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# Semantic Deficits in Children With Language Impairments: Issues for Clinical Assessment

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In evaluating the language of preschool and school-aged children, speech-language pathologists typically assess a number of skill areas. These include (but are not limited to) semantics, syntax, morphology, phonology, and pragmatics. The results of these assessments have serious implications because they are used to determine a child's eligibility for language intervention, the course and goals of therapy, and his or her classroom environment. With so much at stake, it is critical that language evaluations be complete and thorough. Unfortunately, assessment in the area of semantics is often limited to measures of receptive and expressive vocabulary size. This is problematic for at least two reasons. First, early deficits in vocabulary size are not strongly predictive of later language abilities. This has been demonstrated by longitudinal studies of "late talkers" (e.g., Girolametto, Wiigs, Smyth, Weitzman, & Pearce, 2001; Paul, 1996; Rescorla, Roberts, & Dahlsgaard, 1997). In these investigations, 75% or more of children who were identified with limited expressive vocabularies at 2 years of age did not present with language deficits by the age of 6. Likewise, Rice, Wexler, and Hershberger (1998) presented evidence that preschoolers with specific language impairments were more likely, over time, to improve deficits in vocabulary size than problems in morphosyntax. The second problem with focusing only on limitations in vocabulary size is that children with language impairments often have difficulties with other areas of semantics, including the abilities to incidentally learn new words and to create complex representations within and between words (e.g., Kail & Leonard, 1986; McGregor, 1997; Rice, Buhr, & Nemeth, 1990).

ABSTRACT: Children with language impairments demonstrate a broad range of semantic difficulties, including problems with new word acquisition, storage and organization of known words, and lexical access/retrieval. Unfortunately, assessments of children's semantic skills are often limited to measures of receptive and expressive vocabulary size. As a result, the semantic deficits of these children may not receive the attention they need. This article explores the word-learning, lexical storage, and lexical access skills of children with language impairments and the theories that account for their performance. Our review culminates with specific recommendations for speech-language pathologists to improve the breadth of their semantic assessments.

KEY WORDS: word learning, lexical organization, word retrieval, vocabulary, specific language impairment

The acquisition and appropriate use of new words is a complex process. To acquire new words, children must identify both the spoken form and correct meaning from the linguistic experience (including the ongoing speech stream and the physical characteristics of the situation). Once learning is completed, the user must store and organize the word's phonological, syntactic, and semantic information within the lexicon and be able to access this information for expressive use. In this article, we explore the skills that are involved in learning, organizing, and using words; the range of semantic problems that have been observed in children with language impairments; and the theories that account for these issues. Based on this information, we then make specific recommendations for conducting comprehensive semantic evaluations.

Throughout this article, the term language impairments (LI) will be used as a general term to refer to children with language impairments that are not directly related to other

cognitive or sensory difficulties. The more specific term, specific language impairment (SLI), will only be used when referring to individual research that defined participants in this manner. We also include data from children with word-finding deficits (WFD). WFD are shown by the inability to name words, even though receptive knowledge about the words has been demonstrated (for diagnostic methods, see German, 1984, 1989, 2000). Although children with WFD are not always described as having LI (e.g., Newman & German, 2002), most investigations report that these children either (a) have additional general language problems (e.g., Faust, Dimitrovsky, & Davidi, 1997; McGregor, 1997; McGregor & Waxman, 1998) or (b) perform below the average range on nonsemantic standardized language tasks (Dockrell, Messer, George, & Wilson, 1998). Overlap between WFD and LI has also been shown by demonstrations of word-finding problems in children who have been diagnosed with LI (Kail, Hale, Leonard, & Nippold, 1984; Kail & Leonard, 1986).

## WORD LEARNING

Children learn most new words without direct teaching. Evidence for this comes primarily from two sources. First, between the ages of 18 months and 18 years, children learn an average of 9 to 10 new words a day (P. Bloom, 2000; Templin, 1957), many more words than parents or teachers attempt to teach. Second, children as young as 3 years of age appear to be equally adept at learning new words within direct and indirect teaching environments (Jaswal & Markman, 2001, 2003).

Children with LI and SLI are able to learn new words without direct teaching (e.g., Dollaghan, 1987). However, word learning is more difficult for these children than for their peers. These difficulties are exemplified by the results of Rice and colleagues' studies of quick incidental learning (QUIL). In these investigations, children viewed animated stories that presented unfamiliar words without direct references to their meanings. Rice et al. (1990) reported that 5-year-olds with SLI had more difficulty acquiring new words than their age- or language-matched peers. They had great difficulty learning action words, and these problems did not correlate with vocabulary size (or mean length of utterance). Other studies have also shown that learning new verbs is particularly difficult for children with SLI (Eyer et al., 2002; Oetting, 1999; Rice, Oetting, Marquis, Bode, & Pae, 1994). Poor verb acquisition is troublesome because verbs play a central role in both syntactic and semantic processing and development (e.g., Chafe, 1970; Chomsky, 1995; Pinker, 1989; Tomasello & Merriman, 1995).

