IS GOOD SPEECH PERCEPTION SUFFICIENT FOR LEARNING NEW WORDS?

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STATEMENT OF SUPPORT

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Research Assistants (The Pitt Crew)
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American Speech-Language-Hearing Foundation

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Isn’t good speech perception enough?
Adults with hearing loss expect amplification to help them restore communication.

Children receive amplification to help them learn to communicate.
LEARNING NEW INFORMATION

Children
School

Adults
Names (people)
Medical terms (condition/medications)
Places/locations (addresses)
Technical terminology (ipad, iphone, chip)
On-the-job training
Second-language learners
DO WE CONSIDER NEW INFORMATION IN OUR EVALUATIONS?

Hearing Handicap Inventory for Adults
Scores for social and emotional impact

Hearing Handicap Inventory for the Elderly
Scores for situational and emotional impact

Hearing Handicap Inventory Screening Questionnaire for Adults
Score indicating probability of hearing impairment

#3 Do you have difficulty hearing/understanding co-workers, clients, customers?
HOW CAN WE QUANTIFY LEARNING NEW INFORMATION?

Oxford dictionary of American English:
1000+ new entries each year

1. new words
2. new definitions to existing words
Merriam-Webster Dictionary

Database started in the 1880s
15.7 million words

To be included in the database, the new word must be used in a substantial number of citations that come from a wide range of publications over a considerable period of time.

http://www.merriam-webster.com/help/faq-words-into-dictionary
D’Anna, Zechmeister, & Hall (1991)

The average undergraduate student knows between 15,000 and 200,000 words.

Their vocabulary test excluded:

- abbreviations
- affixes
- interjections
- scientific words
- slang
- hyphenated words
- contractions
- foreign words
- technological words

NEW WORDS I LEARNED THIS WEEK

Twentysomething: Someone caught in waithood, waiting for adulthood to happen

Waithood: A debilitating state of helplessness and dependency

Twixter: Someone caught between adolescence and adulthood

NEET: Not in education, employment, or training
Children have a lot of word-learning to do.

- 50,000 word vocabulary
- learned over 18 years (3 to 22 years)
- = 7 new words everyday

Adults need to update their vocabularies as well.

- 1,000 new words per year
- = 3 new words every day
Older adults outperformed younger adults on standardized vocabulary tests (Verhaeghen, 2003).

Flynn Effect (Flynn, 1987): Scores increase with age due to a cohort effect that favors the earlier born.

Henriksen’s (1999) lexical knowledge model:
1. Size - how many words are known
2. Depth - how well the words are known
3. Mastery - comprehension and production of the words
# UPDATES TO ADULT VOCABULARY

<table>
<thead>
<tr>
<th>Word Type</th>
<th>#</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longstanding word with</td>
<td>15</td>
<td><strong>Aghast</strong>: Filled with horror or shock</td>
</tr>
<tr>
<td>established definition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longstanding word with</td>
<td>15</td>
<td><strong>Ship</strong>: The desire of a fan for two fictional characters to be in a</td>
</tr>
<tr>
<td>new definition</td>
<td></td>
<td>romantic relationship</td>
</tr>
<tr>
<td>New word</td>
<td>15</td>
<td><strong>Senioritis</strong>: Affliction of students in their final year of high school</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or college, characterized by a decline in motivation or performance.</td>
</tr>
<tr>
<td>Nonsense word</td>
<td>5</td>
<td><strong>Desill</strong></td>
</tr>
</tbody>
</table>
1. **Voluntourism**
   a) To freely offer services in support of a cause.
   b) The commercial organization of vacations and visits to places of interest.
   c) To enter into the military service voluntarily.
   d) A form of tourism in which travelers voluntarily participate in humanitarian work.
   e) I don’t know.
2. **Affirmative**
   a) To have an effect on; to make a difference to
   b) Agreeing with a statement or a request
   c) Making an assertion
   d) To move someone emotionally
   e) I don’t know
UPDATES TO ADULT VOCABULARY

