INTERNATIONAL LITERACY ASSOCIATION
READING RESEARCH QUARTERLY

Examining the Acquisition of Vocabulary Knowledge Depth Among Preschool Students

Elizabeth B. Hadley
David K. Dickinson
Vanderbilt University, Nashville, Tennessee, USA

Kathy Hirsh-Pasek
Temple University, Philadelphia, Pennsylvania, USA

Roberta Michnick Golinkoff
University of Delaware, Newark, USA

Kimberly T. Nesbitt
University of New Hampshire, Durham, USA

ABSTRACT

Well-developed lexical representations are important for reading comprehension, but there have been no prior attempts to track growth in the depth of knowledge of particular words. This article examines increases in depth of vocabulary knowledge in 4–5-year-old preschool students (n = 240) who participated in a vocabulary intervention that taught words through book reading and book-related play. At pretest and posttest, students defined words verbally and by using gesture. Responses were coded for type of semantic information given. There were significant increases in depth of knowledge for all word types. Concrete nouns were learned significantly better than all other word types, and verbs were learned significantly better than abstract nouns and adjectives. Analysis of semantic content provided nuanced information about word learning across word types. Synonyms and contextual information were learned well for all word types, whereas functional information was learned best for concrete nouns. These results suggest that ease of word learning may not be influenced solely by perceptual accessibility of words but also by the kind of instructional information that can be provided for different word types.

A number of studies have established the important connection between reading comprehension and vocabulary knowledge (Cain, Oakhill, & Bryant, 2004; Quinn, Wagner, Petscher, & Lopez, 2015; Vellutino, Tunmer, Jaccard, & Chen, 2007). However, there is a growing awareness that vocabulary knowledge is a complex construct that cannot be understood solely in terms of breadth, or number of words known (Christ, 2011; Schoonen & Verhallen, 2008). Vocabulary breadth is a descriptor of the overall number of entries in a learner's lexicon, each of which may be known to a greater or lesser extent. Vocabulary depth, a related but distinct aspect of word knowledge, is a descriptor of how well the individual entries in one's lexicon are known (Anderson & Freebody, 1981). In other words, depth can be defined as a learner's richness of knowledge about individual words and has also been shown to contribute to students' ability to understand what they read (Ouellette, 2006). However, depth has been less frequently explored than breadth in the literature, with many vocabulary intervention studies focusing on number of words learned, without asking how much and what kind of knowledge students have gained about individual words or whether this knowledge is of sufficiently high quality to impact reading comprehension.

Although the concept of depth itself has several different dimensions, this article focuses on two key aspects: richness of semantic

Reading Research Quarterly, 51(2)
pp. 181–198 | doi:10.1002/rrq.130

representation of words and knowledge of use in typical contexts (Nation & Snowling, 1998; Ordóñez, Carlo, Snow, & McLaughlin, 2002). We respond to the need for more detailed information about what kinds of instruction can help foster depth. We present a nuanced portrait of preschoolers' acquisition of deep word learning, examining which kinds of semantic information children learned from instruction for words ranging in perceptual accessibility. Our data are drawn from a vocabulary intervention designed to evaluate children's word learning from shared book reading paired with play sessions with varying levels of adult support (Dickinson et al., 2013). This multiphase intervention has been shown to have strong effects on children's depth and breadth of word knowledge (Dickinson et al., 2013). Analyses reported in the present study focus on children's depth of word learning, looking at results by both word type and semantic information.

Acquiring Deep Word Knowledge

The initial process of learning a new word has often been described as fast mapping (Carey, 1978): the quick learning of a few aspects of a word after only a few incidental exposures. Fast-mapped information includes the association between an object and a word label, limited information about the context in which the new word is encountered, and the ability to produce some of the phonemes in the word label (Dollaghan, 1985). Children with a fast-mapped, limited understanding of a word may identify a picture of the word on a receptive vocabulary measure but lack a deeper understanding of the word's nuances and uses in multiple contexts. Therefore, although children may, in a superficial sense, know the word, their semantic knowledge may not be extensive enough for them to use the word in real-world settings or draw on it when comprehending text.

A deep understanding of word meanings is acquired gradually over time (Bion, Borovsky, & Fernald, 2013; Yu & Smith, 2012). Bloom (2000) described the rate of children's word learning not, as is often cited, as learning 10 new words a day but as "learning one-hundredth of each of a thousand different words" (p. 25). He pointed to research showing that common verbs such as *pour* and *fill* are not fully understood even by children as old as 7 (Gropen, Pinker, Hollander, & Goldberg, 1991). Research by Medina, Snedeker, Trueswell, and Gleitman (2011), however, suggested that if the context in which a word is learned is highly informative, such as in a book-reading session in which the story and pictures illustrate the word's meaning, children may be able to gain a great deal of knowledge by encountering the word just once. Encountering a word in multiple, varied contexts, such as in a book-reading session and then during a guided play activity, may also facilitate deeper word knowledge than learning a word in a single context (Bolger, Balass, Landen, & Perfetti, 2008).

Henriksen (1999) described the process of gaining deep word knowledge as network building: discovering links between the word in question and other related terms. Henriksen gave an example of network building for the word *hot*: A child might learn antonyms for this word (e.g., *cold*), synonyms (e.g., *warm*), words that vary in gradation (e.g., *scalding*, *tepid*), and multiple typical contexts for the use of the word.

Deep Word Knowledge and Reading Comprehension

Networks of knowledge associated with words have been identified as a key factor in the relationship between vocabulary knowledge and reading comprehension. Anderson and Freebody (1981) posited that vocabulary and reading comprehension are related because vocabulary serves as an indication of conceptual knowledge. According to this theory, a person can understand what is read not only because he or she knows individual word meanings but also because he or she has built extensive networks of conceptual knowledge from which to draw on, of which vocabulary is the tip of the iceberg. To improve reading comprehension, therefore, vocabulary instruction must build deep, conceptually rich knowledge. Neuman and Celano (2006) suggested that once children begin to acquire this conceptually rich knowledge, they become able to acquire more knowledge at faster rates and that, conversely, children lacking in conceptually rich knowledge fall further behind their peers.

Perfetti's (2007) lexical quality hypothesis, a theoretical model describing the reading process, similarly highlights the centrality of networks of word knowledge in reading comprehension. The hypothesis views comprehension as dependent on the ability to retrieve word identities, which in turn relies on the lexical quality of a word, or how much knowledge a reader has about the form and meaning of a particular word, as well as how closely these elements are connected to one another. As a learner has more experience with a word in a variety of contexts (Bolger et al., 2008), its phonological representation becomes more stable, more grammatical classes and inflections of the word are learned, and the meaning becomes incrementally more precise and less bound to context. High-quality representations, or semantic networks in which elements of form and meaning are tightly connected to one another, can be quickly retrieved, whereas low-quality representations threaten a reader's retrieval speed and ability to comprehend a passage.

The lexical quality hypothesis provides a theoretical framework for understanding the relationship between high-quality word knowledge and reading comprehension, which has been demonstrated in several studies. A study that measured depth by evaluating fourth-grade students' ability to verbally define words showed that depth predicted reading comprehension beyond the association explained by measures of breadth (Ouellette, 2006). Proctor, Silverman, Harring, and Montecillo (2012) corroborated these findings: Depth was a significant predictor of reading comprehension for students in grades 2–4, even after controlling for decoding and vocabulary breadth. In a longitudinal study, Roth, Speece, and Cooper (2002) reported a strong correlation (r = .70) between kindergartners' abilities to give oral definitions (a measure of depth) and their second-grade reading comprehension. Finally, the National Early Literacy Panel (2008) found that definitional vocabulary (a depth of knowledge measure) was more predictive of later decoding and reading comprehension than breadth.

Studies with struggling readers at the elementary level have further corroborated the importance of deep word knowledge for reading comprehension. Nation and Snowling (1998) found that elementary school–age students who had difficulties with reading comprehension scored the same as their peers on measures assessing phonological skills but did less well on tests that measured semantic abilities. These results indicate that students who struggled with reading comprehension did so not because of weak phonological skills but because they had limited semantic knowledge, which led to slower semantic processing and poor comprehension.

Landi and Perfetti (2007) suggested that this weakness in semantic knowledge is due to a lack of relevant experience with words, such as repeated exposures to words' phonological and semantic features. Once a pattern of inadequate exposure to words is established, it can have long-reaching reciprocal effects: A paucity of high-quality experiences with words leads to weak semantic representations, which then leads to poor reading comprehension (Landi & Perfetti, 2007). As early as first grade, students who struggle with reading have lower self-concepts about reading and are rated by teachers as more likely to be off task during class reading activities and less likely to read independently on their own (Morgan, Fuchs, Compton, Cordray, & Fuchs, 2008). This lack of sufficient exposure to print then limits students' ability to build high-quality representations of words, which continues the cycle (Landi & Perfetti, 2007). Helping young students build high-quality representations of words through rich instruction and repeated exposures is therefore essential in providing a strong foundation for reading success.

These studies have shown the importance of deep word knowledge in reading comprehension for elementary students. Given the fact that early language ability is highly predictive of later language competence (Dickinson & McCabe, 2001; Storch & Whitehurst, 2002), the lexical representations that children build early on are likely to be of key importance once they begin reading. Efforts to foster young children's vocabulary learning, therefore, should focus not only on adding new words to their lexicons but also on building rich, high-quality representations of words. These two instructional goals are likely complementary: As learners add new words to their lexicons, their networks of word knowledge become more refined and precise for distinguishing new entries from old ones (Carey, 1978), thereby increasing depth, and when learners gain rich knowledge about a number of aspects of a word, they likely learn other, related words along the way, thereby increasing breadth.

