Introduction: What’s in a Word?

The process of word learning in infancy captivates the interest of parents and researchers alike. Parents eagerly await the infant’s first words, which typically emerge around 12 months of age (P. Bloom 2000). First words are of interest in our management of infants with hearing loss (HL) because they are foundational building blocks for language development stages to come several months down the road. Early words emerge out of a foundation of perceptual, cognitive, motor and social learning that occurs in the first year of life. An interest in word learning processes has arisen in an effort to explain why children initially learn words slowly and then progress to do so rapidly. Lois Bloom (2000) describes typical children’s first words as “few, far between, fragile, tentative and imprecise (p. 125).” She observed that, approximately six months later, children’s word learning often can be characterized as “fast, frequent and robust (p. 125).” Infants in the early stages acquire approximately two words per week (Carey 1981), but by approximately 19 months of age, they learn as many as nine words per day (Bloom 1973 as reported by Hollich et al. 2000).

Several theories have been advanced to explain this phenomenon. Although there are important differences in these theoretical accounts, most view the child as using “smarter” word learning strategies as language grows. Research using the MacArthur-Bates Communicative Development Inventory (Fenson et al. 1993), a parent report measure, provides normative data for several languages on typical vocabulary size as a function of age (9 to 36 months). These efforts have been fundamental to an understanding of quantitative dimensions of vocabulary growth in young children. Developmental researchers like Hollich et al. (2000) suggest the need to understand not only “word counts,” but also the strategies or processes children use in the service of word learning and how those processes may shift over the course of development. In this paper, implications of these theories for our work with children with HL will be considered, along with some of the developmental ingredients that support lexical learning. Most studies of vocabulary development in children with HL point to wide variation in outcomes across the age span. This suggests the need to understand sources of individual difference, so that factors amenable to change may be addressed.

A few quotes from young children are useful as background, because their words reveal some of the developmental components and strategies involved in early word learning. The first example comes from trips to the day care with my second child, who was 18 months old at the time. Being quite fond of buses, he would point, squeal excitedly and say, “buh,” when a bus was approaching. When the bus would leave, he produced a falling inflection, his gesture changed to searching, and he would say, “buh,” as if to mean, “The bus is all gone.” If a bus did not come again for awhile, his voice and gestures conveyed disappointment, and his “buh” seemed to mean, “Shoot, there’s no bus coming!”

This example shows that “what’s in a word” includes more than the syllable itself. Although he would receive credit for only one word (bus) on a parent checklist, the word attempt, gestures and prosody conveyed much more. Toddlers’ words often are layered with affect (like delight or disappointment), which is a key part of the in-
tended message. This process is inherently social. Bloom (1993) asserted that a child’s strong desire to communicate is a driving force in word learning.

A second example came from a 2.6-year-old who walked in a room, secured adult attention, said, “Apparently,” and abruptly left the room. This example shows that children’s initial entries to the lexicon may be incomplete (Carey 1981). Their meanings become shaped and refined through further use in conversation. A mother of a two year old reported that her child was playing in the family room. Two rooms away, his older brother asked if he could have some “C-A-N-D-Y.” The two year old came running in, saying, “Hey, I want C-Y.” Although many words are learned through direct teaching, many more are learned by listening in (Akhtar, Jipson and Callanan 2001; Akhtar 2005). A final example comes from a colleague, who reported that his young child figured that if the item in back of him was “behind” and the item next to him was “beside,” then the one in facing him must be “BEfront.” Although the concept “in front” is still a work in progress for the child, the example shows that children notice patterns in the input and this pattern finding is a critical part of generalizations that become increasingly powerful tools for word learning (Hoff and Naigles 2002).

A Developmental Model of Word Learning

A number of theories have been advanced to explain children’s word learning processes in the second year of life. Figure 1 illustrates features of the Emergentist Coalition Model (ECM) proposed by Hollich et al. (2000). Added to the model for this discussion was a foundational layer (lowest box), intended to represent the perceptual learning that occurs in the first year of life. There is still much to be learned about these foundational stages in infants with HL. The focus of the current paper, however, is on word learning and development in the second year of life, which builds on these foundations.