OVERALL PERFORMANCE

Age Groups | n
---|---
20-39 yrs | 68
40-59 yrs | 63
60-74 yrs | 13
Total | 144

Proportion Correct

<table>
<thead>
<tr>
<th>Generation</th>
<th>30</th>
<th>50</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion Correct</td>
<td>0.46</td>
<td>0.47</td>
<td>0.47</td>
</tr>
</tbody>
</table>

p > .05

Pittman and Stahl (in process)
UPDATES TO ADULT VOCABULARY

**NONSENSE**

- 30: 0.88
- 50: 0.87
- 70: 0.83

Proportion Correct

**ESTABLISHED WORDS**

- 30: 0.37
- 50: 0.42
- 70: 0.46

Proportion Correct

**NEW WORDS**

- 30: 0.65
- 50: 0.59
- 70: 0.52

Proportion Correct

Pittman and Stahl (in process)

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UPDATES TO ADULT VOCABULARY

Conclusions:
1. Vocabulary knowledge is generational
2. Younger adults know fewer (or less about) longstanding words than older adults
3. Older adults know fewer new words than younger adults
Implications:

1. To communicate effectively with younger generations, older adults will need to learn new words.

2. Adults who are at risk for learning new words (e.g., hearing loss) may have the greatest difficulty with every-day communication.
WHAT ARE THE EFFECTS OF AGE AND HEARING LOSS ON WORD LEARNING?

PITTMAN, STEWART, ODGEAR & WILLMAN (IN REVIEW)
NEW WORD DETECTION AND LEARNING MODEL

Stimulus Input

Acoustic Pattern Analysis

Known Words

Recognize?

Next Word

Stimulus Input

Integration

Configuration

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If detection and learning of new words is retained in the adult years, then…

1) adults should perform as well as children

2) the effects of hearing loss should have the same effect in both adults and children
METHODS

Adults:
15 NH (50-67 years)
17 HL (52-78 years)

Children
20 NH (8-12 years)
20 HL (8-12 years)
Tested with two forms of high-frequency amplification:

1) Narrowband (standard)
2) Wideband
Tested with two forms of high-frequency amplification:

1) NLFC off (standard)
2) NLFC on

Thresholds >80 dB HL at 8 kHz
WORD LEARNING MODEL

1. Stimulus Input
2. Acoustic Pattern Analysis
3. Integration
4. Configuration
5. Recognize?
   - Known Words
   - Next Word

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WORD RECOGNITION
BEST PERFORMANCE

![Graph showing word recognition best performance with high-frequency amplification and standard amplification. The graph includes different markers and lines indicating non-linear frequency compression and bandwidth.]

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WORD RECOGNITION

Performance (% correct)

- Children
- Adults

Unaided

Aided

Hearing Loss

Normal

Hearing

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NEW WORD DETECTION AND LEARNING MODEL

- **Configuration**
  - **Stimulus Input**
  - **Acoustic Pattern Analysis**
  - **Known Words**
    - **Recognize?**
      - no
      - yes
        - **Next Word**
  - **Integration**

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Clocks tick on time.

Birds *rike* long worms.

*Dats* catch slow *bice*.
NON-WORD DETECTION
BEST PERFORMANCE

- High-Freq Amplification (% correct)
- Standard Amplification (% correct)

▲ Non-linear frequency compression
● Bandwidth

HIC
HIA

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NON-WORD DETECTION 1.0

Performance (% correct)

- Children
- Adults

Unaided
Aided
Normal
Hearing Loss
Hearing

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Conclusions

1. Adults detect new words as well as, or better than, children
2. Like children, hearing loss reduces their ability to detect unknown words
3. Like children, amplification improves their non-word detection
Clocks tick on time.

Birds *rike* long worms.