Semantic Networks by Word Type

Depth of word knowledge can be conceptualized as a rich network of semantic associations around a word that support semantic processing and reading comprehension. The content of these networks, however, is thought to vary by form class (Miller & Fellbaum, 1991), which may also have consequences for how well different words are learned. A number of studies have reported that verbs are more difficult to learn than nouns (see Gentner, 1982; Imai et al., 2008), even for adults (Gillette, Gleitman, Gleitman, & Lederer, 1999). Maguire, Hirsh-Pasek, and Golinkoff (2006) suggested that all words lie on a continuum of concepts and that words are easier or more difficult to learn based not on their form class but on how perceptually accessible they are, as determined by the factors of shape, individuation, concreteness, and imageability.

Shape can be understood as the extent to which an object or action has a reliable outline or contour (e.g., a cup has a more consistent shape than a person dancing, which has a more consistent shape than someone thinking; Maguire et al., 2006). *Individuation* refers to the ease with which an item can be distinguished from others in a scene (Gentner & Boroditsky, 2001). *Concreteness* refers to whether something is a tangible object (Paivio, Yuille, & Madigan, 1968), and *imageability* to how readily one can produce a mental image for that word (Maguire et al., 2006). These four elements, considered together, characterize a word's perceptual accessibility.

Because verbs tend to lie on the less perceptually accessible end of this continuum, they are generally more difficult to learn, although verbs such as *walking* that easily produce a mental image and have a reliable, consistent shape are easier to learn than more abstract verbs such as *thinking*. Nouns also fall at various points along the continuum. For example, the noun *justice* may be quite difficult to learn, as it is highly abstract and difficult to form a mental image for, whereas a perceptually accessible, easily individuated object such as *sword* may be quite simple to learn. Although verbs vary in perceptual accessibility, in the present study, eight of the nine verbs tested fall on the more perceptually accessible end of the continuum, so we analyzed them together (see Appendix A for more specific information about each word). The nouns tested vary in their perceptual accessibility, so we divided them into "abstract" and "concrete" categories (the abstract nouns are also less perceptually accessible in terms of shape, individuation, and imageability, but we use the terms *concrete nouns* and *abstract nouns* to reflect the common usage of these terms in the literature). We use the term *word type* rather than *form class* to reflect this division in nouns.

The idea that words fall along a continuum from less to more perceptually accessible has important consequences for theories of vocabulary depth. It indicates that the types of semantic information available for words along the continuum will be qualitatively different, so a learner's semantic network for a concrete noun will look different from his or her semantic network for an abstract verb. This also suggests that the instructional information that can be provided for different word types will also be different. In our study, we examine children's learning of words that fall at different points on the continuum, enabling us to determine the impact of word type on learning.

Semantic Networks for Concrete Nouns

Functional Information

For concrete nouns, functional information, or information about what an object does or is used for, has been found to be highly salient for preschool word learners (Booth, 2009; Greif, Nelson, Keil, & Gutierrez, 2006). Preschoolers were found to be more likely to learn words that were described in terms of their function (e.g., a shovel is used to dig) than in nonfunctional terms (e.g., a shovel has a part that is made out of metal; Booth, 2009; Nelson, O'Neil, & Asher, 2008).

Hierarchical Information

Word knowledge also includes the understanding of hierarchical relationships among concrete nouns. This dimension involves the ability not simply to add nodes to the semantic network but also to categorize the relationships among nodes, such as the ability to identify superordinates and subordinates (Verhallen & Schoonen, 1993). Another type of hierarchical relationship among concrete nouns is that of part–whole relations (Henriksen, 1999; Verhallen & Schoonen, 1993). For a word such as *fish*, various characteristic component parts may be included in a child's semantic network, such as *scales*, *fins*, *gills*, and *tail*.

Perceptual Qualities

For concrete nouns, the object's perceptual qualities constitute additional nodes in the semantic network. Although gleaning perceptual information about an object is often thought of as only a first step toward gaining a deeper knowledge of word meaning (Hollich, Hirsh-Pasek, & Golinkoff, 2000), deciding which perceptual qualities are characteristic of particular nouns is a skill that reveals deeper conceptual knowledge (Booth & Waxman, 2002). Perceptual information about objects (e.g., cats have fur, armor is made out of metal, gold is yellow) provides important fodder for the sophisticated process of categorizing what type of object or material something is and how it can be differentiated from other similar objects or materials.

Semantic Networks for Concrete and Abstract Nouns, Verbs, and Adjectives

Synonyms

Another key aspect of a semantic network for concrete and abstract nouns, verbs, and adjectives is synonyms, or the core meaning(s) of a word. A synonym can be either a single word or a short, decontextualized definition when a single-word synonym does not exist (Miller & Fellbaum, 1991). A verb's core meaning is often expressed by using a synonym with a manner qualification, such as "To (verb 1) is to (verb 2) in some manner" (Miller & Fellbaum, 1991). For example, the meaning of the word *gallop* might be expressed in this way: "To gallop is to run fast."

Knowledge of synonyms is often the deciding factor in whether a child knows a word, demonstrating a decontextualized knowledge of word meaning. A student's ability to select synonyms for a word is a commonly used standardized measure of receptive vocabulary knowledge (e.g., Test of Word Knowledge; Wiig & Secord, 1992). In teaching vocabulary, giving synonyms or short, decontextualized word meaning explanations has been shown to help primary-grade students learn new words (Biemiller & Boote, 2006). However, Beck, McKeown, and Kucan (2002) cautioned that providing decontextualized word meaning information is helpful only when couched in child-friendly language and also paired with more contextualized examples of how a word is used.

Gestures

Although knowledge about words is often thought of as only verbal, there is a growing awareness that embodied experiences of words may help support comprehension and that gestures serve as another way of representing the meanings of words (Glenberg, Gutierrez, Levin, Japuntich, & Kaschak, 2004). Just as words serve as a label for underlying semantic information, gestures can serve as a similar kind of label, although they can also provide supplementary information about meaning in ways a word label does not (Göksun, Hirsh-Pasek, & Golinkoff, 2010). Gesture plays an important supporting role in communication because of its ability to clarify or supplement spoken language, especially when that language is complex (McNeil, Alibali, & Evans, 2000). Pairing language with gesture, rather than using language alone, was shown to improve comprehension for preschoolers (McNeil et al., 2000) and for first and second graders (Glenberg et al., 2004). McNeil and colleagues posited that gestures can act as a scaffold for verbal information, helping to guide children's attention to the semantic content of complex language. Gesture may also function as an alternative way for children to express knowledge before they can explain it verbally (Capone, 2007). Examining gestural representations of knowledge, therefore, may show increases in student learning that would otherwise be overlooked (Verhallen & Schoonen, 1993).

Gestures may be a particularly powerful way of teaching the meanings of verbs. Although concrete nouns have stable perceptual features, verbs are dynamic and require children to abstract the verbal essence of an action (Golinkoff et al., 2002). Gestures may be a useful way of representing verbs because they filter out the noise and distill an action into a limited, more meaningful essence.

Contextual Information

Finally, rich word knowledge must include not only semantic information but also an ability to use a word in different contexts (Nagy & Townsend, 2012; Stahl & Fairbanks, 1986). Nagy and Scott (2000) argued that knowing a word means being able to do things with it, and the ability to use a word correctly in context shows a deep, applied knowledge of a word and its use. Like other elements of depth, the ability to appropriately use a word develops over time, progressing from a basic association with the word and its typical context of use (e.g., knowing that the word has something to do with __; Dale, 1965), to being able to use the word in a single context, to eventually learning to use the word flexibly in a range of contexts (Clark, 2010).

Summary

Deep word knowledge for concrete nouns includes functional, perceptual, and hierarchical information, synonyms, nonverbal information, and knowledge about how words are used. The concepts underlying abstract nouns and verbs are complex and relational and, therefore, more easily described with synonyms or gestures or through meaningful context. Adjectives lend themselves to networks of knowledge composed of synonyms, gestures, and use in context.

Measuring Depth of Word Knowledge

Depth of word knowledge is an important construct that is rarely measured in vocabulary interventions. Instead, many assess only whether a child can recognize a word, using tasks such as asking children to select a picture from a group that matches a word spoken by the tester (Dunn & Dunn, 1997; Ouellette, 2006). These kinds of measures do not account for the fact that words can be known to a lesser or greater extent and that differences in depth of knowledge have consequences for reading comprehension (Perfetti, 2007).

The vocabulary measure used in the present study is a definition task in which we ask students to tell us what they know about words. Wasik and Hindman (2014) suggested that for young emergent readers who learn words through oral language, not print, a slightly more limited conception of depth is appropriate: a facility with basic phonological, semantic, syntactic, and contextual, but not orthographic, aspects of a word. Definition tasks capture the quality of the semantic and contextual information a child knows about a word and may also indirectly tap into the strength of his or her phonological and syntactic representation. Consistent with the lexical quality hypothesis, definition tasks test the main criterion for a high-quality representation: the ability to retrieve word identities.

The following three questions are addressed:

1. Did children's depth of vocabulary knowledge for target words increase, as compared with their knowledge of exposure and control words?
2. Did increases in depth of knowledge for target words vary by word type?
3. How did the kind of semantic information learned vary by word type?

