The Effect of Noise on Adults' Word Learning

Min Kyung Han *Holly L. Storkel* *Casey Cox*

University of Kansas

Background

- Previous studies have revealed the effects of word characteristics such as neighborhood density and phonotactic probability on word learning.
  - Neighborhood density: the number of similar sounding words
  - Phonotactic probability: the likelihood of occurrence of a sound sequence
- Storkel, Armbruster, and Hogan (2006) found that adults learned high density words and low probability words more accurately.
- However, little is known about how background noise encountered in our daily lives influences these effects of word characteristics on word learning.

Purpose

- To investigate how neighborhood density and phonotactic probability influence adults' word learning in two noise conditions (i.e., typical vs. challenging)

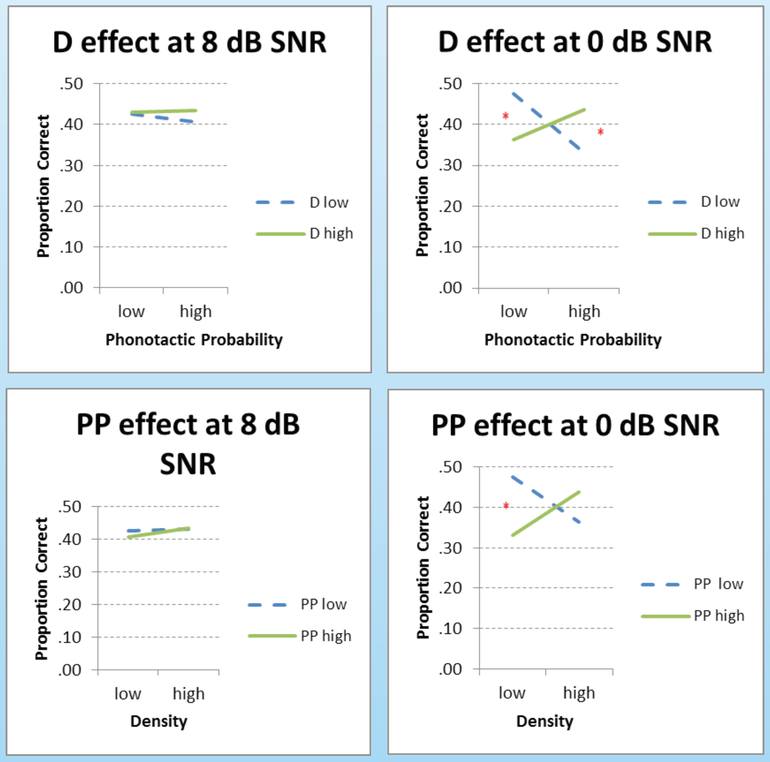
Methodology

- Participants: 58 college students
- Materials:
  - the same materials as used in Storkel et al. (2006)
  - 16 CVC nonwords varying in neighborhood density and phonotactic probability
  - 16 novel objects created or taken from children's stories paired with 16 nonwords
- SNRs: Nonword stimuli were digitally mixed with broadband white noise at +8 and 0 dB SNR using Matlab®
- Procedures: Participants were exposed to the nonword-object pairs in a story context at either + 8 dB SNR (typical noise) or 0 dB SNR (challenging noise).
- Learning was measured with a picture-naming task after 1 exposure, 4 cumulative exposures, and 7 cumulative exposures to the nonwords.
- The responses were phonetically transcribed and scored as correct when a participant's response matched 2 or 3 phonemes to the target word.
- DV: proportion of correct responses
- IVs: noise, neighborhood density, phonotactic probability, time
- Analysis: repeated measures ANOVA for response: 2 noise group (+8 dB SNR vs. 0dB SNR) x 2 neighborhood density (low vs. high) x 2 phonotactic probability (low vs. high) x 3 time (1 vs. 4 vs. 7 exposures)

Results

	0dB & 8dB SNR	8dB SNR (typical noise)	0dB SNR (challenging noise)
E	*	*	*
DxPP	*		*
DxPPxG	*		
DxPPxE			*

*: Significant Effect ($p < .05$)
E: Exposure; D: Neighborhood Density; PP: Phonotactic Probability; G: Group



*: Significant Effect ($p < .05$)
D: Neighborhood Density; PP: Phonotactic Probability

- A significant interaction of density, probability, and noise level was found
- At +8 dB SNR (typical noise), only exposure was significant
- At 0 dB SNR (challenging noise),
  - Density effect: better learning when density and probability converged
    - For low probability words: Low density > High density (i.e., low-low optimal)
    - For high probability words: High density > Low density (i.e., high-high optimal)
  - Phonotactic probability effect:
    - For low density words: Low probability > High probability (i.e., low-low optimal)
    - For high density words: no effect

Discussion and Implication

- Noise alters the effect of neighborhood density and phonotactic probability.
  - Noise dampens the effects of density and probability in a typical noise condition (i.e., +8 dB SNR).
  - Adults require a convergence of density and probability in a challenging noise condition (i.e., 0 dB SNR).
- Noise may heavily tax cognitive processes (e.g., working memory). Specifically, under a taxing condition, adults may require a convergence of cues similar to that observed for children (Hoover, Storkel, & Hogan, 2010).
- The influence of acoustic parameters is not well captured by current word learning models.
- This may be particularly important in understanding word learning by children and adults with hearing impairment.

References

Hoover, J. R., Storkel, H. L., Hogan, T. P. (2010). A cross-sectional comparison of the effects of phonotactic probability and neighborhood density on word learning by preschool children. *Journal of Memory and Language, 63*, 100-116.

Storkel, H. L., Armbruster, J., & Hogan, T. P. (2006). Differentiating phonotactic probability and neighborhood density in adult word learning. *Journal of Speech, Language, and Hearing Research, 49*, 1175-1192.

Acknowledgments

- Dr. Kokkinakis helped with creating noise stimuli to generate SNRs.
- This research was supported by National Institute on Deafness and Other Communication Disorders Grant DC-08095.

KU®