) had fewer than one explicit definition per 10 min, whereas in other classrooms, explicit vocabulary instruction occurred at least every 2 min ($n = 5$). How vocabulary instruction occurred varied widely: Some teachers set aside time to teach weekly vocabulary words, whereas in other classrooms, explicit instruction occurred seemingly spontaneously when an unfamiliar word was encountered during book reading or other language arts activity. Even with this wide variation in approach to vocabulary instruction, explicit vocabulary instruction was uniquely and positively predictive of children's gains in both vocabulary and morphosyntax. This is particularly notable given that previous research has had difficulty in identifying interventions that can improve DHH children's global vocabulary on standardized measures (Luckner & Cooke, 2010). It is consistent with the Lund and Douglas (2016) study, which found explicit vocabulary instruction was the most effective in teaching DHH children new words.

The most frequent teacher talk behavior was closed language elicitations, which occurred, on average, in 24% of teacher conversational turns. When both open-ended and closed language elicitations are considered together, they accounted for 38% of teacher turns. Given the emphasis on open-ended questions in previous literature on language-supporting interactions (Cabell et al., 2011; Wasik et al., 2006), it is remarkable that open-ended questions were not related to gains in vocabulary or morphosyntax in this study, particularly because previous research has emphasized open-ended questions more than reformulations (Aram et al., 2006; Fung et al., 2005; Trussell & Easterbrooks, 2014). However, open-ended questions may be valuable in that they provide opportunities and encouragement for children to participate in meaningful language exchanges that allow adults to provide feedback (Wasik & Jacobi-Vessels, 2017). In other words, it may be that open-ended questions provide an opportunity for adults to reformulate, and

reformulation is the true catalyst for child language learning. This hypothesis is supported by the moderate correlations between reformulation and both types of language elicitation, though more research is needed to further disentangle this relationship.

Wait time seems to be lacking in these classrooms, which indicates that children probably do not have enough time to provide complete, well-thought-out answers (Fagan et al., 1981). Teachers were nearly twice as likely to interrupt an unanswered language elicitation as to wait a full 3 s. Indeed, only 8% of language elicitations were followed by wait time. However, the amount of wait time that occurred in a class did not correlate to language gains. Thus, more research needs to be conducted to determine whether wait time is truly facilitative for children's language development.

Implications for Educators

The variation in usage of teacher talk illuminated a few areas where teacher talk might be improved. For instance, a few teachers reformulated child statements only once or twice during the entire 20-min observation. This may be an area where teacher training programs, speech language pathologists, or professional development providers can mentor teachers and improve child language by changing teacher behaviors.

Previous researchers (e.g., Mol et al., 2009) have suggested that teachers struggle to implement supportive teacher talk behaviors during instruction because there are too many competing goals, such as teaching content. It may be helpful to begin with training teachers in interactive book reading techniques and encouraging them to set aside time for practicing this in the classroom, because interactive book reading is a slightly more constrained environment than, for example, a lesson about the writing process. After teachers show competence with the procedures of interactive book reading, mentors can encourage them to incorporate these practices into everyday conversations with their students.

Explicit vocabulary instruction may represent another area where mentors can support teachers of DHH students. Mentors can remind teachers of the value and necessity

Table 7. Results of hierarchical linear models.

Vocabulary model					
Fixed effect	Coefficient	SE	t	df	p
Intercept	85.82	0.09	98.89	21	< .001
Child level					
Fall score	0.84	0.08	11.19	33	< .001
Classroom level					
Reformulation	0.34	0.13	2.51	21	.020
Open-ended LE	−0.03	0.07	−0.49	21	.627
Vocabulary instruction	0.41	0.15	2.71	21	.013
Random effect	SD	Variance component	df	χ^2	p
Between-classrooms residual	0.22	0.05	21	15.47	> .500
Within-classroom residual	6.25	39.03			
Deviance	388.94				
Morphosyntax model					
Fixed effect	Coefficient	SE	t	df	p
Intercept	3.65	0.22	16.27	19	< .001
Child level					
Fall score	1.24	0.11	11.77	36	< .001
Classroom level					
Reformulation	0.02	0.035	0.67	19	.512
Open-ended LE	−0.03	0.02	−1.56	19	.136
Vocabulary instruction	0.11	0.04	2.82	19	.011
Random effect	SD	Variance component	df	χ^2	p
Between-classrooms residual	0.37	0.14	19	18.93	> .500
Within-classroom residual	1.51	2.29			
Deviance	236.69				

Note. All variables were grand mean centered. LE = language elicitation.

of explicit vocabulary instruction for all students and DHH students in particular. They may also help teachers select words to target and plan to incorporate them into daily conversations.