Methods

Study Design and Research Participants

The present study was conducted as part of Read, Play, Learn, a project aimed at increasing the vocabulary knowledge of preschoolers from low-income backgrounds through a combined method of book reading and play (Dickinson et al., 2013; Weisberg et al., 2015). The goal of the larger intervention was to test the efficacy of play combined with book reading as a method of vocabulary instruction; however, the present study focuses specifically on increases in depth of children's word knowledge by word type (concrete and abstract nouns, verbs, and adjectives) during the course of this intervention, without examining the efficacy of the book-reading and play methods in detail.

This study uses a within-subjects research design in which children served as their own controls. To determine whether children learned a significant amount about words during the intervention, they were assessed on three kinds of words: target words, which were part of the book text, used in the play sessions, and explicitly defined; exposure words, which were not explicitly taught or defined but were in the book read-alouds and used in the play sessions; and control words, which were not used in the intervention at all. This design allowed us to test whether the effects of the intervention were due to merely hearing words used repeatedly or if additional teaching of the words made a significant difference in students' learning.

Data come from 240 four- and five-year-old students (mean age = 4 years 11.3 months, standard deviation = 4.8 months). Eighty-five of these students were enrolled in seven Head Start classrooms in a mid-Atlantic U.S. state, and 155 were enrolled in 11 preschool classrooms from a state-funded program for low-income families in a Southeastern U.S. city. The sample included only students who did not have an Individualized Education Plan and who understood enough English to be able to follow directions, as reported by their teacher. Table 1 summarizes the demographics for the sample. The intervention was delivered by nine female intervention specialists, all of whom possessed a bachelor's or master's degree plus experience in early childhood settings.

TABLE 1
Demographic Information for the Sample

Characteristic	*N*	Percentage
Gender		
Female	130	54.2
Male	110	45.8
Race/ethnicity		
African American	131	54.6
Hispanic	55	22.9
Caucasian	33	13.8
Other	16	6.6
No response	5	2.1
English learner		
No	204	85.0
Yes	36	15.0

Note. English learner = children who speak a language other than English at home.

Materials: Book and Word Selection

The book-reading and play intervention was developed around two themes (dragon and farm), which were chosen for their appeal to young children and opportunities for play. Two books per theme were read aloud to students: *The Knight and the Dragon* by Tomie dePaola and *Dragon for Breakfast* by Eunice McMullen, or *Farmer Duck* by Martin Waddell and *Pumpkin Soup* by Helen Cooper. All four books were comparable in terms of the pictorial representations of most target words, text complexity, and length.

Ten target words per book—abstract and concrete nouns, verbs, and adjectives—were selected using the following procedures. As an initial step, we identified words in the story that were considered Tier 2, or sophisticated words of high utility (Beck et al., 2002), and would therefore need additional explanation for children to understand them fully. Additional target words were inserted in the texts because all four books lacked 10 total Tier 2 words. Because some of the books had minimal text, these adaptations typically involved adding sentences with Tier 2 words that described the action depicted in the book's illustrations. For example, the book *Farmer Duck* includes several illustrations of the duck doing work around the farm without any text describing his actions. We added sentences such as "[The duck] took his shovel and dug the weeds out," thereby providing a fuller description of the book's action without significantly altering the story line.

Next, we considered whether the words could be easily explained in child-friendly terms and were semantically and phonologically distinct from one another. We also cross-referenced our selection with Biemiller's (2010) list of words, which are rated in terms of appropriateness for instruction by grade level. Nine target words did not appear on Biemiller's list. Of the 31 target words that were on the list, 61% were characterized as at least level T2—high-priority words that are typically known by more advanced students by the end of second grade and not known by at-risk students. Approximately half of the target words also appeared on the Dale–Chall (Chall & Dale, 1995) list of words known by 80% of fourth-grade students.

Finally, to ensure that the target words were sufficiently difficult, words that over 30% of students from the previous iteration of the experiment identified correctly at pretest were replaced. We used the same methods to select 17 exposure words and 16 control words that were comparable in difficulty to the taught words and contained similar proportions of the four word types (concrete and abstract nouns, verbs, and adjectives). Because of the significant cognitive demand of the vocabulary measure used in this study, in which students were asked to define words, we randomly selected a subset of 21 target words, 10 exposure words, and eight control words for testing on this measure. See Appendix A for a list of all words assessed, along with their word type, difficulty, and descriptive information.

Procedures

The intervention was conducted over a two-month period, from April to May 2012. All students were individually pretested and posttested by members of the research team for knowledge of the target vocabulary within one week prior to and following the intervention, respectively. Students were randomly assigned to one of three play conditions within classrooms, and classrooms were randomly assigned to one of the two themes. Books within each theme were counterbalanced. Intervention specialists read aloud to mixed-gender groups of three students in a quiet location outside the classroom for four consecutive days during the week. Immediately following each book reading, play sessions were conducted. The current article does not focus on the main effects of different intervention methods.

Book Reading

Intervention specialists read two books aloud to students four times over the course of the intervention. Each target word was explained as part of every book reading, once during each reading as the words occurred in the text and once after each reading was completed as part of a vocabulary and plot review. The explanation consisted of the following:

- Drawing students' attention to a word by pointing to the picture, which also helps illustrate meaning (e.g., "Look, the king is wearing spectacles" while pointing to the glasses in the picture)
- Definitional information delivered in concise, child-friendly language (e.g., "Spectacles are glasses"), including perceptual, functional (e.g., "The spectacles help the king see better"), and hierarchical information whenever possible
- The use of gesture, whenever possible, to kinesthetically reinforce meaning (e.g., "Can you pretend you are wearing spectacles like this?" while the teacher makes spectacles with rounded fingers)
- An example of a word in a context other than the one used in the story (e.g., "Look, your teacher wears spectacles, too!")

During the third and fourth readings, students' verbal participation was encouraged to reinforce each word's phonological and meaning representations (e.g., "What was the king wearing to help him see?").

Play Conditions

A 10-minute play session immediately followed each book reading. Three play conditions were developed to test the effects of adult-supported play on students' word learning. Because the effects of the different play conditions are not the focus of the present study, we included play condition as a covariate in our analyses, controlling for its effects.

Instrument and Scoring

New Word Definition Test—Modified

To measure students' depth of knowledge of target words, an experimenter-designed measure was developed and administered at pretest and posttest. This measure was adapted from Blewitt, Rump, Shealy, and Cook's (2009) New Word Definition Test, which we renamed as the New Word Definition Test—Modified (NWDT–M) to reflect our adaptations to the coding scheme, namely, additional categories for gestures and contextual information. This definition task employs an informal rather than a formal definition task (Snow, Cancino, De Temple, & Schley, 1991). Our focus here is not the structure or form of children's definitions, which may reveal more about their metalinguistic skills than their knowledge of words. Therefore, the NWDT–M does not track the extent to which children give adult-like definitions of words, a skill that requires practice with the form of definitions (Read, 2004), but instead codes for the amount of accurate semantic and contextual information that students provided for each word. The results of the NWDT–M allow for an understanding of the kinds of information that preschool students learn about words ranging in perceptual accessibility.

Students were asked to define concrete and abstract nouns, verbs, and adjectives verbally or by using gestures. Students were not tested on all target, exposure, and control words on this measure due to time constraints and the cognitive demands on children. The NWDT–M test forms for the dragon and farm themes were similar in the number of items, number of words per word type, and difficulty of words. In a previous phase of this study, we identified words that were known by more than 30% of students at pretest, and eliminated those words for the present study to ensure that all words were of a similar difficulty level.

For each word, students were asked, "What is (a) __?" and a follow-up question, "Can you show me or tell me anything else about __?" If a student did not respond to a question, the tester moved on to the next word. All student responses were transcribed by testers and also video- or audiotaped. A coding scheme was developed (adapted from Blewitt et al., 2009) to categorize and score student responses for the number of information units given. Coding was conducted by research assistants, and 20% of all forms were randomly selected and checked for reliability against a master coder after every four forms were completed. Overall percentage agreement averaged 93.2%, with a mean Cohen's Kappa value of .82.

Coding Scheme

We used seven information unit categories to score student responses for semantic content and contextual information: perceptual qualities, functional information, part/whole, synonyms, gestures, meaningful context, and basic context. Each information unit was worth 1 point except for basic context, which was worth 0.5 point. The first three categories were used for concrete nouns only. Perceptual qualities included properties such as how something looks, smells, tastes, feels, or sounds. Functional information included any process, purpose, or use for concrete nouns and answers the question, "What do you do with it?" Part/whole described a distinct part of a target word or the whole that the target word was a part of. The remaining categories were used for all word types. Synonyms included any word or short phrase that was equivalent to the word being explained, and provided decontextualized meaning information. Gestures included gestures, actions, or facial expressions (e.g., the teacher uses a scary face to illustrate the word *fierce*) that showed knowledge of the word's meaning.

We also coded for two types of use in context. Meaningful context included responses that showed knowledge of the target word in a typical, meaningful context, along with semantic information. For example, if a student said, "A shovel is used to dig up weeds in a garden," "used to dig" would be scored for function, and "weeds in a garden" would be scored for meaningful context, because the student used a typical example to explain how a shovel could be used, along with semantic information. Basic context, worth only 0.5 point, was a simple association between a target word and a typical context, without any use of semantic information. For example, students frequently said, "Santa Claus," for *chimney*, a response that does not include any semantic information but still contains an association with a typical context in which the target word is used. Incorrect or irrelevant responses received a score of 0. See Appendix B for more examples of coded student responses.