To better understand why children with LI have difficulty learning words, researchers have examined their abilities to (a) perceive and isolate the phonological form from the ongoing stream of information (i.e., phrases and sentence), (b) hold the phonological form in short-term memory while a lexical search is activated, and (c) extract the correct meaning of the new word to be paired with the phonological form.

### Perceiving and Isolating the Phonological Form

There is no direct evidence that children with LI are unable to or have particular difficulty with isolating individual words from the speech stream. To date, no studies of word boundary marking in phrases and sentences have been conducted on children with LI. However, a number of researchers have investigated other potential deficits in speech perception that may adversely affect the semantic development of these children. For example, Tallal and colleagues presented data suggesting that children with LI have difficulty perceiving rapidly changing acoustic stimuli and that these difficulties may be related to other phonological, semantic, and morphological errors (e.g., Tallal & Piercy, 1973; Tallal & Stark, 1981; Tallal, Stark, & Curtiss, 1976). There is, however, much debate concerning the nature and significance of these findings. Critics of this work have presented concerns over issues such as increased performance with repetition of the task (Robin, Tomblin, Kearney, & Hug, 1989; Tomblin & Quinn, 1983) and poor sensitivity and specificity in identifying children as LI, phonologically impaired, or typically developing (Bishop, Carlyon, Deeks, & Bishop, 1999; Nittrouer, 1999) (see Leonard, 1998, and Nittrouer, 2002, for additional concerns). As such, there is currently insufficient evidence to conclude that difficulty in perceiving rapidly changing stimuli explains the word-learning problems of children with LI.

The speech perception skills of children with LI have also been investigated in terms of their ability to efficiently process acoustic–phonetic information for the purpose of lexical access (Dollaghan, 1998; Montgomery, 1999). To evaluate this, elementary-school-aged children with and without SLI were presented with progressively longer portions of individual words (word intervals of 50–60 ms). After each part of the word was presented, the children were asked to name the word. The primary results of these studies were similar: There was no difference in the minimal amount of acoustic information that children with SLI or their peers needed to name familiar words correctly. A difference was seen, however, with regard to the first correct identifications of the initial phonemes of the words. Dollaghan reported that the SLI group required significantly more information than their peers to correctly name the phonemes. Montgomery found no group differences. Overall, however, these investigations suggest that children with LI do not have significant limitations in speech processing that affect lexical access.

A third group of studies relating speech processing and semantic skills has examined differential effects of prosodic information on new word learning. The prosodic cues that have been investigated include variations in stress (Ellis Weismer & Hesketh, 1998), rate (Ellis Weismer & Hesketh, 1996), and pause time (Rice, Buhr, & Oetting, 1992) within the presentation of novel words. Across investigations, the children with SLI consistently performed more poorly than their age-matched peers on both comprehension and production probes (Rice et al. did not administer a production task). Within-group differences, however, were not found for

the comprehension of novel words under any of these prosodic variations (for either group of children). On production tasks, both groups benefited from the inclusion of emphatic stress. Unlike their age-matched peers, however, children with SLI demonstrated significantly poorer production skills for novel words heard at a fast rate (5.9 syllables per second) than for words presented at slow and normal rates (2.8 and 4.4 syllables per second, respectively).

In sum, children with LI do not present with significant impairments in their abilities to perceive spoken language and use it for semantic purposes. However, performance differences on some, but not all, perceptual tasks suggest that they may have subtle deficits in this area. It has been hypothesized that weaknesses in speech processing have a negative impact on later semantic analysis and use by overburdening the child's working memory and decreasing his or her cognitive resources.

## Holding Phonological Forms in Short-Term Memory

A number of investigations have demonstrated that preschool and school-aged children with LI have trouble holding the phonological forms of new words in short-term memory (e.g., Bishop, North, & Donlan, 1996; Dollaghan & Campbell, 1998; Edwards & Lahey, 1998; Ellis Weismer et al., 2000; Gathercole & Baddeley, 1990; Montgomery, 1995). This evidence primarily comes from studies of nonword repetition, in which participants are asked to repeat a series of made-up words that are presented without associated meanings. The list of nonwords varies across studies, but typically includes words of one to four syllables in length. Examples of nonwords used include *nate, sladding, thickery, blonterstaping* (from Gathercole, Willis, Emslie, & Baddeley, 1991) and *vop, tayvak, naichovabe, vaetachaidoip* (orthographic representations of phonetic transcriptions from Dollaghan & Campbell, 1998). Children with LI typically perform as well as their peers on one- and two-syllable nonwords, but make more errors when the syllable length increases.