Figure 1: Model of developmental ingredients in word learning in the second year of life. Adapted from the Emergentist Coalition Model of Hollich et al. 2000. Reference means “how words map onto objects and events” (Golinkoff and Hirsh-Pasek 2006, p. 30).
The ECM model (Hollich et al. 2000; Golinkoff and Hirsh-Pasek 2006) proposes that developmental processes emerge and cooperate to bring about qualitative shifts in word learning over time. The authors describe their model as a “hybrid” developmental theory, which incorporates elements from several developmental theories of word learning. They propose that infant word learners progress from primary reliance on associational cues to increasing reliance on linguistic cues and social understanding. Three primary premises of this model are: 1) children rely on multiple cues (perceptual, linguistic, social) when learning words, 2) the relative importance or weighting of these cues changes over time as children learn words, and 3) word learning strategies emerge and change (i.e., become “smarter”) as children’s skills increase.

The gray highlighted box in figure 1 represents the proposal that attentional cues play a dominant role in first word learning. Parents scaffold the learning of first words by timing their messages to coincide with children’s attention to objects or events, and parental use of infant directed speech heightens the perceptual salience of the input (Fernald 1985; Fernald and Mazzie 1991). Infants also tend to look at objects and events that are relevant or interesting to them (Bloom and Tinker 2001), and parents support these interests. However, by 15 to 18 months, children are increasingly adept at using linguistic cues (consistent patterns in the input, grammatical cues; Hoff and Naigles 2002) in the service of word learning and they become more skilled at interpreting social cues, like reading adult intentions (Baldwin 1993a, b; Tomasello 2003) to figure out what adults mean. As children become more adept at relying on these multiple cues to word meaning, it makes sense that the learning would increase in efficiency.

### Word Learning Behaviors in the Second Year

Several behaviors that are relevant to word learning in the second year of life have been described in the literature (see table 1). Although general age landmarks are provided in the table, some of these behaviors are related more to vocabulary size than chronological age (Mervis and Bertrand 1994). Therefore, ages should not be interpreted strictly, but more as a guide for their relative emergence in development. A precursor to what is to come is seen around 10 months of age, when infants become intentional communicators (Bates, Camaioni and Volterra 1975), who follow adult eye gaze to the ob-

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**Table 1**: Some developmental landmarks relevant to word learning processes.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Developmental Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>9–12 months</td>
<td>Look at object adult looks at</td>
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<tr>
<td></td>
<td>Follow adult gaze, initiate pointing</td>
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<tr>
<td></td>
<td>Engage in social referencing</td>
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<tr>
<td></td>
<td>Emergence of Intentionality</td>
</tr>
<tr>
<td>~12 months</td>
<td>Coordinated joint attention</td>
</tr>
<tr>
<td></td>
<td>Coordinate attention to objects and adults</td>
</tr>
<tr>
<td>12–15 months</td>
<td>Whole object assumption</td>
</tr>
<tr>
<td>~15 months</td>
<td>Fast mapping/rapid word learning with explicit exposure</td>
</tr>
<tr>
<td>18–19 months</td>
<td>Re-direct gaze to figure out adult intentions</td>
</tr>
<tr>
<td></td>
<td>Use linguistic cues (the roll, rolling)</td>
</tr>
<tr>
<td>18–24 months</td>
<td>Ask what’s that? Reads emotional cues</td>
</tr>
<tr>
<td></td>
<td>Recognizes words are special</td>
</tr>
<tr>
<td>24–30 months</td>
<td>Novelty assumption (&gt; 200 words)</td>
</tr>
<tr>
<td></td>
<td>Learn incidentally</td>
</tr>
<tr>
<td></td>
<td>Advancing pattern use</td>
</tr>
<tr>
<td></td>
<td>Advancing ability to read adult intentions</td>
</tr>
<tr>
<td>36 months +</td>
<td>Advancing ability to consider adult knowledge states</td>
</tr>
</tbody>
</table>

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ject or event being referenced. Knowing to look where adults look helps establish joint attention (Tomasello and Farrar 1986), and supports the perceptual cues available for word learning.