Results

We performed multilevel regression models to address each of our three research questions, testing for (1) overall growth in depth of knowledge, comparing students' learning of target words to that of exposure and control words; and (2) growth in depth of knowledge for target words only by word type and (3) by word type and semantic information category. Multilevel model procedures (Raudenbush & Bryk, 2002) were used to account for interdependency among study observations.

Descriptive Statistics

The descriptive statistics in Table 2 show that there was variance in students' vocabulary knowledge. The distribution was skewed, so log transformations were performed to improve the normality of the distribution.

Because students were randomly assigned to a theme (dragon or farm) and the words tested for each theme were different, it was necessary to determine whether the farm and dragon NWDT–M test forms were comparable. An independent samples *t*-test on NWDT–M pretest and posttest scores for the dragon and farm themes indicated that there was no significant difference in mean pretest NWDT–M scores in the two themes, $t(240) = 0.72$, $p = .473$, 95% confidence interval [−0.55, 1.42], but that there was a significant difference at posttest, $t(240) = −4.00$, $p < .001$, 95% confidence interval [−5.68, −1.93]. Because of this difference, we included theme as a covariate in all subsequent analyses.

Psychometric Properties of Measure

Both of the test forms demonstrate acceptable internal consistency at pretest (farm theme: Cronbach's $\alpha = .73$; dragon theme: Cronbach's $\alpha = .76$) and posttest (farm theme: Cronbach's $\alpha = .76$; dragon theme: Cronbach's $\alpha = .86$). We also evaluated the validity of the NWDT–M by comparing the test scores on a concurrent measure of a highly related construct (Cronbach, 1971; Messick, 1989), in this case, the receptive vocabulary measure

TABLE 2
New Word Definition Test—Modified[a] Descriptive Statistics: Average Number of Information Units per Word by Level of Instruction (*n* = 240)

Word type	Test period	Minimum	Maximum	Mean	Standard deviation	Percentage of the sample with responses above floor level
All words	Pretest	0	1.17	0.20	0.21	85.4
	Posttest	0	2.02	0.47	0.37	96.7
Target words	Pretest	0	1.19	0.13	0.20	60.4
	Posttest	0	2.15	0.55	0.48	90.8
Exposure words	Pretest	0	2.50	0.38	0.42	68.8
	Posttest	0	2.50	0.49	0.45	80.8
Control words	Pretest	0	1.50	0.19	0.23	59.6
	Posttest	0	1.25	0.25	0.26	64.6

Note. Above floor-level responses are those coded as receiving a score greater than 0.
[a]Researcher-modified version of Blewitt, Rump, Shealy, and Cook's[b] New Word Definition Test. [b]Blewitt, P., Rump, K.M., Shealy, S.E., & Cook, S.A. (2009). Shared book reading: When and how questions affect young children's word learning. *Journal of Education & Psychology*, *101*(2), 294–304.

used in this study. Although the NWDT–M measures depth of word knowledge and the receptive measure evaluates breadth of knowledge, studies have shown that these two constructs are distinct but related. The correlations between the NWDT–M and receptive measure were statistically significant (r = .41 at pretest, r = .62 at posttest), demonstrating a moderately strong relationship between them but also indicating that they do not measure exactly the same construct.

Overall Growth in Depth of Knowledge

Although our primary interest in this study was to examine children's growth in depth of knowledge by word type and semantic information category, it was necessary first to determine whether they learned a significant amount about taught words in general before we carried out more detailed analyses. To answer our first research question about overall growth in depth of knowledge, we compared children's learning of taught words with their learning of exposure and control words. Using the following multilevel regression model, we tested whether vocabulary gains varied by level of instruction (target, exposure, and control words):

$$\begin{aligned}\text{Posttest}_{ijk} = {} & \gamma_{000} + (\gamma_{100} \times \text{Taught}_{ijk}) \\ & + (\gamma_{200} \times \text{Exposure}_{ijk}) \\ & + (\gamma_{300} \times \text{Pretest}_{ijk}) + (\gamma_{010} \times \text{Age}_{jk}) \\ & + (\gamma_{001} \times \text{Theme}_{k}) + (\gamma_{002} \times \text{Condition}_{k}) \\ & + U_{00k} + U_{0jk} + r_{ijk}\end{aligned} \tag{1}$$

The model accounted for three nesting levels in the data: Level of instruction$_{ijk}$ (target, exposure, and control) was repeated within children$_{jk}$ (n = 240), and children were nested within play groups$_k$ (n = 85). For parsimony, the classroom random effects were aggregated at the reading playgroup level. Level of instruction was dummy coded with control words as the reference group, which were contrasted to taught (γ_{100}) and exposure (γ_{200}) words. To look at residualized gains, students' pretest vocabulary scores (γ_{300}) were included as a covariate, along with age at pretest (γ_{010}), book theme (γ_{001}), and play condition (γ_{002}). Book theme was coded with the dragon theme as the reference group, and play condition was coded with free play as the reference group. Theme was included as a covariate because the words used in the two themes were different from one another.

Analysis indicated that after accounting for the model covariates of pretest vocabulary knowledge, γ_{300} = 0.59, standard error (SE) = 0.04, $p < .001$; age at pretest, γ_{010} = 0.003, SE = 0.001, $p < .001$; theme, γ_{001} = −0.03, SE = 0.01, $p < .001$; and play condition, γ_{002} (free play vs. guided play = 0.03, SE = 0.01, p = .001, free play vs. directed play = 0.03, SE = 0.01, p = .001), students knew more taught words at posttest than control words, γ_{100} = 0.10, SE = 0.01, $p < .001$, and more exposure words than control words, γ_{200} = 0.04, SE = 0.01, $p < .001$. Post hoc pairwise comparisons with least significant difference adjustments also confirmed that students knew more taught words than exposure words ($p < .001$). On average, after controlling for covariates, students gave 4.68 more information units at posttest for the target words as a whole, or 0.42 more information units per target word. The pretest–posttest effect sizes were 1.22 for target words, 0.26 for exposure words, and 0.22 for control words.

Growth in Depth of Knowledge by Word Type

The first analysis determined that students had indeed shown significantly greater growth in their knowledge of taught words than exposure and control words. Further analyses were conducted only on target words and examined students' growth in knowledge of target words in more detail. Our second research question proposed to investigate how students' learning varied by word type. Using the following multilevel regression model, we tested whether vocabulary gains varied by word type (concrete nouns, abstract nouns, verbs, and adjectives).

$$\begin{aligned} \text{Posttest}_{ijk} = {} & \gamma_{000} + (\gamma_{100} \times \text{Verbs}_{ijk}) + (\gamma_{200} \\ & \times \text{AbstractNouns}_{ijk}) + (\gamma_{300} \times \text{Adjectives}_{ijk}) \\ & + (\gamma_{400} \times \text{Pretest}_{ijk}) + (\gamma_{010} \times \text{Age}_{jk}) \\ & + (\gamma_{001} \times \text{Theme}_{k}) + (\gamma_{002} \times \text{Condition}_{k}) \\ & + U_{00k} + U_{0jk} + r_{ijk} \end{aligned} \tag{2}$$

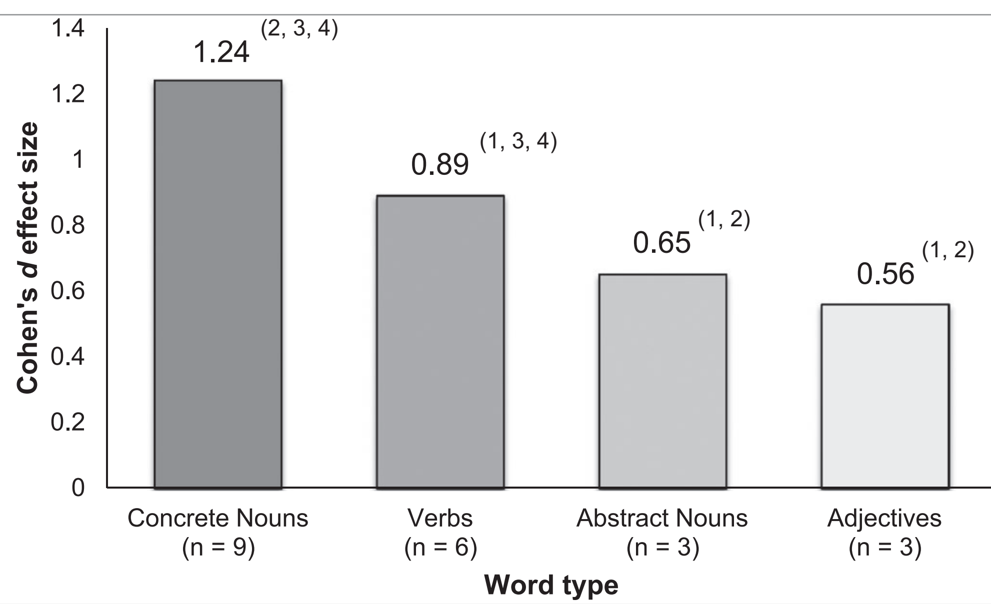
The model accounted for three nesting levels in the data; word type$_{ijk}$ (concrete nouns, abstract nouns, verbs, and adjectives) was repeated within children$_{jk}$, and children were nested within play groups$_k$. Word type was dummy coded with concrete nouns as the reference group, which was contrasted to verbs (γ_{100}), abstract nouns (γ_{200}), and adjectives (γ_{300}).