The predominant theory that accounts for the phonological short-term memory deficits of children with LI is the phonological loop hypothesis by Baddeley and colleagues (e.g., Baddeley, 1986, 2003; Gathercole & Baddeley, 1990). According to this theory, short-term memory is divided into three components: the phonological loop (also referred to as the articulatory loop), the visuospatial sketchpad, and the central executive. The *phonological loop* is responsible for the short-term storage of auditory stimuli and subvocal rehearsal for retaining that information. The *visuospatial sketchpad* serves a similar role for visual information, and the *central executive* controls the amount of attention that is distributed among the other components. Working memory, under this model, is a trade-off between storage and processing capabilities. According to the phonological loop hypothesis, children with LI have a particular deficit in the phonological loop. As a result, they quickly lose part or all of the phonological information that is required for learning new words and morphemes.

A similar model to the phonological loop hypothesis is Just and Carpenter's (1992) capacity theory of comprehension. Just and Carpenter viewed short-term memory performance as being directly influenced by the amount of activation that is taking place. Activation refers to the amount of cognitive energy that is being used for storage and processing. Because there are limits to how much activation can take place, the amount of phonological storage and processing that occurs is restricted. In this way, Just and Carpenter's theory is similar to the central executive component of Baddeley's model (see Montgomery, 2003, for additional comparisons between these two models).

Just and Carpenter (1992) did not specifically discuss their theory of comprehension in terms of children with LI. However, evidence of poor verbal short-term memory capacity has been demonstrated in this group. This comes from investigations that compare word recall performances across conditions. Recalling isolated word lists does not appear to be a significant problem for children with LI and SLI (Gillam, Cowan, & Day, 1995; Montgomery, 2000). However, these children have difficulty recalling word lists in contexts that include additional cognitive demands. For example, Gillam et al. found that 9- to 12-year-olds with LI performed similarly to their peers in recalling lists of numbers that included a nonsense suffix, as long as they could state the numbers in any order. When asked to recall the digits in the same order of their presentation, the children with LI had significant difficulty. Likewise, Montgomery found that the recall of 8-year-olds with SLI did not differ from that of their age-matched peers in basic recall or reordering of the items based on their size. However, the SLI group had particular difficulty when they were asked to reorder the items by size within semantic categories. Finally, Ellis Weismer, Evans, and Hesketh (1999) examined word recall in 7-year-olds with and without SLI by asking the children to remember the final words from a list of sentences and to judge each sentence for its truthfulness (e.g., "Pencils eat candy."). Among their findings were that (a) both groups were equally accurate at judging the truth value of the sentences, (b) the SLI group remembered fewer of the sentence final words, and (c) there were distinct patterns to the group's word recall errors. The children with SLI tended to produce primacy errors (recalling a sentence initial word rather than sentence final) more often than target intrusion errors (recalling a word from an earlier group of sentences). The children with typical language development showed the opposite pattern.

## Extracting Word Meanings

Along with isolating and remembering the correct phonological form, learning a new word requires children to extract the proper meanings of the word. In direct teaching contexts, the meanings may be stated and/or easily deduced (e.g., "Look. I have a *whisk*. I'll use it to stir the batter."). How children determine the correct meanings of words during day-to-day conversation, however, is far from clear. This problem is often exemplified by Quine's (1960) fictionalized account of a linguist who encounters native users of a completely unknown language. As a rabbit hops

by the linguist and the natives, one of the natives says, "Gavagai." Quine points out that with no other information available, the linguist cannot be sure what the native has meant. Did she mean to signify, "the rabbit creature," "the assembly of rabbit parts," "a phase of rabbit behavior," or something completely different? Children are not in the exact same situation as Quine's linguist because they have an understanding of at least some of the linguistic and social information that is being presented. However, specifying the meaning of a new word is difficult for them because the referent may not be easily determinable from the context or the environment.

A number of different models have been proposed to explain how young children acquire the meanings for their first words. These models include the use of (a) lexical principles to constrain the number of possible interpretations (e.g., Golinkoff, Mervis, & Hirsh-Pasek, 1994; Markman, 1991; Merriman & Bowman, 1989), (b) social–pragmatic cues to direct the child toward the correct meaning (e.g., Tomasello, 2003; Akhtar & Tomasello, 2000), and (c) child-internal drives and the child's developing theory of mind to guide and interpret the language of others (e.g., L. Bloom, 2000; P. Bloom, 2000) (see Golinkoff et al., 2000, for direct comparisons between these and other models; also see Hollich et al., 2000, for a proposal that combines these models). To date, little research has been conducted regarding the concepts that children with LI form when first learning new words. Alt (2003) found that 4- and 5-year-olds with SLI were less accurate than their age-matched peers in identifying descriptive features of novel object words. These models may relate to Alt's findings because each model has a developmental component (i.e., they all present skills that mature over time), and many of the linguistic difficulties observed in children with SLI reflect delays in acquisition (as opposed to deviant patterns of use) (see Leonard, 1998).

