Research Article

Detecting and Learning New Words: The Impact of Advancing Age and Hearing Loss

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Purpose: Lexical acquisition was examined in children and adults to determine if the skills needed to detect and learn new words are retained in the adult years. In addition to advancing age, the effects of hearing loss were also examined.

Method: Measures of word recognition, detection of nonsense words within sentences, and novel word learning were obtained in quiet for 20 children with normal hearing and 21 with hearing loss (8–12 years) as well as for 15 adults with normal hearing and 17 with hearing loss (58–79 years). Listeners with hearing loss were tested with and without high-frequency acoustic energy to identify the type of amplification (narrowband, wideband, or frequency lowering) that yielded optimal performance.

Results: No differences were observed between the adults and children with normal hearing except for the adults’ better nonsense word detection. The poorest performance was observed for the listeners with hearing loss in the unaided condition. Performance improved significantly with amplification to levels at or near that of their counterparts with normal hearing. With amplification, the adults performed as well as the children on all tasks except for word recognition.

Conclusions: Adults retain the skills necessary for lexical acquisition regardless of hearing status. However, uncorrected hearing loss nearly eliminates these skills.

The assembly of an effective vocabulary is considered a fundamental accomplishment of childhood. A child’s vocabulary is compiled slowly at first and increases exponentially through the grade school years (Bloom, 2001). Most new words are learned through repeated instruction from parents and teachers and through passive exposures to the conversations of others (Akhtar, 2005; Akhtar, Jipson, & Callanan, 2001; Martinez-Sussmann, Akhtar, Diesendruck, & Markson, 2011). By early adulthood, vocabulary size is estimated to be between 15,000 and 200,000 words depending on the manner in which a word is defined (D’Anna, Zechmeister, & Hall, 1991). According to Oxford Dictionaries, the English language consists of approximately 250,000 unique words 1 with as many as 1,000 new words or new definitions of existing words added each year, while hundreds of other words are removed. Haviland Ferguson Reves (1926) suggested that the birth and life expectancy of a new word is somewhat unpredictable because it can rise in popularity quickly, and then it either “dies in the obscure corners of forgotten words and unabridged dictionaries, or passes into legitimate speech” (p. 261). Simply put, new words are created and adopted into everyday dialogue, or they are used for a time and then forgotten as their relevance diminishes. Either way, the dynamic nature of the English language requires regular updates to vocabulary throughout the lifespan in addition to words learned in childhood. To achieve a moderately sized vocabulary of 50,000 words, a 21-year-old adult would have to learn 7.6 words every day for 18 years beginning at the age of 2 years. After that, an adult would need to learn two to three new words every day for the rest of his or her life to keep the vocabulary current.

It is also the case that adults learn words as they become necessary at different stages of life. For example, young adults learn new terminology related to specific professions through academic or on-the-job training, whereas older adults often learn new terminology as their health changes with advancing age (e.g., symptoms, medical procedures, diagnoses, medications; Leach & Samuel, 2007). An inability to update lexical knowledge throughout adulthood may cause communication to become increasingly

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1 en.oxforddictionaries.com/explore/how-many-words-are-there-in-the-english-language

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and incrementally outdated within the current lexical landscape.

How Words Are Learned

According to a word recognition and learning framework proposed by Pittman and Rash (2016), the recognition of a familiar word and the learning of a new word share similar processes. The framework was conceived by commandeering the lexical neighborhood model (Luce & Pisoni, 1998) and adding components for the processing of unknown words. Figure 1 shows a simplified version of this merger. The first step in the perception of any spoken word is an analysis of its acoustic and phonetic content. The product of that analysis is then processed for recognition by comparing it to known words. Depending on the similarity of the input to other words in the vocabulary (lexical neighbors), several words sharing the same acoustic and phonetic pattern may be identified. Lexical processing continues until the closest possible match is determined with a reasonable level of certainty. Incorrect identification may reflect the degree of distortion imposed by the listening condition or the listener’s hearing sensitivity.

Perception of an unknown word begins in the same fashion, but lexical processing will yield few if any viable word matches. When this occurs, the opportunity exists to learn something about the unknown word and add it to the inventory of known words. Configuration of a new word involves the integration of the acoustic analysis with metadata from the listener’s lexicon. Essentially, a meaningful representation of a new word is created by combining the acoustic and phonetic properties with the meaning of the word derived from the context in which it occurred. A representation of the new word is then entered into the lexicon awaiting additional exposures that will allow refinement of the acoustic and semantic properties.