This analysis indicated that students showed significantly greater growth in their knowledge of concrete nouns as compared with verbs, $\gamma_{100} = -0.05$, $SE = 0.01$, $p < .001$; abstract nouns, $\gamma_{200} = -0.12$, $SE = 0.01$, $p < .001$; and adjectives, $\gamma_{300} = -0.13$, $SE = 0.01$, $p < .001$. Post hoc pairwise comparisons with least significant difference adjustments revealed that students also learned significantly more about verbs than abstract nouns ($p < .001$) and adjectives ($p < .001$). There was no significant difference in the learning of adjectives and abstract nouns. Students showed significant growth in knowledge for each of the four word types from pretest to posttest ($p < .001$). Figure 1 shows the pretest–posttest effect sizes for each word type and the significant contrasts in learning by word type. Table 3 lists descriptive information for target words by word type.

Growth in Depth of Knowledge by Word Type and Semantic Information Category

Our third research question asked how the kind of semantic information learned varied by word type. To address this question, we tested whether significant gains were made from pretest to posttest for each semantic information category by word type, using the following multilevel regression model:

FIGURE 1
Cohen's *d* Pretest–Posttest Effect Sizes for Concrete Nouns, Verbs, Abstract Nouns, and Adjectives



Note. Reference group is level of instruction at time 1 (pretest). (1) = significant difference ($p < .001$) from concrete nouns; (2) = significant difference ($p < .001$) from verbs; (3) = significant difference ($p < .001$) from abstract nouns; and (4) = significant difference ($p < .001$) from adjectives.

TABLE 3
New Word Definition Test—Modified[a] Descriptives: Average Number of Information Units per Target Word by Word Type (*n* = 240)

Word type	Test period	Minimum	Maximum	Mean	Standard deviation	Percentage of the sample with responses above floor level
Concrete noun	Pretest	0	2.33	0.18	0.32	43.8
	Posttest	0	3.00	0.78	0.70	85.0
Verb	Pretest	0	2.50	0.22	0.38	45.4
	Posttest	0	2.00	0.57	0.55	75.4
Adjective	Pretest	0	2.00	0.06	0.23	7.9
	Posttest	0	2.00	0.24	0.42	31.7
Abstract noun	Pretest	0	2.00	0.05	0.22	9.6
	Posttest	0	2.33	0.30	0.49	35.8

Note. Above floor-level responses are those coded as receiving a score greater than 0.
[a]Researcher-modified version of Blewitt, Rump, Shealy, and Cook's[b] New Word Definition Test. [b]Blewitt, P., Rump, K.M., Shealy, S.E., & Cook, S.A. (2009). Shared book reading: When and how questions affect young children's word learning. *Journal of Education & Psychology*, *101*(2), 294–304.

$$\begin{aligned}\text{Vocab}_{ijk} = \gamma_{000} &+ (\gamma_{100} \times \text{Observation}_{ijk}) \\ &+ (\gamma_{010} \times \text{Age}_{jk}) + (\gamma_{001} \times \text{Theme}_k) \\ &+ (\gamma_{002} \times \text{Condition}_k) + U_{00k} + U_{0jk} + r_{ijk}\end{aligned} \quad (3)$$

The model accounted for three nesting levels in the data; assessment observation*ijk* was repeated within children*jk*, who were nested within play groups*k*. The independent variable of interest is Observation (γ_{100}) and represents the contrast of pretest and posttest scores for each semantic information category by word type. Separate models were conducted for each semantic information category by word type. Because separate tests were run for each semantic information type (19 tests), we used a Bonferroni-adjusted α level of .003 per test (.05/19) to determine significance. The kind of semantic information that students learned differed by word type (see Table 4).

Students showed significant growth in their knowledge of all semantic information categories for concrete nouns, learning functional information best, followed by meaningful context, synonyms, part–whole relations, gestures, perceptual qualities, and basic context. Students also showed growth in all semantic information categories for verbs, learning synonyms best, followed by meaningful context, gestures, and basic context. For abstract nouns, students showed significant growth only in their knowledge of synonyms and meaningful context. They showed no growth in knowledge of the basic context and gesture categories for abstract nouns. Finally, students showed growth in knowledge of synonyms for adjectives. Although meaningful context was taught for all of the adjectives in the study, and gesture was taught for 67% of them, students did not show significant growth in those categories. Table 4 shows the growth in depth of knowledge from pretest to posttest for taught words in all word types by semantic information category, along with the percentages of words in each category taught using that kind of semantic information and effect sizes for each category.

Discussion

Depth of knowledge is an important and distinct facet of vocabulary knowledge that supports reading comprehension (Ouellette, 2006). Because children who already have rich vocabulary knowledge are better able to acquire more rich vocabulary knowledge, and those who lack that knowledge fall further behind (Neuman & Celano, 2006), there is a pressing need for efforts that focus on building vocabulary depth in young children. However, there is very little information about the kind of instruction that fosters this learning. We know that increased encounters with words build depth (Beck & McKeown, 2007), but there has been little research addressing the question of which specific kinds of information about words are best learned by children, therefore adding to their depth of knowledge. The present study addresses this gap by showing that certain kinds of input are especially helpful in fostering depth and that these kinds of input vary by word type.

The words we taught in this study fell at different points along the conceptual continuum, ranging in their perceptual accessibility. Concrete nouns such as *handkerchief* were easy to observe and individuate, had a consistent shape, and were highly imageable. In

TABLE 4
Unstandardized Coefficients (standard errors) and Effect Sizes for Students' Growth in Knowledge of the Target Words by Word Type and Semantic Information Type Used to Teach the Words (n = 240)

Word type and semantic information category	Percentage of the words taught using the semantic information category	Coefficient (*b*)	*d*
Concrete noun			
Function	89	0.21 (0.02)	0.96*
Meaningful context	100	0.15 (0.01)	0.84*
Part/whole	33	0.12 (0.01)	0.83*
Synonym	100	0.07 (0.01)	0.65*
Gesture	11	0.04 (0.01)	0.53*
Perceptual quality	56	0.05 (0.01)	0.40*
Basic context		0.03 (0.01)	0.25*
Verb			
Synonym	100	0.12 (0.01)	0.79*
Meaningful context	100	0.09 (0.01)	0.53*
Gesture	67	0.05 (0.01)	0.42*
Basic context		0.04 (0.01)	0.29*
Abstract noun			
Synonym	100	0.05 (0.01)	0.49*
Meaningful context	100	0.04 (0.01)	0.38*
Basic context		<0.01 (0.01)	0.04
Gesture	0	<0.01 (0.02)	0.03
Adjective			
Synonym	100	0.05 (0.01)	0.46*
Basic context		0.02 (0.01)	0.15
Meaningful context	100	0.01 (0.01)	0.13
Gesture	67	<0.01 (0.02)	0.11

Note. *d* = Cohen's *d* standardized mean difference effect size. The reference group for effect sizes is level of knowledge at time 1 (pretest).
*$p < .001$.

contrast, verbs such as *returning* and abstract nouns such as *plan* had no consistent shape, were difficult to picture, and could not be physically manipulated or as easily observed in the world. Over the course of the intervention, all of these words were taught by providing a short verbal definition and contextual information, but beyond these common features, we did not systematically control the kind of information supplied about words, because different words lent themselves to different kinds of supportive information. Indeed, it would be nearly impossible to fully vary word type by information type. For example, although words such as *returning* and *plan* can be defined, it is difficult to use an iconic gesture to represent these words or to supply functional information for them. This variability in instruction and in word types provides an opportunity to examine children's depth of word learning in a detailed way, looking at their relative learning of words by both word type and the categories of semantic information that students were able to learn for each word type.

Results by Word Type

Our results are consistent with Maguire and colleagues' (2006) theory that perceptual accessibility, which includes the factors of shape, imageability, concreteness, and individuation, predicts the ease with which words are learned. The words that showed the most growth in learning were those that were the most perceptually accessible. Students learned the most about concrete nouns (Cohen's d = 1.24), followed by verbs (of which all but one were perceptually accessible; Cohen's d = 0.89), abstract nouns (Cohen's d = 0.65), and finally adjectives (Cohen's d = 0.56). This finding applies not only to form class differences but also to differences within form classes; in this study, the highly abstract concepts labeled by certain nouns were more difficult to learn than concrete verbs.

Semantic Information Categories

The conceptual continuum theory posits that perceptual accessibility is the primary determinant of ease of learning. Our examination of the kinds of information that we could naturally supply about different words made evident that the types of information that can be provided about word meanings may be a second factor that affects word learning and may help explain differential learning of varying types of words.

We found that certain types of semantic information were more often retained than others. The most perceptually accessible category of words, concrete nouns, was taught with a synonym, an explanation of what the word meant in context, and a reference to a picture in the book (see Table 4). All but one of the concrete nouns were also explained using functional information (e.g., "We use <u>nostrils</u> to breathe"), about half were explained using perceptual qualities (e.g., "<u>Nostrils</u> look like little holes"), and a third of the words were explained by pointing out a part of the object or the whole of which the object is a part (e.g., "<u>Scales</u> are on a fish's body"; see Table 4). Students' learning of concrete nouns reflects this instruction. They showed significant growth in their knowledge of function, context, synonym, part–whole relationships, gesture, and perceptual qualities. Interestingly, function was the category that showed the most growth (Cohen's d = 0.96) for concrete nouns, and although only a third of the words were explained using part–whole relationships, this type of semantic information also had a large effect size (Cohen's d = 0.83).