The abilities of children with and without LI to use linguistic information in acquiring word meanings have been investigated. Gleitman's (1990) syntactic bootstrapping theory proposed that young children are able to deduce part of a new word's meaning from the syntax of the sentences in which the novel word appears. For example, children will infer one kind of meaning if a novel verb is heard within transitive sentences (e.g., "She *gleeped* the ball.") and another kind of meaning if it is heard within ditransitive sentences (e.g., "She *gleeped* the ball to him."). In the first example, *gleep* appears to mean a motion that is done directly to the ball (like *kick* or *spin*). The second example suggests that *gleep* is a way to transfer an object (like *give* or *pass*). Direct evidence of children using syntactic bootstrapping to learn a new word's meaning has been demonstrated in children as young as 2 years of age (e.g., Fisher, 2002; Hoff & Naigles, 2002; Naigles, 1990; Naigles & Kako, 1993).

Because children with LI have difficulties with morphology and syntax, it is reasonable to suspect that they may not be able to take full advantage of syntactic bootstrapping. O'Hara and Johnston (1997) and van der Lely (1994) presented novel words in different sentence frames (variations of transitive, locative, coordinated, active, and passive types) to 6- to 9-year-olds with SLI. The children were asked to act out the sentences with sets of toys. In both studies, the children with SLI performed less accurately than their language-matched peers. However, error pattern analysis revealed evidence of syntactic bootstrapping in the children with SLI. For example, under their original scoring system (correct/incorrect), O'Hara and Johnston's SLI participants portrayed 43% of the sentences correctly. When these data were reanalyzed to include responses that correctly matched the syntactic type of the utterance (transitive vs. locative vs. coordination) but erred on other factors (such as the agent and recipient), the accuracy of the SLI group increased to 69%. O'Hara and Johnston argued that this evidence, along with a negative influence of sentence length, pointed to a processing limitation, not poor syntactic bootstrapping, being at the heart of the group differences.

Oetting (1999) presented the most direct evidence of the ability of children with SLI to use syntactic bootstrapping for acquiring new verbs. Among the tasks in this study, 6-year-old children with SLI and their age- and language-matched peers were asked to (a) identify the transitivity of novel verbs from single-sentence utterances, (b) identify the transitivity of novel verbs within a QUIL task, and (c) match the spoken word labels to the correct referent from a QUIL task. In both of the transitivity tasks, the children were asked to identify between a transitive and an intransitive interpretation. There were no group differences on the sentence transitivity task. On the QUIL transitivity task, the children with SLI and their language-matched peers (4-year-olds) performed significantly above chance (suggesting that they were able to glean some information from the syntax), but significantly less accurately than the age-matched peers. On the verb retention QUIL task, the children with SLI performed below chance level and significantly below both their age-and language-matched peers. Taken together, these studies suggest that children with SLI (at least by 6 years of age) do not have significant difficulties with syntactic bootstrapping. Furthermore, the difficulties that these children have with learning verbs do not appear to be based on deficits in extracting meaning from syntax.

The data presented to this point demonstrate that children with LI are able to learn new words within indirect teaching environments. However, they are not as skilled at doing so as their age-matched, and sometimes language-matched, peers. Although conclusive evidence has not been found, children with LI do not appear to have significant deficits with isolating words from the speech stream or with using syntactic cues to facilitate word learning. However, they have considerable problems with maintaining phonological forms in short-term memory and with connecting new phonological forms to correct meanings. Each of these processes affects the abilities of children to acquire new words.

## THE STORAGE, ORGANIZATION, AND ACCESS OF LEXICAL ITEMS

Once a new word has been acquired, it must be placed within the lexicon for long-term storage. Considering that

each word contains phonological, semantic, syntactic, and other types of information, and that the average high school graduate knows more than 60,000 words (P. Bloom, 2000), the amount of knowledge that is stored within the lexicon is staggering. The speed and accuracy at which young children are able to process and use language suggest that their lexicons are highly organized. Precisely how children organize and access the information within their lexicon is unclear. Current models of lexical organization and access are useful as a framework to describe the lexical difficulties of children with LI.

## Models of Lexical Organization

Current notions regarding the developing lexicons of children have been primarily based on adult models of lexical long-term storage (Dollaghan, 1992). Adult models that describe language processing (e.g., Marslen-Wilson, 1989; McClelland & Elman, 1986), lexical access and retrieval (e.g., Bock & Levelt, 1994; Levelt, 1991), and both (e.g., Collins & Loftus, 1975) have been applied to the semantic development of children. Despite the differences in these models, they can be used to identify the lexical knowledge that children need to have. To better understand what children need to know about the makeup of individual lexical entries and how each entry is connected to the others, we focus our discussion on the commonalities between these models.