Around 12 months of age, there is an important qualitative shift in the joint attention process. Infants engage in *coordinated joint engagement*, for the purposes of sharing the event (Bakeman and Adamson 1986; Tomasello 2003). Infants look back and forth from adult to object to adult. In many cases, there is a social effort on the part of the infant to share the event. Akhtar and Tomasello (2000) suggest that these developments may be the beginnings of children's social cognition (e.g., developing the ability to read others' minds). Some word learning theories suggest that children operate from certain constraints or biases that reduce the problem space as they figure out what words mean. One such bias, the whole object assumption, leads children to associate names with a whole item, not the parts (Markman 1989; Hollich, Golinkoff and Hirsh-Pasek 2007). So infants as young as 12 months, upon hearing a new word like “truck,” will assume that adults are referring to the whole vehicle, not the wheels or the flat bed part. Theorists suggest that this principle helps children avoid mismappings of meaning as they learn names for objects.

Around 18 to 19 months, children’s behaviors reflect increasing contributions from linguistic and social skills. Children begin to read adult intentions, which guide their understanding of what adults are referring to when they speak (Baldwin and Moses 2001). Studies by Baldwin (1991, 1993a) showed that when an adult used a novel label for an item while the child was looking at a different novel object, the child would shift focus and look at the adult to determine what was being referenced. Infants appreciated the importance of social cues (where the adult was looking) during this discrepant word-learning task. Tomasello (2003) suggests that these young children are coming to understand adults “as intentional agents,” an early precursor to theory of mind or “mind reading.” Some argue that linguistic cues (*pattern finding*) dominate in the child’s learning at these ages (Hoff and Naigles 2002). This view places emphasis on the infant's tendency to look for regularities or patterns in speech as clues to word meaning. The conversational setting is seen as a rich source of “data” that the child will use over time to note regular co-occurrences in the language. In this view, when an infant hears a new word, she uses surrounding familiar words (semantic cues) and the structure of the sentence (grammatical cues) to figure out what the unfamiliar word might mean (e.g., *rolling* must be an action, whereas *the roll* must refer to a thing). When we consider “what is in a word,” it is important to recognize that words may be bundled with social-emotional cues (conveyed by prosody, word choice), grammatical cues, and cues in the phonological sequences or patterns. It is impressive to consider how children become more efficient in accessing and integrating such cues.

Around 13–15 months of age, children show an ability to learn at least initial word representations after just a few explicit exposures (Woodward, Markman and Fitzsimmons 1994). Around 24 months of age, or when productive vocabulary exceeds 200 words, other qualitative changes are often observed in children's strategy use. One commonly observed strategy seen in children is a “novelty assumption” also called the “novel nameless category principle” (Golinkoff, Hirsh-Pasek, Bailey and Wegner 1992; Mervis and Bertrand 1994). Carey and Bartlett (1978) originally demonstrated that young children, when faced with a novel word would associate it with the only unfamiliar object in the immediate context. She presented different colored trays and asked children to “get the *chromium* tray, not the red one.” Children knew the colors of the other trays present, and assumed that the unfamiliar color must be *chromium*. Suppose a child sees four objects on the counter, and the child already knows *shoe*, *sock* and *pacifier*. The child does not know a word for one of the items (*lotion*). When the mother says, “please get me the *lotion*,” the child assumes she must mean this word that does not have a name, and retrieves the correct item. Use of this type of strategy helps children narrow the problem space as words are learned. Children in this age group are aware that things are supposed to have names. This is evident in their emergence of the “what’s that?” type of question around 18–24 months of age (Miller 1981).

By 24 to 30 months of age, children are even more adept at using pattern-finding and social cues in the service of word learning. Learning becomes less dependent on explicit exposure, and there is evidence that children learn new words incidentally by overhearing them in context. For example, Akhtar, Jipson and Callanan (2001) empirically demonstrated that by 2 years of age children learn novel words by overhearing others. As linguistic sophistication grows, children advance in noticing patterns that help them make smart predictions about words (Hoff and Naigles 2002). Their mind reading abilities continue to mature. Akhtar and
Tomasello (1996) showed that children attend to the speakers’ emotions and their actions (i.e., stopping the search for a toy) as cues to word meaning. For example, the adult announced she was going to find the “toma” and showed disappointment when retrieving one of the objects. Later, she showed excitement about a different object and stopped the search. Children used this information to infer the correct object name. Sabbagh and Baldwin (2001) explored how children’s emerging understanding of the knowledge states of others may assist them in word learning. They found that 3- and 4-year-old children showed better word learning when the speaker professed to be knowledgeable about the name of the objects, as opposed to indicating ignorance (and thus relying on “guessing”).