The less perceptually accessible words in the study—abstract nouns, verbs, and adjectives—were also taught with a synonym and an explanation of what the word meant in context. Pictures from the book were referenced for two thirds of the abstract nouns and verbs and about a third of the adjectives. Gesture was another important element of instruction for these words: Two thirds of the verbs and adjectives were labeled with a gesture illustrating the word's meaning. Consistent with the instruction given, synonym was the best learned category for verbs (Cohen's d = 0.79), abstract nouns (Cohen's d = 0.49), and adjectives (Cohen's d = 0.46). The meaningful context category also showed significant growth for all word types except adjectives. Finally, the gesture category showed significant growth for verbs (Cohen's d = 0.42) but not for adjectives, in spite of the instruction given.

These results demonstrate that not only were the concrete nouns better learned because of their perceptual accessibility, but they also naturally lent themselves to fuller, more varied kinds of instructional information. The less perceptually accessible words, in contrast, were not only less imageable, less concrete, more difficult to individuate, and without a consistent shape but were also more difficult to define in terms of function or discuss as a part or whole. Therefore, our data suggest that speed of learning of words may reflect the converging effects of both their perceptual accessibility and the type of information that can be provided.

Educational Implications

Our results can help inform vocabulary instruction by guiding the type of information that teachers use to explain new words to preschoolers. For the concrete nouns in our study, students found functional information highly salient. This finding is in line with Booth's (2009) findings that providing functional information for objects is a powerful way to help increase preschoolers' depth of word knowledge. To support word learning for concrete nouns, then, teachers should not only exploit their perceptual accessibility by using pictures and pointing out important parts of the object but should also explain an object's function. Perceptual information can also serve as a gateway to conceptual information (Booth, 2009): for example, describing what armor looks like (e.g., hard, made out of metal) naturally leads into a description of what it is used for (to protect a person's body in a fight).

These results also make it clear that verbs (even the concrete ones used in this study), abstract nouns, and adjectives simply have fewer readily describable features as compared with concrete nouns. In spite of this limitation, the verbs taught in this study were well learned (Cohen's d = 0.89), most likely because they are relatively accessible perceptually. Because of these features, we were able to teach students simple, easy-to-remember gestures for many of the verbs. This suggests that teaching verbs through gesture or other forms of embodied learning can indeed serve as a helpful scaffold for the verbal information provided (McNeil et al., 2000).

The growth in learning for abstract nouns (Cohen's d = 0.65) and adjectives (Cohen's d = 0.56) was modest but still significant. Given that these types of words are abstract, have few describable features, and are difficult to explain, how can we help children learn them? One important takeaway from these results is that both synonyms and meaningful context were well learned for almost every word type (students did not show growth in meaningful context for adjectives). The large effect sizes for synonyms suggests that children can learn and provide brief, simple definitions, further justifying the use of clear word meaning explanations when new vocabulary words are introduced to children (Biemiller & Boote, 2006). This result held for all form classes in the study, showing that even when words are fairly abstract, children are able to learn something about a word's essential meaning through instruction.

The meaningful context category also showed significant growth for all word types except adjectives, suggesting that children not only need clear semantic information about words but also remember and use information about the typical contexts in which words are used. This finding supports instructional methods that emphasize the importance of both giving definitions and teaching vocabulary in context (Beck et al., 2002; Biemiller & Boote, 2006; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004). This may be especially important for words that are difficult to learn. Hearing a difficult, highly abstract word (e.g., *plan* in this study) used in context multiple times (in this study, at least eight times) allows children to progressively refine their knowledge of the nuances of its meaning. However, average growth per word was somewhat limited, suggesting that eight exposures may not be sufficient. Bolger et al. (2008) found that adult learners had higher quality knowledge of words when encountering them in multiple varied contexts as opposed to a single context multiple times. In this study, preschool students' encounters with words in related but different contexts, such as the book-reading and play settings, may have had additional benefits in helping students refine their word knowledge.

Limitations

The number of words for each word type here is small, particularly for the adjectives and abstract noun categories, and the findings here may not be applicable to adjectives or abstract nouns that are significantly more concrete or more abstract than the ones used in this study. We have provided the specific words used (see Appendix A) to help guide interpretation.

Further studies should also look at the learning of abstract verbs to more fully explore the impact of certain types of instruction on words along the conceptual continuum.

It is also important to note that students' increases in word knowledge were relatively small (about 0.42 information units per word), given that students could theoretically score a nearly unlimited number of points for each word (although the highest score for an individual word was 6 points). However, the demands of the definition task are significant, and it is meaningful that preschool students learned and expressed semantic information about Tier 2 words with only a verbal prompt.

Furthermore, we did not test students at a later date for maintenance of vocabulary knowledge. Further studies exploring the instructional implications of different kinds of vocabulary instruction should explore whether more extensive types of vocabulary instruction lead to better retention of knowledge as opposed to brief, less comprehensive instruction.

Conclusions

The present study adds to the research on children's language acquisition by examining the factors that lead to depth of learning by word type. We respond to the need in the field for reports of vocabulary interventions that discuss not only how many words children have learned but also how much, what kind of information has been learned about different types of words, and how this information can be used to better tailor vocabulary instruction. Furthermore, studies do not always report the type of words taught. Given that depth of learning may interact with word type, our study reinforces the importance of attending to word type when planning and reporting results of vocabulary interventions. Our results suggest not only that some words are learned more quickly and with greater depth because they are more perceptually accessible but also that these perceptually accessible words also lend themselves to a greater variety of highly salient instructional information types. Highly abstract words, then, are not only more difficult for children to learn on their own but also more difficult to learn through instruction. Students must gain a deep knowledge of highly abstract, conceptually complex words to achieve academic success (Snow & Uccelli, 2009), and our results demonstrate that clear information about meaning and use of words in meaningful contexts can help support learning. Further efforts must concentrate on ways to foster depth of knowledge for the words that students will need most as they progress through school.

NOTE

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A110128 to Vanderbilt University, Temple University, the University of Delaware, and Lehigh University.

REFERENCES

Anderson, R.C., & Freebody, P. (1981). Vocabulary knowledge. In J.T. Guthrie (Ed.), *Comprehension and teaching: Research reviews* (pp. 77–117). Newark, DE: International Reading Association.

Beck, I.L., & McKeown, M.G. (2007). Increasing young low-income children's oral vocabulary repertoires through rich and focused instruction. *The Elementary School Journal*, *107*(3), 251–271. doi:10.1086/511706