Adult models of the lexicon suggest that individual entries contain a wide variety of information. Among the components that have been discussed are the word's semantic meaning, phonological form, syntactic properties, and visuospatial information. Two distinct processing levels within individual lexical entries have been proposed: the lemma and the lexeme (e.g., Bock & Levelt, 1994; Collins & Loftus, 1975). The *lemma* contains all of the conceptual and syntactic information that is known about a given lexical item (Bock and Levelt separate conceptual and syntactic information into two sublevels.) Among the types of conceptual knowledge that have been discussed within the lemma are specific attributes (such as size, shape, and color), category type, and use/function. For example, lemma-level information for the lexical item *duck* may include that ducks are birds that have flat beaks and quack, they tend to live on or near water, and *duck* is a count noun. The *lexeme* contains phonological and morphological information that is associated with an entry. Lexeme-level information for *duck* includes the phonemes /d/, /ʌ/, and /k/ and the morpho-phonological variants that are allowed (such as the plural /dʌks/). In order for children to be effective lexical users, their entries must contain adequate amounts of information within both the lemma and the lexeme, and these two levels of processing need to communicate with each other.

Adult lexical models suggest that there are also important connections between individual entries. The lexicon is no longer considered to be designed like a dictionary, where complex entries are organized but not integrated. Instead, current models suggest that lexical entries, and the individual pieces of information within them, are interconnected. Levelt (1989), for example, discussed intrinsic and associative connections between entries. *Intrinsic* relationships are those that are based on shared concepts, syntax, morphology, and/or phonology. In other words, intrinsic relationships exist between lexical items with similar lemma and/or lexeme information. The items *duck* and *snake* are intrinsically related because they both are animals and they both lay eggs. *Associative* relationships are based on lexical items that frequently co-occur. Thematic, or functional, relationships are one type of associative relationship. For example, *duck* and *water* are associated by the fact that ducks are often found in and on water.

Children use intrinsic and associative relationships in different ways as they learn new words. By 2 years of age, children extend novel words to other exemplars (e.g., Golinkoff, Church Jacquet, Hirsh-Pasek, & Nandakumar, 1996; Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992). They prefer to extend new words to items that have shared intrinsic properties over those with associative relations (Landau, Smith, & Jones, 1998; Markman & Hutchinson, 1984). Likewise, there are variations in how different types of intrinsic relationships affect word learning. For example, children as young as 2 years of age readily extend newly learned words to exemplars that share shape or basic categorical relationships (e.g., a *duck* is a kind of *animal*) (e.g., Golinkoff, Shuff-Bailey, Olguin, & Ruan, 1995; Landau et al., 1998; Soja, Carey, & Spelke, 1992). Superordinate categories, on the other hand, may not be fully understood and used for word learning until at least 7 years of age (Golinkoff et al., 1995; McGregor & Waxman, 1998). Taken together, these findings demonstrate that young children have knowledge of intrinsic and associative relationships and that this knowledge has an influence on their word learning. However, not enough is known about the developmental course of this knowledge. Ingram's (1989) statement, "There is little in the way of proposals for stages of lexical acquisition as there are for syntactic and phonological acquisition," (p. 396) continues to be accurate.

## The Lexical Difficulties of Children With LI

A number of investigations have demonstrated that children with LI (including those with WFD) have difficulty with storing, organizing, and/or accessing lexical knowledge. There is some debate, however, as to the nature of these difficulties. The nature of the problem may lie within the child's lexicon itself. Dollaghan (1992) proposed three different structural ways in which the lexical entries of children with LI may differ from those of their peers. First, children with LI may have a smaller number of lexical entries than their peers. Second, they may have less information that is associated with individual entries than their peers. Third, children with LI may have inadequate connections between lexical entries. A similar viewpoint is expressed in the storage hypothesis (Kail et al., 1984). According to the storage hypothesis, children with LI are slower to learn new words, and thus have less familiarity with the words in their lexicon than their typically developing peers do. This decrease in familiarity results in less elaborate representations and fewer lexical connections. An alternative view is that the semantic difficulties of children

with LI are the result of retrieval difficulties, not within lexical entries or their connections. The retrieval hypothesis states that children with LI have lexical problems because the algorithms that are used to access the word are not as efficient as those used by their peers (e.g., Fried-Oken, 1987; Newman & German, 2002). Although the storage and retrieval hypotheses are not mutually exclusive (e.g., one could have poorly elaborated representations and difficulty accessing them), they are typically discussed in contrast to each other.

Support for the storage hypothesis has come from investigations that have used both receptive and expressive language tasks. Kail, Leonard, and colleagues (Kail et al., 1984; Kail & Leonard, 1986; Leonard, Nippold, Kail, & Hale, 1983) conducted a series of experiments that examined naming accuracy and response speed in groups of LI and typically developing children between 5 and 12 years of age. The participants completed a number of language tasks, including the recall of word lists, identification of perceptual and lexical differences, free recall of category members, similarity judgments, and the effects of contextual cues. In general, the LI groups were slower in naming pictures and less accurate at using categorization cues and in recalling words than their peers. Similar findings were also reported by Wiig, Semel, and Nystrom (1982). Kail, Leonard, and colleagues argued that if retrieval was the nature of the poorer performance of the LI groups, then these children should demonstrate different patterns of responses to experimental conditions that affect retrieval, such as set size, linguistic cues, and repetition of recall. In most comparisons, however, children with LI and their peers were able to use retrieval cues to facilitate performance. As a result, Kail, Leonard, and colleagues interpreted these data as supporting the storage hypothesis.