Word Learning in Children with Hearing Loss

Only a few studies have specifically examined word-learning behaviors in young children with hearing loss (HL). The following section reviews a small set of papers relevant to word learning rates and processes. The first study was a report on rates of expressive vocabulary development in 113 young children with HL (Mayne, Yoshinanago-Itano, Sedey and Carey 2000). These studies used a parent report measure (MacArthur-Bates Communicative Development Inventory, MBCDI; Fenson et al.1993) to examine vocabulary size at several ages, using cross sectional and some longitudinal data. Outcomes for children with HL were compared to norms for infants with normal hearing (NH). Approximately half of the participants with HL were identified prior to 6 months of age. Findings revealed that acceleration in the rate of expressive vocabulary development was observed in the young children with HL after 25 months of age (approximately 7 months later than observed in toddlers with NH).

Strategy use was explored in a study of novel word learning study in 19 children with moderate to profound HL (Lederberg, Prezbindowski and Spencer 2000). Two experiments explored rapid word learning (also called fast mapping) and novel mapping strategies (i.e., use of the novelty assumption described above). The terms rapid word learning or fast mapping refer to children’s ability to learn at least a partial word representation after minimal exposure (1 or 2 times). Results of this study showed that children with HL were delayed relative to NH children in developing rapid word learning skills, but eventually acquired words rapidly in explicit naming contexts (e.g., direct teaching). Like NH children, they reached this stage before they used novel mapping strategies. Previous studies suggest that vocabulary size, not age, is related to children’s use of the novel mapping strategy (Mervis and Bertrand 1994). Lederberg et al. (2000) supported this finding, and showed that children with HL acquired the strategy once they had a productive vocabulary of about 200 words, a time point that was delayed relative to children with NH. The authors con-
cluded that children with HL show delayed but typical patterns of word learning strategies, and that strategy use is closely tied to vocabulary size.

Interactive play scenarios were used to examine word learning in 2- to 5-year-olds; 24 deaf children with cochlear implants (CI) compared to 24 children with NH (Houston, Carter, Pisoni, Iler-Kirk and Ying 2005). Children were taught names for Beanie Baby toys, and the invented names were derived from perceptually salient attributes of the toy (e.g., “Spots” for the Dalmation). Younger children were systematically taught eight character names and older children were taught 16 names. Both groups were given immediate and delayed (after two hours) tests of recognition and recall. Results showed that the performance of children with CIs was poorer than that of the NH group on this word-learning task. For unfamiliar words, children with CIs had more difficulty than NH peers in the delayed test condition. In addition, wide ranges in performance were seen in the CI group, which the authors concluded may relate to atypical underlying phonological skills needed for word learning.

The finding of large individual differences in vocabulary production is supported by two studies examining rates of expressive vocabulary development in early-identified infants with HL. Figure 2 compares parent-reported (MBCDI) expressive vocabulary development from three data sets, presented left to right respectively: 1) Colorado sample of 113 children, with outcomes plotted as the 25th through the 90th percentile (Mayne et al. 2000); 2) longitudinal data on 25 children enrolled in a longitudinal study at Boys Town National Research Hospital (BTNRH); and 3) normative sample data for 1800 children for the MBCDI, also plotted from the 25th to the 90th percentile as a function of age (Fenson et al. 1994). In the Colorado data set, the average child (50th percentile) appears to make slow changes in vocabulary until the 32–34 month interval, when vocabulary size accelerates. In contrast, the average children in the normative sample (right section of figure 2) show acceleration around 18 months, with a fairly steep slope thereafter. Interestingly, findings for the individual longitudinal subjects from BTNRH (middle section) look comparable to the Colorado data set. Both studies show much wider ranges of performance at the later ages than observed in the normative (NH) data set. There is a pressing need for a better understanding of individual differences and factors that contribute to such variable outcomes for children.