Figure 1. Schematic of the word recognition and learning framework created by merging the neighborhood activation model (Luce & Pisoni, 1998) with an emerging model of word learning (Gray, Pittman, & Weinhold, 2014; Leach & Samuel, 2007; Storkel & Lee, 2011).

Several aspects of this framework have been examined both directly and indirectly over the last 100 years. The largest literature involves the recognition of known words by individuals of all ages in a variety of listening environments. In general, recognition of known words has been shown to improve with age in childhood (Ren et al., 2015; Rigler et al., 2015), to decrease as hearing sensitivity decreases (Lash, Rogers, Zoller, & Wingfield, 2013; Moulin et al., 2016), and to be poorer in noise than in quiet (Bent & Atagi, 2015; Gordon-Salant, Yeni-Komshian, & Fitzgibbon, 2010). Less is known about the influence of these factors on listeners’ ability to detect and learn new words, especially in adult populations.

Research suggests that adults are able to detect and learn new words and to recall new words after a period of sleep (Kurdziel, Mantua, & Spencer, 2016; Weighall, Henderson, Barr, Cairney, & Gaskell, 2016). Additionally, new words can be misperceived for other words already known to the listener in environments that contain noise (Rogers & Wingfield, 2015). Finally, the likelihood of learning a new word increases with exposure to the word (Szmalec, Duyck, Vandierendonck, Mata, & Page, 2009) and if it shares phonemes with many known words rather than with just a few (Vitevitch, Storkel, Francisco, Evans, & Goldstein, 2014).

The Vulnerability of Hearing Loss

Much of the research regarding the effects of hearing loss on word learning has been conducted in children. This research was motivated by the significantly smaller vocabularies in children with hearing loss compared with their peers with normal hearing (Blamey et al., 2001; Pittman, Lewis, Hoover, & Stelmachowicz, 2005). This disparity suggests that hearing loss somehow constrains children’s ability to detect and learn new words. Fortunately, amplification improves children’s identification of words that they do not know when presented in isolation or in the context of a sentence (Pittman & Rash, 2016; Pittman & Schuett, 2013; Pittman, Stewart, Odgear, & Willman, 2017). Detection of unknown words is a critical prerequisite to learning new words for both children and adults. If listeners cannot detect that a specific word is unknown to them, they will miss the opportunity to learn that word. Once new words are detected, children with hearing loss are in a position to learn these words as quickly as children with normal hearing when provided with appropriate amplification (Pittman, 2008, 2011; Pittman et al., 2005, 2017).

Purpose

The purpose of this project was to examine the impact of advancing age, hearing loss, and amplification on listeners’ ability to recognize familiar words and to detect and learn new words. The performance of adults with

2The extant literature contains hundreds of references for these effects. The references provided are the recent demonstration of these effects.
hearing loss in unaided and aided listening conditions was compared with their pediatric counterparts as well as with their peers with normal hearing. It was hypothesized that if the detection and learning of new words is retained in the adult years, then adults will perform as well as children. It was also hypothesized that if hearing loss impairs the detection and learning of new words, then the effects of hearing loss would be similar for both adults and children. If these hypotheses are supported, the results will provide evidence that lexical development continues into the adult years and that uncorrected hearing loss may place adults, like children, at risk for slow adoption of new words in rapidly changing lexical environments.

Method

Participants

Seventy-three individuals participated in this study. They included 15 adults with normal hearing (50–67 years, mean = 57.7 years, SD = 5.2 years), 17 adults with hearing loss (52–78 years, mean = 65.8 years, SD = 5.5 years), 20 children with normal hearing (8–12 years, mean = 10 years, SD = 1.5 years), and 21 children with hearing loss (8–12 years, mean = 9.5 years, SD = 1.2 years). Figure 2 shows the average (±1 SD) unaided free-field hearing thresholds for the children and adults with hearing loss (filled and open squares, respectively). The gray area represents the minimum and maximum free-field hearing thresholds of the children and adults with normal hearing combined.

Stimuli

The stimuli for each task were produced by the same adult female voice and recorded in a 9’ × 12’ double-walled sound booth. The stimuli were recorded at a sampling rate of 44.1 kHz, 16-bit resolution using a microphone with a flat frequency response to 10 kHz (AKG, C535EB). The speech samples were digitized and edited into individual .wav files using Adobe Audition v1.5 and equated for root-mean-square level by the experimental software upon presentation. A sufficient number of stimulus lists were created so that no lists were repeated. In the event that the lists were not equivalent in difficulty (unknown for some tasks), the lists were counterbalanced across listening and hearing aid conditions. All stimuli were low-pass filtered at 10 kHz for presentation with the exception of one amplification condition (see below).