Beck, I.L., McKeown, M.G., & Kucan, L. (2002). *Bringing words to life: Robust vocabulary instruction*. New York, NY: Guilford.
Biemiller, A. (2010). *Words worth teaching: Closing the vocabulary gap*. Columbus, OH: SRA/McGraw-Hill.
Biemiller, A., & Boote, C. (2006). An effective method for building meaning vocabulary in primary grades. *Journal of Educational Psychology*, *98*(1), 44–62. doi:10.1037/0022-0663.98.1.44
Bion, R.A.H., Borovsky, A., & Fernald, A. (2013).Fast mapping, slow learning: Disambiguation of novel word–object mappings in relation to vocabulary learning at 18, 24, and 30 months. *Cognition*, *126*(1), 39–53. doi:10.1016/j.cognition.2012.08.008
Blewitt, P., Rump, K.M., Shealy, S.E., & Cook, S.A. (2009). Shared book reading: When and how questions affect young children's word learning. *Journal of Education & Psychology*, *101*(2), 294–304. doi:10.1037/a0013844
Bloom, P. (2000). *How children learn the meanings of words*. Cambridge, MA: MIT Press.
Bolger, D.J., Balass, M., Landen, E., & Perfetti, C.A. (2008). Context variation and definitions in learning the meanings of words: An instance-based learning approach. *Discourse Processes*, *45*(2), 122–159. doi:10.1080/01638530701792826
Booth, A.E. (2009). Causal supports for early word learning. *Child Development*, *80*(4), 1243–1250. doi:10.1111/j.1467-8624.2009.01328.x
Booth, A.E., & Waxman, S.R. (2002). Word learning is 'smart': Evidence that conceptual information affects preschoolers' extension of novel words. *Cognition*, *84*(1), B11–B22. doi:10.1016/S0010-0277(02)00015-X
Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, *96*(1), 31–42. doi:10.1037/0022-0663.96.1.31
Capone, N.C. (2007). Tapping toddlers' evolving semantic representation via gesture. *Journal of Speech, Language, and Hearing Research*, *50*(3), 732–745. doi:10.1044/1092-4388(2007/051)
Carey, S. (1978). The child as word learner. In M. Halle, J. Bresnan, & A. Miller (Eds.), *Linguistic theory and psychological reality* (pp. 264–293). Cambridge, MA: MIT Press.
Chall, J.S., & Dale, E. (1995). *Readability revisited: The new Dale-Chall readability formula*. Cambridge, MA: Brookline.
Christ, T. (2011). Moving past "right" or "wrong" toward a continuum of young children's semantic knowledge. *Journal of Literacy Research*, *43*(2), 130–158. doi:10.1177/1086296X11403267
Clark, E.V. (2010). *First language acquisition* (2nd ed.). Cambridge, UK: Cambridge University Press.
Coyne, M.D., Simmons, D.C., Kame'enui, E.J., & Stoolmiller, M. (2004). Teaching vocabulary during shared storybook readings: An examination of differential effects. *Exceptionality*, *12*(3), 145–162. doi:10.1207/s15327035ex1203_3
Cronbach, L.J. (1971). Test validation. In R.L. Thorndike (Ed.), *Educational measurement* (2nd ed., pp. 443–507). Washington, DC: American Council on Education.
Dale, E. (1965). Vocabulary measurement: Techniques and major findings. *Elementary English*, *42*(8), 895–901, 948.
Dickinson, D.K., & McCabe, A. (2001). Bringing it all together: The multiple origins, skills and environmental supports of early literacy. *Learning Disabilities Research & Practice*, *16*(4), 186–202. doi:10.1111/0938-8982.00019
Dickinson, D.K., Turner, K.A., Collins, M.F., Nicolopoulo, A., Golinkoff, R.M., Hirsh-Pasek, K., … Rivera, B.L. (2013, April). *More word learning occurs when book reading is followed by teacher-supported play*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.
Dollaghan, C. (1985). Child meets word: "Fast mapping" in preschool children. *Journal of Speech and Hearing Research*, *28*(3), 449–454. doi:10.1044/jshr.2803.454
Dunn, L.M., & Dunn, L.M. (1997). *Peabody Picture Vocabulary Test* (3rd ed.). Circle Pines, MN: American Guidance Service.
Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S.A. Kuczaj (Ed.), *Language development: Vol. 2. Language, thought, and culture* (pp. 301–334). Hillsdale, NJ: Erlbaum.
Gentner, D., & Boroditsky, L. (2001). Individuation, relativity and early word learning. In M. Bowerman, & S.C. Levinson (Eds.), *Language, culture, and cognition: Vol. 3. Language acquisition and conceptual development* (pp. 215–256). New York, NY: Cambridge University Press.
Gillette, J., Gleitman, H., Gleitman, L., & Lederer, A. (1999). Human simulations of vocabulary learning. *Cognition*, *73*(2), 135–176. doi:10.1016/S0010-0277(99)00036-0
Glenberg, A.M., Gutierrez, T., Levin, J.R., Japuntich, S., & Kaschak, M.P. (2004). Activity and imagined activity can enhance young children's reading comprehension. *Journal of Educational Psychology*, *96*(3), 424–436. doi:10.1037/0022-0663.96.3.424
Göksun, T., Hirsh-Pasek, K., & Golinkoff, R.M. (2010). How do preschoolers express cause in gesture and speech? *Cognitive Development*, *25*(1), 56–68. doi:10.1016/j.cogdev.2009.11.001
Golinkoff, R.M., Chung, H.L., Hirsh-Pasek, K., Liu, J., Bertenthal, B.I., Brand, R., … Hennon, E. (2002). Young children can extend motion verbs to point-light displays. *Developmental Psychology*, *38*(4), 604–614. doi:10.1037/0012-1649.38.4.604
Greif, M.L., Nelson, D.G.K., Keil, F.C., & Gutierrez, F. (2006). What do children want to know about animals and artifacts? *Domain-specific requests for information. Psychological Science*, *17*(6), 455–459. doi:10.1111/j.1467-9280.2006.01727.x
Gropen, J., Pinker, S., Hollander, M., & Goldberg, R. (1991). Syntax and semantics in the acquisition of locative verbs. *Journal of Child Language*, *18*(1), 115–151. doi:10.1017/S0305000900013325
Henriksen, B. (1999). Three dimensions of vocabulary development. *Studies in Second Language Acquisition*, *21*(2), 303–317. doi:10.1017/S0272263199002089
Hollich, G., Hirsh-Pasek, K., & Golinkoff, R.M. (2000). II. The emergentist coalition model. *Monographs of the Society for Research in Child Development*, *65*(3), 17–29. doi:10.1111/1540-5834.00092
Imai, M., Li, L., Haryu, E., Okada, H., Hirsh-Pasek, K., Golinkoff, R.M., & Shigematsu, J. (2008). Novel noun and verb learning in Chinese-, English-, and Japanese-speaking children. *Child Development*, *79*(4), 979–1000. doi:10.1111/j.1467-8624.2008.01171.x
Landi, N., & Perfetti, C.A. (2007). An electrophysiological investigation of semantic and phonological processing in skilled and less-skilled comprehenders. *Brain and Language*, *102*(1), 30–45. doi:10.1016/j.bandl.2006.11.001
Maguire, M.J., Hirsh-Pasek, K., & Golinkoff, R.M. (2006). A unified theory of word learning: Putting verb acquisition in context. In K. Hirsh-Pasek, & R.M. Golinkoff (Eds.), *Action meets word: How children learn verbs* (pp. 364–391). New York, NY: Oxford University Press.
McNeil, N.M., Alibali, M.W., & Evans, J.L. (2000). The role of gesture in children's comprehension of spoken language: Now they need it, now they don't. *Journal of Nonverbal Behavior*, *24*(2), 131–150. doi:10.1023/A:1006657929803
Medina, T.N., Snedeker, J., Trueswell, J.C., & Gleitman, L.R. (2011). How words can and cannot be learned by observation. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(22), 9014–9019. doi:10.1073/pnas.1105040108
Messick, S. (1989). Validity. In R.L. Linn (Ed.), *Educational measurement* (3rd ed., pp. 13–103). New York, NY: American Council on Education/Macmillan.
Miller, G.A., & Fellbaum, C. (1991). Semantic networks of English. *Cognition*, *41*(1–3), 197–229. doi:10.1016/0010-0277(91)90036-4

Morgan, P.L., Fuchs, D., Compton, D.L., Cordray, D.S., & Fuchs, L.S. (2008). Does early reading failure decrease children's reading motivation? *Journal of Learning Disabilities*, *41*(5), 387–404. doi:10.1177/0022219408321112

Nagy, W.E., & Scott, J.A. (2000). Vocabulary processes. In M.L. Kamil, P.B. Mosenthal, P.D. Pearson, & R. Barr (Eds.), *Handbook of reading research* (Vol. 3, pp. 269–284). Mahwah, NJ: Erlbaum.

Nagy, W.E., & Townsend, D. (2012). Words as tools: Learning academic vocabulary as language acquisition. *Reading Research Quarterly*, *47*(1), 91–108. doi:10.1002/RRQ.011

Nation, K., & Snowling, M.J. (1998). Semantic processing and the development of word-recognition skills: Evidence from children with reading comprehension difficulties. *Journal of Memory and Language*, *39*(1), 85–101. doi:10.1006/jmla.1998.2564

National Early Literacy Panel (2008). *Developing early literacy: Report of the National Early Literacy Panel*. Washington, DC: National Institute for Literacy.

Nelson, D.G.K., O'Neil, K.A., & Asher, Y.M. (2008). A mutually facilitative relationship between learning names and learning concepts in preschool children: The case of artifacts. *Journal of Cognition and Development*, *9*(2), 171–193. doi:10.1080/15248370802022621

Neuman, S.B., & Celano, D. (2006). The knowledge gap: Implications of leveling the playing field for low-income and middle-income children. *Reading Research Quarterly*, *41*(2), 176–201. doi:10.1598/RRQ.41.2.2

Ordóñez, C.L., Carlo, M.S., Snow, C.E., & McLaughlin, B. (2002). Depth and breadth of vocabulary in two languages: Which vocabulary skills transfer? *Journal of Educational Psychology*, *94*(4), 719–728. doi:10.1037/0022-0663.94.4.719

Ouellette, G.P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology*, *98*(3), 554–566. doi:10.1037/0022-0663.98.3.554

Paivio, A., Yuille, J.C., & Madigan, S.A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology*, *76*(1, Pt. 2), 1–25. doi:10.1037/h0025327

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, *11*(4), 357–383. doi:10.1080/10888430701530730

Proctor, C.P., Silverman, R.D., Harring, J.R., & Montecillo, C. (2012). The role of vocabulary depth in predicting reading comprehension among English monolingual and Spanish-English bilingual children in elementary school. *Reading and Writing*, *25*(7), 1635–1664. doi:10.1007/s11145-011-9336-5

Quinn, J.M., Wagner, R.K., Petscher, Y., & Lopez, D. (2015). Developmental relations between vocabulary knowledge and reading comprehension: A latent change score modeling study. *Child Development*, *86*(1), 159–175. doi:10.1111/cdev.12292

Raudenbush, S., & Bryk, A. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Newbury Park, CA: Sage.

Read, J. (2004). Plumbing the depths: How should the construct of vocabulary knowledge be defined? In P. Bogaards, & B. Laufer (Eds.), *Vocabulary in a second language: Selection, acquisition, and testing* (pp. 209–227). Philadelphia, PA: John Benjamins.

Roth, F.P., Speece, D.L., & Cooper, D.H. (2002). A longitudinal analysis of the connection between oral language and early reading. *The Journal of Educational Research*, *95*(5), 259–272. doi:10.1080/00220670209596600

Schoonen, R., & Verhallen, M. (2008). The assessment of deep word knowledge in young first and second language learners. *Language Testing*, *25*(2), 211–236. doi:10.1177/0265532207086782

Snow, C.E., Cancino, H., De Temple, J., & Schley, S. (1991). Giving formal definitions: A linguistic or metalinguistic skill? In E. Bialystock (Ed.), *Language processing in bilingual children* (pp. 90–112). Cambridge, UK: Cambridge University Press.

Snow, C.E., & Uccelli, P. (2009). The challenge of academic language. In D.R. Olson, & N. Torrance (Eds.), *The Cambridge handbook of literacy* (pp. 112–133). New York, NY: Cambridge University Press.