### Possible Sources of Individual Differences

Longitudinal research in the Infant Development Laboratory at BTNRH is focused on word learning in young children with NH and HL. A primary goal is to increase our understanding of factors that influence development of the early lexicon. This work will be described in relation to three primary questions:

1. **Do phonetic delays influence expressive vocabulary development?** We reasoned that even with early intervention, quality and quantity of auditory experience for children with HL is influenced by periods without amplification, and factors like noise, distance, and reverberation. Reduced experience may affect perceptual learning, which could slow phonetic development, and ultimately word production.

2. **Are there factors that limit children’s access to auditory experiences?** We are exploring factors like consistency of device use and features of maternal input and their influence on word learning.

3. **Do children with HL have access to overhearing as a route to word learning?** This work is motivated by the recognition that incidental learning is a major route to word learning early in life in children with NH (Akhtar et al. 2001).

### Phonetic Delays

In relation to the first question, it is important to recognize that Vihman (1996), Stoel-Gammon (1998) and others have demonstrated that there is considerable overlap between the syllables produced in babble and the phonetic composition of children’s early words. McCune and Vihman (2001) point to the importance of babble for the child’s stabilization of vocal-motor schemes that prepare the child for word production. Thus, if children are delayed in syllable production and have a restricted consonant repertoire, expressive vocabulary production may be delayed. Recently published work from our lab (Moeller et al. 2007a,b) supported the continuity hypothesis, in finding that children who made slow transitions to production of complex syllables, also were slower than average in developing expressive vocabulary. These longitudinal studies compared prelexical vocalizations and early verbalizations of 21 NH infants with 12 infants with varying degrees of HL (from mild to profound). Wide ranges in performance were observed in the early-identified children with HL, whose outcomes on a variety of measures
varied from within normal limits to significantly below normal limits. Results showed that infants and young children with HL, compared to age-matched children with NH, produced:

1. Smaller consonant inventories, on average. It was positive to note, however, that their inventories expanded with age, which was not the case in some previous studies conducted prior to early detection (Stoel-Gammon and Otomo 1986).

2. Later onset of canonical babble and less complex syllable production. Notably, three of four children with pure tone averages (PTAs) < 50 dB HL produced babble at ages close to the expected ages for NH infants. Nathani, Oller and Neal (2007) recently reported longitudinal data on four infants with moderate-to-severe HL. Two babbled within normal limits, but later than the average for NH infants, and two were delayed in babble onset.

3. Some children spent a longer time than hearing peers in transitions between certain stages. For example, several children demonstrated what appeared to be a prolonged stage of jargon prior to and during the single word stage. The term jargon refers to utterances with variegated, complex syllables in babble with intonation contours that mimic spoken phrases. Although many children in the NH group produced these types of utterances, they commonly progressed quickly to dominant use of word approximations or words. In contrast, for some children with HL, these elaborated syllable strings of jargon dominated their productions for several months. In some cases, this pattern foreshadowed acceleration in expressive vocabulary (a spurt in production of single words and short phrases). It may be that some children with HL require additional practice at this level as a foundation for phonological encoding during word learning.

In general, many of the children with HL showed early delays in phonetic development, but stage progression that was parallel to age-matched peers. However, average data do not show the full picture, and may obscure important patterns of individual differences. Figure 3 illustrates three distinct patterns of development on a measure of syllable complexity collected between 12 and 18 months of age. In each section of figure 3, the black filled symbols represent the average syllable complexity level (measured as mean level of babble) for 21 NH children. The gray area shows the standard deviations for this measure for the NH group. The first pattern (left section) shows two children with HL whose syllable development was within normal limits compared to hearing peers throughout the observational period. S1 (PTA = 50 dB HL) and S2 (PTA = 48 dB HL) were early-identified infants with HL. Interestingly, S1 progressed to typical rates of vocabulary development, whereas S2 demonstrated slow transitions to words, with a jargon stage that was still dominant at 36 months of age.