Word Recognition

Participants repeated aloud sets of 25 words from the NU-6 word-recognition test (Tillman & Carhart, 1966). Each participant’s verbal responses were captured with a digital audio recorder (Olympus, WS 801/802) coupled to a head-worn microphone (Shure, WH20) positioned approximately 2 in. from the corner of the speaker’s mouth. Responses were scored as either correct or incorrect by two independent examiners. Differences in scores between the two listeners were reconciled by a third listener. Differences never exceeded one test item (4%). No reinforcement was provided for this task.

Nonword Detection

For this task, participants were instructed to count the number of nonsense words embedded within short sentences (Pittman & Schuett, 2013). Each sentence contained four 1-syllable words that were arranged in a semantically and grammatically correct fashion. Each list contained 15 sentences composed of equal numbers of sentences having zero, one, and two nonsense words. The nonsense words were created by substituting a phoneme with a real word to make the word anomalous. The nonsense words occurred in each position within the four-word sentences, including sentences with two nonsense words.

Sentences were selected and presented at random without replacement. Participants indicated their responses by selecting the appropriate number displayed on individual buttons on a computer monitor (e.g., 0, 1, 2, and 3). Examples include “Fat frogs swim well” (no nonsense words), “Birds rake long worms” (one nonsense word), and “Bug gites will titch” (two nonsense words). Although no sentences contained more than two nonsense words, the option to select three nonsense words was offered as a foil. Reinforcement was provided via a video game interface that advanced one step for each correct response. Overall performance was calculated as the percentage of sentences for which the correct number of nonsense words was perceived.

Rapid Word Learning

For this task, participants learned novel names for unfamiliar images (Pittman, 2008, 2011). The images
Participants with hearing thresholds < 80 dB HL were fit binaurally with Oticon Alta receiver-in-the-canal mini behind-the-ear (BTE) devices to provide extended bandwidth amplification. The hearing aids were programmed according to Desired Sensation Level adult- or child-fitting parameters (Scollie et al., 2005) using the participant’s hearing thresholds and real-ear-to-coupler differences obtained during the unaided test session. All fittings were adjusted as necessary at the beginning of the aided testing session using real-ear measurements for soft, average, and loud recorded speech inputs (Verifit, Audioscan). Hearing aid output was within 5 dB of the prescribed targets for the average values of the long-term speech spectrum. To achieve the broadest possible bandwidth of amplification, gain at 8 kHz was adjusted to provide at least 5 dB of sensation for a soft-level input (55 dB SPL). During testing, the stimuli were low-pass filtered at 10 kHz for presentation. Because high-frequency energy is restricted by the tubing in many BTE instruments (Gustafson, Pittman, & Fanning, 2013), a narrowband condition was presented as well by low-pass filtering the stimuli at 4 kHz. The bandwidth condition yielding the highest performance was determined for each participant and used for statistical analyses.

Participants with hearing thresholds > 80 dB HL were fit binaurally with Phonak Bolero Q70-P BTE devices to provide NLFC. These hearing aids were also programmed according to Desired Sensation Level adult- or child-fitting parameters (Scollie et al., 2005), and the compression parameters for the NLFC were calculated using the Frequency-Lowering Fitting Assistant (Alexander, 2014). This was accomplished by first determining the output of the hearing aid for an average speech input (65 dB) with the frequency compression turned off. The frequency at which the average amplified output equaled the hearing threshold was entered into the Fitting Assistant. The cutoff frequency and compression ratio values from the manufacturer’s fitting software were also entered into the Fitting Assistant. These parameters were then adjusted to achieve the optimal amplified bandwidth represented in the compressed signal. Like high-frequency amplification, it was expected that some participants would benefit from NLFC, whereas others would not (Glista et al., 2009). To determine the optimal amplification setting for each participant, the settings for this feature were saved to two memories with NLFC enabled in one memory but not in the other. The devices were then paired with a remote control. To reduce examiner bias, one research assistant programmed the hearing aids and randomly assigned the amplification feature to one of the two memories. A second research assistant conducted the behavioral tests without knowledge of the content of the memories. The remote control was operated by the examiner at all times. The participant confirmed that the desired memory was enabled via the audible indicator provided by the device. The memory yielding the highest performance (NLFC on or off) was determined for each participant and used for statistical analyses.