*Dats* catch slow *bice*.
## Signal Detection Theory

<table>
<thead>
<tr>
<th></th>
<th>Nonsense</th>
<th>Real</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonsense</strong></td>
<td>HIT</td>
<td>FALSE ALARM (MISPERCEPTION)</td>
</tr>
<tr>
<td><strong>Real</strong></td>
<td>MISS (REPAIR)</td>
<td>CORRECT REJECTION</td>
</tr>
</tbody>
</table>
EFFECTS OF HEARING LOSS

Adults

Children

Binuaral Free-Field PTA (.5,1,2,4 kHz)

D-Prime

NHA

Unaided

NHC

Unaided

Pittman, Daliri, et al (in process)

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EFFECTS OF AMPLIFICATION

**Adults**

**Children**

---

Pittman, Daliri, et al (in process)

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BONE-CONDUCTION COUPLING

Performance (d prime)

<table>
<thead>
<tr>
<th></th>
<th>Softband</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COCHLEAR IMPLANT + HEARING AID

Performance (d-prime)

CI only

Bimodal

Pittman & Luo (in process)
NON-WORD DETECTION 3.0

<table>
<thead>
<tr>
<th># of nonsense words</th>
<th>Example phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>He was short.</td>
</tr>
<tr>
<td>1</td>
<td>He was dort. Ve was short. He tuz short.</td>
</tr>
<tr>
<td>2</td>
<td>Ve tuz short. He tuz dort. Ve was dort.</td>
</tr>
<tr>
<td>3</td>
<td>Ve tuz dort.</td>
</tr>
</tbody>
</table>
51 NH adults (19-50 years)

Steady-state noise
NEW WORD DETECTION AND LEARNING MODEL

Stimulus Input

Acoustic Pattern Analysis

Recognize? yes no

Known Words

Configuration

Integration

Next Word

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RAPID WORD LEARNING
RAPID WORD LEARNING

\[ P_c = 1 - 0.84e^{-n/c} \]

Learning Speed:
3 = 1 trial (perfect learning)
2 = 10 trials
1 = 100 trials
0 = 1000 trials (no learning)
WORD LEARNING
BEST PERFORMANCE

High-Freq Amplification (learning speed)

Standard Amplification (learning speed)

- HIC
- HIA

△ Non-linear frequency compression
● Wide-band amplification

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RAPID WORD LEARNING

Performance (learning speed)

- Children
- Adults

Unaided Hearing Loss

Normal Hearing

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IS RAPID WORD LEARNING REAL WORD LEARNING?

96 NH Adults (19-43 years)

Training

Retention Post Test

Word Bank

<table>
<thead>
<tr>
<th>Sentop</th>
<th>Nushtul</th>
<th>Pedsoet</th>
<th>Homtul</th>
<th>Kaystill</th>
<th>Podtep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doztul</td>
<td>Stomul</td>
<td>Stomun</td>
<td>Pedton</td>
<td>Doznud</td>
<td>Gaystill</td>
</tr>
<tr>
<td>Daystin</td>
<td>Stillmay</td>
<td>Depton</td>
<td>Smentos</td>
<td>Maystill</td>
<td>Maysttin</td>
</tr>
<tr>
<td>Sothnud</td>
<td>Tayskit</td>
<td>Fosmud</td>
<td>Kensom</td>
<td>Smenkop</td>
<td>Gaysmit</td>
</tr>
<tr>
<td>Fosnush</td>
<td>Homstun</td>
<td>Kitstin</td>
<td>Kentop</td>
<td>Depmost</td>
<td>Kayskim</td>
</tr>
</tbody>
</table>

Your answer  Your answer

Wright, Pittman, Wright (in process)
RAPID WORD LEARNING IS REAL WORD LEARNING

Performance (% correct)

Trials

Training
Retention

Wright, Pittman, Wright (in process)
1. New word learning is not a perishable skill. Adults are able to learn new words as rapidly as children.

2. Hearing loss impairs/slow word learning equally and significantly in both children and adults.

3. Normal or near-normal performance can be achieved with optimal amplification.
IS GOOD SPEECH PERCEPTION SUFFICIENT FOR LEARNING NEW WORDS?

Learning Speed vs. Word Recognition

- HIC
- HIA
- NHC
- NHA

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The end