Insights to S2’s extremely extended jargon phase are contained in her history. At 16 months of age, this

![Figure 3](image-url)

**Figure 3:** Three patterns of performance for individual subjects with HL on measures of syllable complexity as a function of age compared to NH data. Filled circles represent the average scores for 21 NH children; gray areas represent the standard deviations for the NH group. MLB refers to a measure called mean length of babble, calculated on 50-utterance samples.
child had the most advanced prelinguistic phonetic development (including fricative production) of any of the 12 children with HL in the study. The family moved when the child was 17 months old, and early intervention services and amplification use were discontinued. She returned to the longitudinal study at 36 months of age, and the continuing use of jargon was documented. Presumably, this case suggests that for some children lack of consistency in device use can further alter their auditory experience, with consequences for phonological and lexical development. In addition, we observed that it can be difficult for mothers to respond with contingent messages when children produce long jargon strings, because their intended meaning is unclear or ambiguous. This could further influence the quality of the auditory-linguistic experience for the child.

A second pattern (middle of figure 3) was observed in three children (S3, S4, S5), who produced simple syllables for a prolonged period. Their scores over the observational period were significantly below the average range. This pattern of prolonged reliance on simple syllables (i.e., glides and vowels; few true consonants) was identified as a “red flag,” signaling the need to closely monitor these children (Moeller et al. 2007a). One of these children was highly inconsistent in his use of amplification. At later ages, the other two were diagnosed with difficulties in motor aspects of speech production. The third pattern (right section of figure 3) was observed in three children whose scores initially were below normal limits, but rapid shifts in syllable complexity were observed over a two-month interval. Two of the three children showed this pattern following receipt of cochlear implants.

If some early-identified children with HL are slower to produce complex and varied syllable types, their transitions to word production would be expected to be slower as well. This led us to examine word attempts in the period from 16 to 24 months in 21 NH children compared to 10 early-identified children with HL (Moeller et al. 2007b). Fifty spoken utterances produced at each age were classified into three mutually exclusive categories: 1) noncommunicative vocalizations (e.g., vocal play not directed at an adult), 2) communicative utterances that were not intelligible word attempts, and 3) words or word approximations. The proportion of utterances falling into each of the categories at 16 and 24 months are shown in figure 4. It is evident that both groups of children produced few true words at 16 months. However, at 24 months, understandable words and word approximations dominated the samples of the NH group. In contrast, communicative vocalizations that could not be understood as words dominated the samples of the children with HL at this age. These findings suggest that for some early-identified infants, vocal and phonetic delays may impact the transition to word attempts that are clear enough to be understood. In turn, this may influence how mothers and fathers can respond to the child’s communication. Following the work of Otomo (2001), we are currently exploring the nature of parental responses to “fledgling” word attempts, as this may provide insights about facilitative parental strategies. These studies support the need to further understand whether children with HL make efficient transitions between developmental landmarks, and what factors may foster or hinder such transitions.

Device Use and Reductions in Auditory Experience

Infants in our study are observed at regular intervals (every six to eight weeks) from an early age (4 months in a first longitudinal study; 9 months in a second). We have observed that even motivated families struggle at times to maintain full time device use with young infants. Because such difficulties can impact the child’s cumulative auditory experience, we implemented a survey in an effort to quantify over time the degree to which this was an issue for families. The survey (Device Use in Daily Life) asked mothers to judge the consistency with which their children used amplifi-

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1 Rules for categorizing are fully explained in Moeller et al. 2007b.
cation in several common daily situations (e.g., car, daycare, outdoor play, family outings). Mothers rated use consistency on a scale from “never” to “always.” They also completed a daily schedule, noting periods of use and non-use (e.g., nap time). Mothers were coached to respond as honestly as possible. Examiners acknowledged that some infants have difficulty using devices in some situations, and that the researchers were trying to understand these difficulties. Parental reports about device use are plotted in Figure 5. They include responses collected for 14 early-identified children, seen at four age points. It is positive to note that for all the situations queried, use consistency increases with age. By the final sample (24–28 months), the majority of responses indicated that the child used the device “frequently” to “always.” However, the 11-month data are particularly concerning, in that several situations were rated as “occasional use.” Around this age, infants gain an understanding of causality, and they may figure out that pulling the hearing aids out gets parental attention. This may be a time in development when parents need additional support and strategies for maintaining as much device use as possible.