McGregor and Waxman (1998) provided further support for the storage hypothesis in their investigation of children's intrinsic word knowledge. In their study, they showed preschoolers with and without WFD pictures of familiar objects and asked contrast questions about the relationship between the object and other words with superordinate, basic, and subordinate relationships. For example, after being shown a *rose*, the children were asked: (a) "Is this an animal?" (superordinate), (b) "Is this a tree?" (basic), and (c) "Is this a dandelion?" (subordinate). The children were expected to answer "no" and were prompted to provide labels that matched the categorical relationship. Both groups demonstrated knowledge of subordinate and basic relationships, although their accuracy and performance patterns differed. The labels given by the children with WFD were less accurate and consisted of more indeterminate errors (e.g., "I don't know" or acceptance of the word used in the question) than semantic substitutions. The opposite pattern was seen for the children with typical language development. Similar error patterns have been reported in other studies (e.g., Faust et al., 1997; German, 1982; Lahey & Edwards, 1999; McGregor, 1997). McGregor and Waxman hypothesized that the WFD group's performance was the result of inadequacies in the connections within and between lexical entries. The increased use of indeterminate responses, therefore, was the result of an inability to even access the correct semantic field.

If the nature of the semantic deficits of children with LI is based on poorly elaborated semantic representations, then nonspeech activities should also reveal representational difficulties. McGregor and colleagues (McGregor & Appel, 2002; McGregor, Newman, Reilly, & Capone, 2002) investigated this issue by asking children to draw pictures of objects that they earlier did and did not name accurately. Adults, blind to the study, were then asked to rate the children's drawings. Less extensive semantic representations were demonstrated by children with SLI because they (a) accurately named fewer words than their peers and (b) the drawings they made of words that were not named were consistently judged to be less accurate than those of the named words (see also McGregor, Friedman, Reilly, & Newman, 2002). In other words, the children with SLI demonstrated poorer knowledge of misnamed words, even when retrieval of the word's phonological form was not required.

The retrieval hypothesis has been addressed primarily through investigations of children with WFD. Although a number of studies discuss the retrieval hypothesis, few provide direct evidence for support of it over the storage hypothesis (e.g., Faust et al., 1997; Fried-Oken, 1987). For example, Newman and German (2002) examined the naming accuracy of elementary-school-aged children under a variety of lexical conditions. Although statistical comparisons were not made between the groups, the children with WFD appeared to consistently name items with less accuracy than their peers. Within each of the conditions, however, children with WFD and their peers both performed with higher accuracy on the predicted variable. Specifically, their naming accuracy was improved for (a) higher versus lower word frequency, (b) younger versus older age of acquisition, (c) lower versus higher lexical neighborhoods (Notable variations were reported under different neighborhood conditions. However, the groups performed with similar patterns.), and (d) a strong–weak versus a weak–strong stress pattern. Newman and German argued that the occurrences of these lexical effects demonstrate adequate representations in children with WFD, thus supporting the retrieval hypothesis. These findings, however, do not necessarily demonstrate adequate representations. They only show that the children's performances vary by situation, which is not counter to the storage hypothesis. The storage hypothesis states that the poor representations of children with LI are the result of less familiarity with words because these children are slow processors. It does not say that all words have equally poor representations. It is reasonable, therefore, to presume that children with LI would know more about words that they have had more experiences with. Because each of the variables studied by Newman and German was principally a measure of familiarity, the findings of this study do not go against the storage hypothesis.

It is difficult to completely discount either the storage or retrieval hypothesis, especially when expressive language tasks are used. As stated earlier, it may be that children with LI have difficulty with both of these aspects of word

organization and access. Theoretical support for the simultaneous occurrence of storage and retrieval difficulties has been proposed by Faust et al. (1997) and Nippold (1992). Direct evidence for this proposal comes from intervention studies of children with WFD. Hyde Wright (1993) and McGregor and Leonard (1989) examined the effects of teaching different types of information on word naming. Storage (referred to in these studies as elaboration) was trained through the introduction of new information in order to build richer knowledge stores for each word. Retrieval, on the other hand, was trained through cues designed to facilitate access to information that had already been stored. School-aged children with LI were trained on sets of words under elaboration, retrieval, and elaboration plus retrieval. All three conditions included lemma- and lexeme-level information. In both studies, consistent naming improvements were reported only for the elaboration plus retrieval condition. Variable results were reported for the other two conditions.

## IMPLICATIONS FOR ASSESSMENT

The data and theories presented in this article demonstrate that the semantic deficits of children with LI extend beyond problems with vocabulary size. These children have difficulty with (a) learning new words within indirect teaching environments, (b) storing the phonological forms of new words in short-term memory, (c) creating and storing elaborate lexical representations, and (d) expressively using known lexical items. It is important to note, however, that one can only presume this pattern for individual children with LI. To date, no single investigation has addressed each of these skills within the same children.