Amplification Parameters

A pair of specific commercially available hearing aids was obtained from two manufacturers for this project to optimize amplification for listeners with a range of hearing losses in the high frequencies. Extended bandwidth amplification was provided to 10 adults and 19 children with hearing thresholds < 80 dB HL at 4 and 8 kHz, whereas nonlinear frequency compression (NLFC) was used to provide high-frequency information to seven adults and 10 children with thresholds > 80 dB HL at 4 and 8 kHz. All other features within the devices were disabled (e.g., feedback suppression, directional microphones), including all buttons (e.g., memory, volume control). Each participant received custom earmolds for use with the hearing aids chosen for them during testing.
Test Procedure and Analysis

Testing was conducted in a sound-treated room equipped with multiple loudspeakers as well as a computer monitor and mouse. The listeners were seated 1 m from a loudspeaker at 0° azimuth. The stimuli were presented at 54 dB SPL at the calibrated position within a sound-treated test booth. This presentation level is consistent with softer conversational speech but is fully audible to listeners with normal hearing. Also, this level reduced the occurrence of distortion due to amplitude compression in the hearing devices as well as the likelihood of floor effects in the performance of the listeners with hearing loss or ceiling effects for the listener’s with normal hearing.

Custom laboratory software was used to present the stimuli and record responses. The examiner entered responses for the word recognition task (correct, incorrect) while the participants interacted directly with the software for the other two tasks. On each trial, the software provided a 15-s response window. The interstimulus interval was 1 s if a response was entered or 15 s with no response. The parameters for each trial (stimulus, response, correct/incorrect/no response) were stored automatically after each trial for later analyses.

For statistical analyses, performance for the word recognition and nonword detection tasks was arcsine transformed to equalize the variance over the range of scores (Studebaker, 1985). Performance for the word learning task was expressed in values of speed (trials to criterion) as described above. For all analyses, there was no need to adjust the degrees of freedom to accommodate a lack of sphericity in the data.

This study was approved by the institutional review board at Arizona State University. Written consent was obtained from each adult participant, whereas informed assent was obtained from the children with written consent from their parents. Each test session lasted approximately 2 hr. Participants were paid $15 per hour for their efforts and were allowed to keep the custom earmolds made for them during the study. No other incentives were provided.

Results

Determining Optimal Performance

Figure 3 shows the performance of each child and adult with hearing loss (circles and triangles, respectively) in the wideband and NLFC conditions (filled and open symbols, respectively) as a function of their performance in the narrowband condition. The gray areas in the upper two panels represent the 95% confidence intervals modeled after the binomial theory (Thornton & Raffin, 1978), whereas the gray area in the lower panel represents the 95% confidence intervals calculated from the combined word learning rates of the children and adults with normal hearing. Data falling within these areas represent individuals whose performance was similar with both amplification settings. Data falling above or below the gray areas are individuals whose performance was better or worse, respectively, with NLFC or wideband amplification compared with narrowband amplification. Although a detailed report regarding the impact of bandwidth on overall performance for these tasks is reported in Pittman et al. (2017), these figures provide information regarding the effect of high-frequency
information to individual listeners. Specifically, listeners performed as well or better with high-frequency amplification for word recognition and learning, whereas benefit/detriment was more variable for nonword detection. Also, greater variability was observed for both the children and adults using NLFC for word recognition and nonword detection with less variability and correspondingly little benefit for word learning.

Based on these results, the amplification condition resulting in best performance was identified for each participant for each task. Across tasks, 20% of the participants performed best with narrowband amplification, 9% performed equally well, and 71% benefited from high-frequency amplification. Values associated with best performance in each task were submitted for statistical analyses. It should be noted, however, that optimal amplification was not always the same across tasks for each participant. Only three of the 18 adults and 10 of the 21 children performed optimally with the same amplification setting in all three tasks. Thus, performance was evaluated separately for each task as this approach to personalized amplification was somewhat artificial.

**Effects of Age and Hearing Loss**

Figure 4 shows average performance (±1 SE) as a function of group (hearing loss, normal hearing) and aided condition (unaided, aided). Results for word recognition, nonword detection, and word learning are shown in Panels A, B, and C, respectively, by age group (children, adults). Overall, the children and adults achieved similar performance for each task regardless of hearing status. As expected, the listeners with normal hearing achieved the highest performance on each task. The listeners with hearing loss performed poorly in the unaided condition and showed markedly improved performance with amplification. For some tasks, their performance in the aided condition was near or equivalent to that of their counterparts with normal hearing.