The data also suggest that some situations (e.g., car, playing outside) are more challenging for parents than others. Parents report that situations where infants and toddlers are not able to be closely supervised are particularly problematic for them. By the final age point, five of 14 families had established full time use in all settings. Most of the others maintained frequent use across the majority of settings, but this falls short of our early intervention objectives. In practice, parents need ongoing support on this issue that may require adaptation with the child’s developmental stage. In addition, there is a pressing need for further research to identify sources of difficulty that families encounter in maintaining device use with their infants. Although sometimes an issue of parental compliance and understanding, many other issues may be involved. Infant temperament and emotional regulation appears to create challenges for some families. It is our observation that parents will only re-seat the ear mold so many times before they worry about interfering with their relationship with the infant. Parents report difficulties with hearing aid use following infant ear infections or during teething. Quality and specialization of early intervention may be a contributing factor as well. Greater understanding of the sources, contexts, and dimensions of this problem for families could lead to the creation of specific counseling and educational resources.

Learning Words through Overhearing

It has been established that by 2 to 2½ years, it is common for children to learn novel words through indirect routes, by listening in on the conversations of others (Tomasello and Barton 1994; Akhtar et al. 2001; Akhtar 2005). The sheer rate at which children develop words suggest that not all words are learned through direct teaching (P. Bloom 2000). Observational studies confirm that 2- to 3-year-olds monitor the conversations of adults, evidenced by their topic-relevant joining of the conversation (Dunn and Shatz 1989). It is well established that overhearing is a powerful route that NH children use for acquiring new words and gaining insights into what people mean and how they use words socially. Akhtar (2005) demonstrated that some infants learn novel words through overhearing as early as 18 months of age. To explore how children with HL may access this route to word learning, we adapted an experimental procedure, based on the work of Akhtar et al. (2001). In our version of the task, children are presented with four boxes, each containing an unusual kitchen gadget. A nonsense word (“toma” or “neepa”) is randomly assigned to one of the gadgets, while the other three remain nameless. These nameless items are introduced with neutral language (“I’m going to show you what’s in here, let’s see what’s in here, I’ll show you this one”). The target words are introduced in matched phrases that contain the novel word (“I’m going to show you the toma, let’s see the toma, I’ll show you the toma”). The
children play a hiding and finding game over three rounds, receiving exactly 9 exposures to the target word. Children play the game in two conditions (also counterbalanced): 1) a direct teaching condition, and 2) an overhearing condition. In the overhearing condition, the child sits in a designated spot at the side and plays a quiet game with a second experimenter. The child’s mother plays the game with the experimenter, and receives 9 exposures to one of the nonsense words (toma or neepa). Following each condition, the child is tested for comprehension and production of the target word, along with a trial designed to check for toy preferences. In the overhearing condition, we seek to determine if the child listens in on the mother’s learning game to learn her word. Both conditions are recorded using digital video, and behaviors that appear to be relevant to word learning, along with looking behaviors are coded. For example, in the overhearing condition, some children alert as soon as the novel word is mentioned. This shows that they are “novelty detectors,” who appear to be aware that words are special. Some children ask for the names of non-named objects, showing awareness that “things are supposed to have names.” Some children respond differentially with language responses on the target trials, again showing an awareness that “words are special.”

Preliminary data from this currently ongoing study are shown in figure 6. To date, the experiment has been completed with 27 NH children (mean age = 31.1 months) and 15 children with HL (mean age = 42.6 months). Four response patterns are possible (no words learned, learning in direct teaching only, learning in overhearing only, or learning novel words in both conditions). Over half of the NH children showed evidence of fast mapping the novel word, but did so in the direct condition only. In contrast, over half of the children with HL did not show evidence of fast mapping. That is, they did not learn words in either condition. On the positive side, however, several children with HL learned words in BOTH conditions, demonstrating that some of these children are accessing overhearing as a route to word learning. More subjects are needed in this group, so the work is continuing. However, a common denominator among the children with HL who succeeded in overhearing was age-appropriate receptive vocabulary skills. Additional factors (attention, perceptual abilities, executive function, ability to divide attention, ease of listening) may be involved, so further research is needed. It is encouraging, however, to note that some young children with HL were able to perform this task in a quiet setting.