Limitations and Directions for Future Research

One major limitation is that this study only examined the effect of teacher talk for DHH children acquiring spoken English. It is equally important to examine effective teacher talk for DHH children who are acquiring sign language as well as bimodal and bilingual children. There is some suggestion that these findings may generalize to all DHH children. For example, interactive storybook reading facilitates vocabulary learning for DHH children acquiring sign (Trussell & Easterbrooks, 2014) and for DHH children acquiring spoken languages other than English (Aram et al., 2006; Fung et al., 2005). Clearly this is an area that needs further research.

A second limitation is that this study was observational and correlational, and therefore, we cannot draw firm conclusions about causation. Although the claim that reformulating and explicitly teaching vocabulary can improve DHH children's language abilities is supported by theory (e.g., Cruz et al., 2013; DesJardin & Eisenberg, 2007) and

evidence with hearing children (e.g., Cabell et al., 2011; Cleave et al., 2015), this claim cannot be supported solely with this study. For example, it is possible that good teaching or specific teaching philosophies (e.g., Moog & Stein, 2008) were the true cause of gains, and these effective teaching philosophies happen to emphasize reformulations and explicit vocabulary instruction. Indeed, there was a great deal of variability in the rates at which teachers used each behavior, and this study was not designed to examine potential causes of that variation. The variation could be merely the result of naturally occurring variations in the supportiveness of adult communication (Cabell et al., 2011; DesJardin & Eisenberg, 2007; Weizman & Snow, 2001), or it could be related to features of the classroom such as the number of children present. Variation may also have been related to different teacher training or familiarity with the needs of DHH students. However, this study was designed to examine the language that DHH children encounter in their everyday school settings, and these settings include adults with various backgrounds interacting with multiple children at a time. Future research should examine which factors predict more supportive language input from teachers and what methods are effective in improving teacher input. A well-designed intervention tested in a randomized controlled trial would be a good next step.

Third, we could only reach limited conclusions about the relation between teacher talk and gains in morphosyntax knowledge. The HLM analyses suggested that the residuals associated with our morphosyntax measure were not normally distributed, so our morphosyntax analyses may not be reliable. This was unfortunate because the DHH children were very delayed in their morphosyntax, more than 2 *SDs* below hearing norms. Future research would benefit from using a larger sample size that permits more complex analyses, as well as using additional instruments that may provide a fuller picture of language gains. Alternative instruments for measuring child language may be particularly important, as other researchers have also found that preschool teachers' language support practices and classroom-based language interventions may have little effect on children's syntax and morphosyntax knowledge (Cabell et al., 2011; Justice et al., 2008). Other assessments or measures of language (such as syntactic diversity in a language sample or criterion-referenced tests) may highlight different gains (Piasta et al., 2012). This may be especially true for wait time.

Conclusion

This study provides promising information about the teacher talk practices in DHH children's elementary classrooms and the relationship of those practices to children's language gains. Positive practices to support child language seem to be used in most classrooms, although the rates of these behaviors vary. Reformulation and explicit vocabulary instruction may be particularly effective in predicting young DHH children's language gains. Future research can examine which aspects of these behaviors are most impactful and whether training teachers in these behaviors can be causally linked to practically significant gains in child language skills.

Acknowledgments

This research was supported by the National Center for Special Education Research and the Institute of Education Sciences, U.S. Department of Education through Grant R324C120001 awarded to Georgia State University. The content of this article does not represent views of the Institute or the U.S. Department of Education. We thank Carol Connor, Ann Kruger, Audrey Leroux, Megan Crymes, Brenda Schick, Victoria Burke, and the Center on Literacy and Deafness research team for their valuable feedback and support of this research.

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Appendix A (p. 1 of 3)

Transcript Excerpts and Codes

Codes are in square brackets after teacher turns.

All names have been changed. Some excerpts have been lightly edited for brevity.

1. Teacher and students are discussing a wordless picture book.

Teacher: Give me a sentence for this side of the page. [open-ended LE] [immediate child response]

Dustin: Um, she is getting her {unintelligible word}.