These data clearly demonstrate that a complete examination of a child's semantic skills must extend beyond vocabulary testing and include measures of these four areas. This task, however, is easier said than done because there are few standardized tests that evaluate multiple aspects of semantic knowledge. Instead, clinicians must rely on a combination of standardized and nonstandardized tasks to accurately identify and describe a child's semantic abilities. Both options for semantic assessment are discussed below. Where clinician-developed, nonstandardized tasks are described, we strongly recommend that clinicians closely follow the procedures that have been cited in the literature (especially those that have been shown as being difficult for children with LI) and be aware of linguistic and sociocultural influences on semantic performance.

There is currently only one formalized test that examines children's incidental word-learning abilities—the Diagnostic Evaluation of Language Variance (DELV; Seymour, Roeper, & de Villiers, 2003). This criterion-referenced test includes a subtest that exposes children to novel words while they view a picture (e.g., "The girl is sugging the man to send the ball."). The children are then shown a field of four pictures and asked comprehension questions about the novel words. The comprehension questions on this test focus on the thematic roles of the objects in the original picture (e.g., "Which one was the sugger?"). As a result, this incidental learning task is focused more on assessing grammatical knowledge (i.e., syntactic bootstrapping) than on associating novel words with particular referents. Clinicians can develop their own word-learning activities to assess children's abilities to incidentally learn new words. They can present novel words within contexts that include the correct referent but do not directly define the word. Follow-up testing to determine if the new words were learned can be conducted via an object- or picture-naming task (see Golinkoff et al., 1992, for example).

The storage of phonological forms in short-term memory has primarily been evaluated through nonword repetition tasks. Dollaghan and Campbell (1998) and Gray (2003) reported that nonword repetition may be a strong diagnostic indicator of LI and SLI (see also Ellis Weismer et al., 2000). The Children's Test of Nonword Repetition (CNRep; Gathercole & Baddeley, 1996) provides standardized comparisons for children's abilities to repeat new phonological forms. However, these comparisons have limited validity with children from outside of the United Kingdom (the origin of the CNRep's normative sample). Clinicians may wish to use the nonword lists and procedures from the research cited above for their own nonstandardized assessments. We caution against clinicians developing their own nonword repetition lists because there are a number of nonphonological influences that can affect performance on this task (see Dollaghan, Biber, & Campbell, 1995, and Snowling, Chiat, & Hulme, 1991, for examples). Finally, the interpretation of nonstandardized nonword repetition results is somewhat limited because there is currently little data available that individual results can be compared to.

Children's lexical representations can be evaluated by a number of standardized and nonstandardized procedures. Many standardized tests include items that examine what children know about individual words and how words are connected within the lexicon. For example, the Preschool Language Scale–4 (Zimmerman, Steiner, & Pond, 2003) (as well as its earlier versions) includes receptive and expressive items that evaluate category membership, part–whole relationships, and thematic relationships. However, these items are dispersed throughout the test, and an efficient system for reviewing a child's semantic performance is not provided. The DELV and the Expressive Vocabulary Test (Williams, 1997) both examine connections between lexical items by asking children to name multiple words that describe the same picture. Many clinicians are familiar with sorting and labeling tasks as treatment tools. These activities can also be administered to examine the different types of semantic relationships the children have within and between words (e.g., "Find all of the things that belong in a kitchen."). Peña, Bedore, and Rappazzo (2003) demonstrated how a number of intrinsic and associative relationships could be used for assessment purposes.

The word-finding difficulties of children who are 4 years of age and older can be formally assessed with the Test of Word Finding, Second Edition (TOWF-2; German, 2000). This test examines word finding by comparing children's abilities to name and comprehend objects and

actions. The TOWF-2 also evaluates lexical representations through categorical labeling, attribute defining, and response time measures. Clinicians can develop their own word-finding measures that are similar to the procedures of the TOWF-2. The key to doing so is to evaluate the child's receptive knowledge of items that he or she has had difficulty naming (either through an expressive vocabulary test or a nonstandardized task). If many unnamed items are identified correctly, then a word-finding problem is likely. Follow-up testing, using procedures discussed in the previous paragraph, can be used to determine the extent of the child's lexical knowledge of the unnamed items. This may help to identify consistent features or aspects of knowledge that the child is missing.

As clinicians develop and use a wider variety of semantic assessment tasks across these areas of difficulty, they must be cautious of a number of linguistic and sociocultural influences on a child's performance. Linguistic influences may come from within the lexicon or from other aspects of language. The acquisition of new words can be affected by variations in phonological form, attached morphology, and timing between when the word is said and when its referent is seen. Storkel (2001) and Storkel and Morrisette (2002) found that preschool and school-aged children learned more novel words and created more elaborate representations if those words included frequently occurring phonemes in common word locations (i.e., high phonotactic probability). Bedore and Leonard (2000) revealed that variations in the morphology attached to new words can affect their acquisition. The participants in this study acquired more novel words when the exposure and testing phases included the same morphology (e.g., "She neen**s**." and "Show me neen**s**.") than when the morphology varied (e.g., "She neen**s**." and "Show me neen**ed**."). A final example comes from the 4-year-olds who were studied by Tomasello and Cale Kruger (1992), who learned novel verbs better if the verb's phonological form was heard before the associated action was shown (as opposed to seeing the action first or a simultaneous presentation). Expressive word use can be influenced by factors such as familiarity, age of acquisition, number of lexical neighbors, and stress pattern (Newman & German, 2002). There is no conclusive evidence that children with LI are any more or less sensitive to these influences than their peers. However, each factor must be considered in the development of semantic assessment tasks because, if left unchecked, they can result in unexpected variations in performance.