The scores obtained for each participant were subjected to repeated-measures multivariate analyses of variance with unaided and aided performance for each task as the dependent variables and age group (children, adults) and hearing status (normal, impaired) as fixed effects. To meet the requirements of the test, the scores for the listeners with normal hearing were used for analyses in the unaided and aided conditions. Table 1 shows the main effects of amplification, age, and hearing status for each task as well as two interactions that most directly inform the purpose of this study. Also shown is the effect size for each statistic ($\eta_p^2$), which indicates the proportion of variability in the dependent variable (i.e., performance in the unaided and aided conditions) that is accounted for by each of the fixed effects (i.e., age and hearing status). These values provide an additional metric with which to evaluate statistically significant results.

For each task, significant main effects were observed for amplification and hearing status but not for age. No Age × Hearing Status interaction was found for word recognition or for word learning, indicating that the adults performed as well as children on these tasks and according to their hearing status. The nonsignificant interaction of Amplification × Age × Hearing Status confirmed that both the children and adults with hearing loss benefited from amplification such that their performance on each task improved similarly. However, the significant Age × Hearing Status interaction for nonword detection indicates that the adults’ performance differed from that of the children’s in some fashion across hearing groups. One-way analyses of variance revealed a significant effect of age for the listeners with normal hearing, $F(1, 33) = 10.499, p = .003, \eta_p^2 = .241$, suggesting that the children with normal hearing had not yet reached adult levels of nonword detection. Similar
analyses for the listeners with hearing loss revealed no difference between the adults and children in the unaided, $F(1, 36) = 0.865, p = .36, \eta^2_p = .024$, or aided, $F(1, 37) = 1.27, p = .266, \eta^2_p = .034$, listening conditions. Further, the children with hearing loss performed as well as their counterparts with normal hearing, $F(1, 39) = 0.609, p = .44, \eta^2_p = .016$, whereas the adults with hearing loss did not, $F(1, 32) = 25.22, p < .001, \eta^2_p = .449$. These results indicate an advantage of age when detecting unfamiliar words within a sentence that is lost in the presence of hearing loss. Also, optimal amplification allowed the children in this age range to perform at the levels of their peers.

**Is Speech Perception Enough?**

Given the similar configuration of results across tasks for each age group, correlation coefficients were calculated between the word recognition and word learning results to determine if a listener’s ability to learn new words could be predicted from his or her ability to perceive speech accurately. Figure 5 shows the word learning speed for each child and adult as a function of their word recognition score. Both participants with normal hearing and participants with impaired hearing are included in the figure (open and filled symbols, respectively) as well as linear regression functions for each group. The distribution of data points extends over the full range of learning speed but only over half of the range of possible word recognition scores. In fact, most of the data fell within a narrow range of word recognition scores (85%–100%). A significant correlation was found between word recognition and word learning for the children ($r = .35, p = .028$) but not for the adults ($r = .29, p = .101$). Although significant, these correlation coefficients indicate that only 12% and 8% of word learning speed could be accounted for by word recognition in the children and adults, respectively. Thus, it appears that the accurate perception of familiar words is not sufficient to predict a listener’s ability to learn new words.

### Table 1. Results of the multivariate repeated-measures analysis of variance. Bold font indicates $p < .05$.

<table>
<thead>
<tr>
<th>Task</th>
<th>Main effect/interaction</th>
<th>df</th>
<th>$F$</th>
<th>$p$</th>
<th>$\eta^2_p$</th>
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<td>.595</td>
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<td>Hearing status</td>
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<td>121.00</td>
<td><strong>.000</strong></td>
<td>.647</td>
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<td>.928</td>
<td>.000</td>
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<tr>
<td></td>
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<td>.864</td>
<td>.000</td>
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<td>3.22</td>
<td>.077</td>
<td>.047</td>
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<tr>
<td>Nonword detection</td>
<td>Amplification</td>
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<td>.519</td>
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<td><strong>.004</strong></td>
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<td>1, 70</td>
<td>2.01</td>
<td>.161</td>
<td>.028</td>
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</table>