Teacher: Who remembers what this is called? [closed LE] [immediate child response]

Elena: I know.

Priscilla: Apron.

Teacher: What's she tying around, Elena? [closed LE] [wait time allowed]

Elena: Um, I think it is...a, she tying it around because you can't get your clothes...

Teacher: Well, that's what it's for, but it has a name.

Priscilla: Apron.

Teacher: Apron. It's an apron and it keeps your clothes clean, you're right. [vocabulary instruction] [reformulation]

Priscilla: My mom asks me if she needs help with a special thing.

Teacher: So do you wear an apron when you're cooking? [closed LE] [immediate child response]

Priscilla: Yeah. It's pink.

Teacher: What about this side, Mason? What's happening right here, what is she doing? [open LE²] [immediate child response]

Mason: She is getting a book.

Teacher: She's getting a book. What, what book do you think she's getting? [imitation] [closed LE] [immediate child response]

Mason: Um, pancake book.

2. Teacher and students are composing a story about a picture.

Teacher: Oh, this is gonna be a good story. Okay, we have "once upon a time there was a frog and a princess who wanted to marry each other." Caroline, tell me something else about the frog and a princess. [open LE] [immediate child response]

Caroline: The frog and the princess are gonna kiss. Or the frog will turn a prince.

Teacher: Tell me, the frog and the princess are going to kiss. [imitation] [open LE] [immediate child response]

Caroline: The frog and the princess are going to kiss.

Teacher: So...? [open LE] [immediate child response]

Caroline: So the frog will will turn a prince.

Teacher: Turn into a prince. [reformulation]

Caroline: Turn into a prince.

Teacher: Oh, I love it.

²Note that, although there are two or possibly three questions in this turn, only the last question is coded. This applies to both what type of language elicitation is coded (open or closed) and how wait time is handled.

3. *A student is sharing about her weekend and the teacher is writing a story about it on the board.*

Teacher: All right, so we're going to start with Anne, you're going to tell us something special. Are you ready? And Emma, are you ready to listen?

Emma: Yeah!

Teacher: Okay.

Anne: My, um, oh my, my my {unintelligible} buyed.

Teacher: Can you use the word bought? [open LE] [immediate child response]

Anne: Bought.

Teacher: Because it already happened. [grammar instruction]

Anne: Bought box for me.

Teacher: Bought a box for you. [reformulation]

Anne: Yes.

Teacher: That sounds exciting.

Anne: {unintelligible} circle.

Teacher: Okay, wait a minute. Bought a box. {teacher is writing child's sentence in story on board}

Teacher: For me. It's a circle box? [reformulation]

Anne: Yeah.

4. *Teacher and students are looking at books they will read later.*

Teacher: Arthur Babysits. What's a babysitter? [open LE] [wait time allowed]

Teacher: Or if you babysit, what are you doing? Look at the picture. [open LE] [teacher interruption]

Owen: {unintelligible} dolls or things.

Teacher: You can play with babies? [reformulation]

Owen: Mhm.

Teacher: Okay. Do you know what babysitting is? [open LE] [immediate child response]

Kevin: No, I don't know.

Teacher: You don't know? Okay. When your mom or your dad, well when they want to leave the house, can you stay by yourself? [reformulation] [closed LE] [immediate child response]

Kevin: Unh-unh.

Owen: No.

Teacher: No. What happens when they leave? Who stays with you because you can't be alone? [closed LE] [immediate child response]

Owen: Grandma Janine.

Teacher: Oh, Grandma Janine, mhm. That's probably why you don't know what a babysitter is. Who stays with you when mom and go away for a while? [closed LE] [immediate child response]

Kevin: Um, my mom and dad go to a meeting.

Teacher: When they go to a meeting, who is with you? [closed LE] [immediate child response]

Kevin: Um, I stay home, {unintelligible} my uh, my cousin Renee.

Teacher: Renee comes over. Okay, guess what? Grandma Janine and Renee, they babysit you. [reformulation] [vocabulary]

Owen: Mhm.

Kevin: But why {unintelligible} not baby?

Teacher: I know, unh-unh, a babysitter is an adult or a teenager that comes over to watch you and to make sure you're okay. That's what a babysitter's job is, to make sure that kids that are younger are okay. I babysit sometimes. [vocabulary]

5. *Teacher and students are preparing to read a picture book.*

Teacher: Looking at Lincoln is the title of this book.