To gain a better understanding of child behaviors that may signal learning through overhearing, we completed interviews with 60 mothers of NH children (aged 2.0–3.6 years). They were asked to provide examples of their young children learning words by overhearing or instances of the child listening in on conversations in various contexts (e.g., from other rooms, in the car). This project seeks to analyze maternal responses with the goal of identifying new research questions related to overhearing behaviors. Results on NH children are being compared to the reports from mothers of children with HL. To date, we have completed 20 interviews with these families, whose children range in age from 2.9–5.8 years. Some preliminary findings are summarized in table 2. Mothers of the NH children were easily able to report multiple examples of words their children learned through overhearing. Mothers of children with HL provided a few examples, but this task was more challenging for them in general. Eighty percent of the mothers of NH children reported that their children listen in on conversations from another room. The social-affective nature of these instances was obvious in their
answers. They reported that their children become upset about parents arguing, or sharing something private about their children. In response, children would say, “Stop it, mom and dad,” or “Mommy, don't talk about that!” In contrast, only 25% of the parents of the children with HL observed listening in from another room. One mother reported that her son listens in, but he “gets the message all wrong.” Mothers also were asked if the child picked up special words or phrases used in the family. NH-2-year-olds were observed to use such terms, but they were typically phonologically simple forms (boo-boo, pee-pee). 3-year-olds with NH were reported to use many terms and phrases, which appeared to be phonologically complex (better get crackalackin). Reports for children with HL comprised phonologically simple forms. When asked about overhearing in the car, 85% of mothers reported that their NH children do so. These mothers reported the need to whisper or curtail conversations to keep “little ears from listening in” on certain conversations. Only 20% of the parents of children with HL reported them listening in or joining conversations in the car. The majority of parents characterized the car as a challenging listening situation. This may be a context where FM system use should be considered for young children (See chapter 14 by Stelmachowicz in this volume).

Summary

Many developmental ingredients contribute to children’s increasing sophistication as word learners (Hollich et al. 2000; Bloom and Tinker 2001). Many children with HL are slower than NH children to develop early words, and acceleration in the pace of learning is reported to be later (Mayne et al. 2000; Moeller et al. 2007b). Given the consistent reports of wide ranges in vocabulary outcomes in this population, there is a critical need to understand factors that contribute to these individual differences. Preliminary answers to three primary questions raised in this paper follow:

1. Do delays in vocal/phonetic development influence word learning? Our work suggests that the answer is “yes,” for some early-identified children with hearing loss. Initial stages of vocal and verbal development may take longer, yet positive outcomes still can be realized. Transitions between stages are of interest.

2. Do certain factors limit auditory experience? Our data suggest that variables like consistency of device use and quality of intervention are influencing outcomes. They require further study.

3. Do children with HL access overhearing as a route to word learning? Some children with strong vocabulary skills are able to do so in quiet settings. Research is needed to explore children’s ability to access incidental learn in complex listening situations. As we look to the future, it is critical to address several research gaps. Relatively little is known about the perceptual foundations to word learning in this population, and it is encouraging that a number of laboratories are currently exploring these issues. There is a need to understand how perception informs production in infants with HL. Further, we need to understand strategies parents use to support communication during transitional stages, as this may lead to specific strategies that can be used in early interventions. In addition, there is a pressing need to understand the nature of challenges to infant device use, and to develop specific resources that will aid parents in addressing these challenges. Finally, it is too often assumed that “early intervention” is a single entity. There is a critical need for in-

Table 2: Key points from maternal overhearing interviews.

<table>
<thead>
<tr>
<th>Report Category</th>
<th>NH (n = 60) (2.0 – 3.6)</th>
<th>HI (n = 20) (2.9 – 5.8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning words by Overhearing</td>
<td>Numerous specific examples</td>
<td>Few/some</td>
</tr>
<tr>
<td>Listen In from other room</td>
<td>80% observe this Social affective responses</td>
<td>25% observe this</td>
</tr>
<tr>
<td>Use “family” words</td>
<td>“boo-boo” to “get crackalackin’” simple forms reported</td>
<td></td>
</tr>
<tr>
<td>In the car</td>
<td>85% report “listening in; Whisper, curtail conversations</td>
<td>20% report listening in</td>
</tr>
</tbody>
</table>
tervention studies that explore quantitative (frequency, intensity) and qualitative (specialized vs. generic, characteristics of providers) dimensions of service provision, and how these characteristics interact with family and child factors. Collectively, these efforts will contribute to the goal of optimizing early learning in children with hearing loss.

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