**Discussion**

Recall that the purpose of this project was to examine the impact of advancing age, hearing loss, and amplification on listeners’ ability to recognize familiar words, detect unknown words, and learn new words. It was hypothesized that if the ability to detect and learn new words is retained in the adult years, then the adults would perform as well as the children. With one exception, both the adults with normal hearing and adults with impaired hearing were able to detect new words as accurately, and learn them as rapidly, as their pediatric counterparts. Thus, this hypothesis was confirmed. It was also hypothesized that if hearing loss impairs the detection and learning of new words, then the performance of both the adults and children with hearing loss would be reduced equally compared...
with the listeners with normal hearing, which was also confirmed. Fortunately, the use of amplification improved the performance of both groups to levels near or equivalent to that of their peers with normal hearing. It should be noted that the adults with hearing loss were, on average, 9 years older than their counterparts with normal hearing, which may have contributed to their poorer performance for word recognition and nonword detection. Overall, these results indicate that adults with and without hearing loss retain the skills necessary to continue their lexical development. However, uncorrected hearing loss appears to nearly eliminate these skills, potentially constraining the efficient and rapid updates to vocabulary knowledge that many communication environments demand.

One interesting question arising from these results is how nonword detection and word learning might be affected when hearing loss is uncorrected. Pittman and Schuett (2013) found that children were more likely to miss unknown words within sentences, presumably because they repaired the nonsense words into real words to fit the context of the sentence. In a follow-up study, Pittman and Rash (2016) used an auditory lexical decision task to confirm that children with hearing loss are more likely than children with normal hearing to unknowingly repair nonsense words into real words. These same errors may occur in adults as well. Rogers and Wingfield (2015) found that older adults (65–85 years) were more likely than younger adults (18–21 years) to misperceive real words presented in pairs based on the semantic context of the pair. For example, older adults were more likely than younger adults to misperceive “row-goat” as “row-boat.” Although hearing loss was not measured directly or accommodated in this study, presentation levels were adjusted to normalize performance across groups. The older listeners’ tendency to repair words to fit the context of the stimuli remained and is similar to the repair strategies observed in children. The authors concluded that this tendency was likely due to a history of successful repair in everyday conversation. Pittman and Schuett (2013) suggested that the same was true for children and added that such repair strategies are both an advantage and a disadvantage to individuals with hearing loss; that is, repair strategies may improve perception of familiar words in conversation, but these same strategies may prevent the detection of unknown words in the same conversation, resulting in missed opportunities for further lexical development.

It should be noted, however, that several factors governing word learning were not addressed in the present study. First, the listener’s current lexical knowledge was not evaluated. The speed with which children are able to learn new words has been shown to be directly related to the size of their vocabularies (Pittman et al., 2005). Second, cognitive factors (e.g., working memory capacity, processing speed) were not measured and can influence a listener’s ability to parse nonsense from real stimuli as well as acquire new words (Hansson, Forsberg, Lofqvist, Maki-Torkko, & Sahlen, 2004; Stiles, McGregor, & Bentler, 2012). Finally, the adults with hearing loss were nearly 10 years older than that of their peers with normal hearing, which may have been accompanied by auditory and cognitive changes. Although the hypothesis was supported by statistically robust results, additional analyses involving these three factors may provide the opportunity for a more nuanced interpretation of the results reported here.

Although the manner in which hearing loss impacts lexical development is an interesting topic for further examination, the impact of impaired word learning on overall communication may be a more important area for future research. Opportunities to learn new words occur in a variety of situations where adults are expected to navigate new information (e.g., on-the-job training, foreign language learning, interaction with skilled workers and professionals). Almost nothing is known about the effect of acquired hearing loss in these situations. The results of the present study indicate that, uncorrected hearing loss in adults, like children, slows the uptake of new words significantly despite direct interaction with the acoustic and visual stimuli. As opportunities to learn new words are lost, one possible outcome for adults is a slow and incremental decline in new vocabulary that may impair their ability to interact effectively with others in their environment.

These results also suggest that optimally fit hearing aids are an effective remedy for hearing loss in adults, just as they are for children. Unfortunately, adults with hearing loss often wait years before adopting their first hearing aid(s) (Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007; Kochkin, 2012). A common perspective of adults who do not adopt hearing aids is that their hearing loss is not poor enough to warrant the expense (Meyer & Hickson, 2012). It is possible that they are unaware of the amount of new information that is generated on a regular basis and that personal amplification could help them keep pace with that information. Instead, they may attribute the difficulty they experience when perceiving or retaining new information to declining cognitive skills rather than to hearing loss. Regardless of the role that learning plays in the uptake of hearing aids, any delay may gradually and increasingly impair communication as the cumulative vocabulary knowledge of others exceeds their own.

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