A child's sociocultural history can also affect his or her performance on semantic assessment tasks. As described earlier, identifying a new word's meaning is part of semantic acquisition. Because languages encode meaning differently, the word-learning performances of children with different language backgrounds will vary depending on the type of words that are targeted. For example, English verbs are predominantly encoded for manner-of-motion, whereas Spanish verbs are encoded for the path of the motion (Naigles, Eisenberg, Kako, Highter, & McGraw, 1998; Naigles & Terrazas, 1998; Talmy, 1985). As a result, children who are native or dominant Spanish users are likely to have difficulty with tasks that involve learning verbs that are not specified for the path of the action. Language background can also influence performance on assessment tasks involving lexical storage and organization. Peña et al. (2003) demonstrated differences in lexical organization by administering a battery of lexical tasks (including associations, characteristic properties, categorization, functions, linguistic concepts, and similarities and differences) to Hispanic 4- to 7-year-olds who were either (a) predominant speakers of English, (b) predominant speakers of Spanish, or (c) bilingual speakers of English and Spanish. Although all three groups performed at similar levels overall, there were different patterns of performance based on linguistic experience. For example, predominant English speakers scored higher on receptive similarities and differences, and predominant Spanish speakers were better at receptive characteristic properties.

Socioeconomic status (SES) has also been shown to have an effect on a child's lexical knowledge (e.g., Chapman, Schwartz, & Kay-Raining Bird, 1991; Dollaghan et al., 1999). Hart and Risley (1995) recorded the day-to-day language experiences of 1- and 2-year-olds growing up in welfare, working class, and professional environments. When the children were 3 years of age, their SES was significantly correlated with vocabulary use ($r$ = .73) and vocabulary growth ($r$ = .70). These differences persisted at least through the third grade (Walker, Greenwood, Hart, & Carta, 1994) and are likely to affect all areas of semantic assessment.

The primary concern with evaluating the language skills of children with nonmainstream cultural and socioeconomic backgrounds is making an accurate diagnosis. Because these children may perform as poorly as children with LI in each of the semantic areas discussed, clinicians must determine the nature of the difficulties. Are they due to impairments in language acquisition and use, are they the result of differences in language experience, or are both factors influencing performance? This problem has been addressed in a number of ways. One solution has been to develop tests that discriminate sociocultural language differences from clinical language impairments. The DELV (Seymour et al., 2003) was designed to do this by eliminating items whose responses vary across language experience and by focusing on tasks that are specific to the problems of children with LI. Peña et al. (2003) recommended that clinicians supplement their assessment protocols. They suggested (a) testing beyond the ceiling and below the basal of standardized tests, (b) testing bilingual children in both languages, and (c) using interactive testing approaches (such as clinical interviews and dynamic assessment). Finally, Campbell, Dollaghan, Needleman, and Janosky (1997) addressed this issue by promoting the use of processing-dependent measures. Processing-dependent measures are assessment tasks that are designed to evaluate children's psycholinguistic processing—their ability to learn and use new linguistic information. This is contrasted with assessing children's current language knowledge (the focus of most current standardized tests). Nonword repetition and activities that involve new word learning (such as fast mapping and QUIL) are examples of semantically based processing-dependent measures.

These tasks appear to be especially useful because they also reflect areas of significant weakness in children with LI. When available, we suggest that clinicians follow each of these recommendations.

## CONCLUSION

The semantic skills of children with and without LI are complex and of significant clinical and theoretical interest. We are encouraged by the attention that this aspect of language development receives in the research literature. However, there are a number of outstanding issues that need to be addressed. For example, we agree with Ingram's (1989) and Crystal's (1998) conclusions that significant improvements need to be made in our understanding of children's semantic representations and how they develop. We also support the development of comprehensive models that address the multiplicity of lexical errors that have been reported in children with LI.

Given the multiple areas of semantic difficulty that have been identified in children with LI, speech-language pathologists must expand their semantic assessments beyond measures of vocabulary size. Currently, there is limited standardized information regarding semantic performance other than vocabulary size. As a result, most of the assessment activities described in this article cannot be used to identify children as having LI. However, these tasks are important tools for clinicians because they define the areas of semantic acquisition and use that children are having difficulty with. By focusing specifically on these problems, clinicians can improve the effectiveness and efficiency of their intervention.

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