Stahl, S.A., & Fairbanks, M.M. (1986). The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research*, *56*(1), 72–110. doi:10.3102/00346543056001072

Storch, S.A., & Whitehurst, G.J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology*, *38*(6), 934–947. doi:10.1037/0012-1649.38.6.934

Vellutino, F.R., Tunmer, W.E., Jaccard, J.J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, *11*(1), 3–32. doi:10.1080/10888430709336632

Verhallen, M., & Schoonen, R. (1993). Lexical knowledge of monolingual and bilingual children. *Applied Linguistics*, *14*(4), 344–363. doi:10.1093/applin/14.4.344

Wasik, B.A., & Hindman, A.H. (2014). Understanding the active ingredients in an effective preschool vocabulary intervention: An exploratory study of teacher and child talk during book reading. *Early Education and Development*, *25*(7), 1035–1056. doi:10.1080/10409289.2014.896064

Weisberg, D.S., Ilgaz, H., Hirsh-Pasek, K., Golinkoff, R., Nicolopoulou, A., & Dickinson, D.K. (2015). Shovels and swords: How realistic and fantastical themes affect children's word learning. *Cognitive Development*, *35*, 1–14. doi:10.1016/j.cogdev.2014.11.001

Wiig, E.H., & Secord, W. (1992). *Test of Word Knowledge*. San Antonio, TX: Psychological.

Yu, C., & Smith, L.B. (2012). Modeling cross-situational word–referent learning: Prior questions. *Psychological Review*, *119*(1), 21–39. doi:10.1037/a0026182

Submitted March 31, 2015
Final revision received September 13, 2015
Accepted September 14, 2015

ELIZABETH B. HADLEY (corresponding author) is a doctoral candidate in the Department of Teaching, Learning, and Diversity at Vanderbilt University, Nashville, Tennessee, USA; e-mail elizabeth.b.hadley@vanderbilt.edu.

DAVID K. DICKINSON is the Margaret Cowan Chair of and a professor in the Department of Teaching, Learning, and Diversity at Vanderbilt University, Nashville, Tennessee, USA; e-mail david.dickinson@vanderbilt.edu.

KATHY HIRSH-PASEK is the Debra and Stanley Lefkowitz Faculty Fellow in the Department of Psychology at Temple University, Philadelphia, Pennsylvania, USA; e-mail khirshpa@temple.edu.

ROBERTA MICHNICK GOLINKOFF is the Unidel H. Rodney Sharp Professor in the Departments of Psychology and Linguistics and Cognitive Science at the University of Delaware, Newark, USA; e-mail roberta@udel.edu.

KIMBERLY T. NESBITT is an assistant professor in the Department of Human Development and Family Studies at the University of New Hampshire, Durham, USA; e-mail kimberly.nesbitt@unh.edu.

Word Type, Difficulty, and Means for Target, Exposure, and Control Words Tested on the NWDT–M Measure

Word type	Word	Abstract or concrete?	Level of instruction	Theme	Living Word Vocabulary difficulty rating[a]	On the Dale–Chall common word list[b]?	Tier 2[c]?	**Pretest *M* (*SD*)**	**Posttest *M* (*SD*)**
Adjective (or adverb)	*accidentally*	Abstract	Exposure	Dragon	T2	Yes	Yes	0.32 (0.51)	0.30 (0.43)
	intelligent	Abstract	Target	Dragon	T2	No	Yes	0.02 (0.20)	0.21 (0.46)
	peaceful	Abstract	Target	Farm	T2	Yes	Yes	0.17 (0.47)	0.46 (0.66)
	recent	Abstract	Control	Farm	T6	No	Yes	0.00 (0.00)	0.07 (0.25)
	wearily	Abstract	Target	Farm	T2	Yes	Yes	0.02 (0.18)	0.08 (0.32)
Noun	*celebration*	Abstract	Control	Dragon	E	No	Yes	0.64 (0.76)	0.81 (0.81)
	chimney	Concrete	Target	Farm	E	Yes	Yes	0.33 (0.67)	0.87 (0.82)
	curtain	Concrete	Control	Farm		Yes	Yes	0.58 (0.71)	0.67 (0.80)
	enemies	Abstract	Target	Dragon	E	Yes	Yes	0.14 (0.39)	0.44 (0.62)
	field	Concrete	Exposure	Farm	E	Yes	Yes	0.46 (0.81)	0.58 (0.94)
	foolishness	Abstract	Target	Dragon		No	Yes	0.08 (0.28)	0.21 (0.45)
	handkerchief	Concrete	Target	Dragon		Yes	Yes	0.02 (0.20)	0.86 (1.07)
	hedge	Concrete	Control	Farm	T6	No	Yes	0.17 (0.42)	0.30 (0.64)
	heel	Concrete	Control	Dragon	L2	Yes	Yes	0.00 (0.00)	0.00 (0.00)
	lane	Concrete	Target	Farm	E	Yes	Yes	0.07 (0.34)	0.48 (0.86)
	nostrils	Concrete	Target	Dragon		No	Yes	0.05 (0.31)	1.15 (1.21)
	plan	Abstract	Exposure	Farm	E	Yes	Yes	0.23 (0.49)	0.25 (0.49)
	pliers	Concrete	Control	Dragon	D	No	Yes	0.08 (0.33)	0.16 (0.49)
	pond	Concrete	Exposure	Dragon	T2	Yes	Yes	0.83 (1.03)	1.00 (1.02)
	quarrel	Abstract	Target	Farm	T6	No	Yes	0.00 (0.00)	0.27 (0.55)
	quilt	Concrete	Exposure	Dragon	E	Yes	Yes	0.13 (0.41)	0.29 (0.74)
	scales	Concrete	Target	Dragon		Yes	Yes	0.05 (0.20)	0.52 (0.88)
	servants	Concrete	Target	Dragon		Yes	Yes	0.24 (0.58)	0.75 (1.07)
	shield	Concrete	Exposure	Dragon		No	Yes	0.45 (0.93)	0.60 (0.93)
	stool	Concrete	Exposure	Farm	E	Yes	Yes	0.69 (0.98)	0.78 (0.90)
	throne	Concrete	Target	Dragon	L2	Yes	Yes	0.06 (0.37)	0.77 (1.10)
	tip	Concrete	Exposure	Farm	T2	Yes	Yes	0.09 (0.34)	0.13 (0.31)
	valley	Concrete	Target	Dragon	E	Yes	Yes	0.02 (0.11)	0.57 (0.95)
	weeds	Concrete	Target	Farm	L2	Yes	Yes	0.22 (0.63)	0.76 (1.02)
	wheelbarrow	Concrete	Exposure	Farm		No	Yes	0.47 (0.88)	0.69 (0.98)

(continued)

(continued)

Word type	Word	Abstract or concrete?	Level of instruction	Theme	Living Word Vocabulary difficulty rating[a]	On the Dale–Chall common word list[b]?	Tier 2[c]?	Pretest *M* (*SD*)	Posttest *M* (*SD*)
Verb	*charging*	Concrete	Target	Dragon	E	Yes	Yes	0.04 (0.23)	0.43 (0.71)
	chuckling	Concrete	Target	Dragon	E	No	Yes	0.05 (0.24)	0.62 (0.72)
	emerging	Concrete	Target	Dragon	T2	No	Yes	0.01 (0.10)	0.49 (0.81)
	fetching	Concrete	Target	Farm		No	Yes	0.39 (0.63)	0.67 (0.75)
	galloping	Concrete	Target	Dragon	E	Yes	Yes	0.25 (0.56)	0.64 (0.77)
	plummeting	Concrete	Control	Farm		No	Yes	0.01 (0.04)	0.00 (0.00)
	returning	Abstract	Target	Farm	E	Yes	Yes	0.34 (0.51)	0.52 (0.63)
	scowling	Concrete	Control	Dragon	T6	No	Yes	0.02 (0.13)	0.03 (0.16)
	sobbing	Concrete	Exposure	Farm	T2	Yes	Yes	0.01 (0.09)	0.11 (0.40)

Note. D = words known by fewer than 40% of students by the end of grade 6; E = words known by most students at the end of grade 2; L2 = low-priority words known by 40–80% of students by the end of grade 2; *M* = mean; *SD* = standard deviation; T2 = high-priority words known by 40–80% of students by the end of grade 2; T6 = words known by 40–80% of students by the end of grade 6.
[a]Biemiller, A. (2010). *Words worth teaching: Closing the vocabulary gap*. Columbus, OH: SRA/McGraw-Hill. [b]Chall, J.S., & Dale, E. (1995). *Readability revisited: The new Dale–Chall readability formula*. Cambridge, MA: Brookline. [c]Beck, I.L., & McKeown, M.G. (2007). Increasing young low-income children's oral vocabulary repertoires through rich and focused instruction. *The Elementary School Journal*, *107*(3), 251–271.

APPENDIX B

Examples of Student Responses and Codes Assigned

Word type	Target word	Student response	Information unit(s) coded for
Concrete noun	*basket*	"You carry stuff with it."	Function
	chimney	"Made of bricks."	Part/whole
	nostrils	Points to nostrils and sniffs.	Gesture
	shield	"[A] shield protects you when you get in a fight with a dragon and he blows fire at you."	Function, meaningful context
	throne	"A throne is golden."	Perceptual quality
Verb	*chuckling*	"A quiet laugh."	Synonym
	fetching	"I throw the ball to my dog, and he fetches it and gives it to me."	Meaningful context
	returning	"Run away and go back. In the story, the farmer ran away, and he never returned."	Synonym, meaningful context
	sobbing	"You crying."	Synonym
Abstract noun	*foolishness*	"*Foolishness* means that you're acting crazy."	Synonym
Adjective	*intelligent*	"Means that you could build a science fair project."	Basic context