Andrew: Title.

Teacher: How do I know that that's the title? Why isn't this the title up here? [open LE] [immediate child response]

Keira: Cause cause Lincoln {unintelligible} write it.

Andrew: Why?

Teacher: No, Lincoln didn't write it. The title is usually really big, right? Would this be the title really small up here? [closed LE] [immediate child response]

Keira: No.

Teacher: What do you think is up here? [closed LE] [immediate child response]

Keira: Medium.

Andrew: Really small.

Teacher: What is this word? What are these? [closed LE] [immediate child response]

Keira: Um, up.

Teacher: It says, Maria Kalman. What's that mean? Who is that? [closed LE] [immediate child response]

Keira: Right here. The girl. {pointing to picture of a girl on book cover}

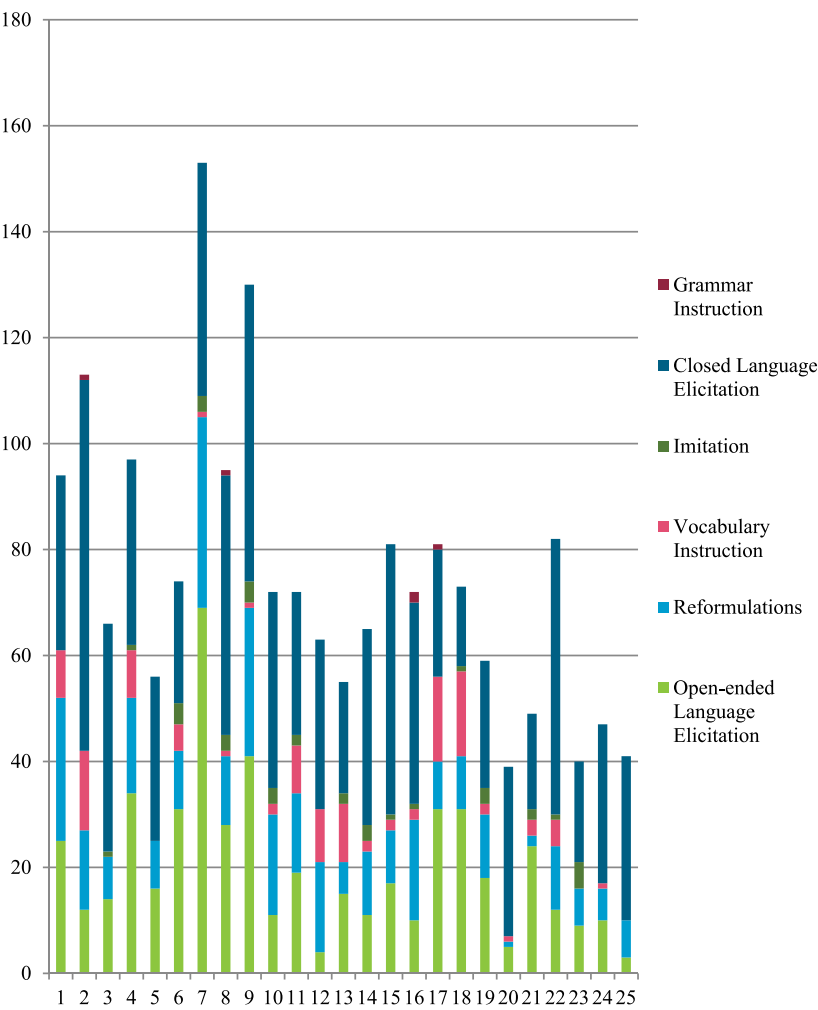
Appendix A (p. 3 of 3)

Transcript Excerpts and Codes

Teacher: Who do you think Maria Kalman is, Andrew? [closed LE] [immediate child response]
Andrew: A dog.
Teacher: Why would she be on the book? [open LE] [immediate child response]
Andrew: To look at.
Keira: Because she wanted to see {unintelligible}.
Teacher: Maybe she wrote the story?
Keira: Yeah.
Teacher: She's the author. Maybe this is her and she's writing about when she went to visit the Lincoln Memorial.
Keira: But she's not real, she's fake.
Teacher: Well maybe she draws pictures too.

Appendix B

Occurrence of Teacher Talk During 20-Minute Observation (Raw Count)



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