COMPARING INTELLIGIBILITY OF SEVERAL NON-NATIVE ACCENT CLASSES IN NOISE

Shawn A. Weil

Dept. of Psychology, Cognitive/Experimental Area - Ohio State University, Columbus, OH

Sytronics, Inc., Dayton OH

Summary

How does noise affect perception of foreign accented speech? English sentences spoken by non-native talkers with various language backgrounds were presented to native speakers. The Speech Reception Threshold (SRT) was found for 5 different accent classes, and contrasted with noise-free intelligibility. Modest trends towards global differences in intelligibility based on accent class were found, both with and without noise. However, the pattern of results differed as a function of noise. This result suggests that noise and accent characteristics interact to differentially degrade intelligibility.

Introduction

In the air traffic control room or university classroom, individuals with a wide range of language backgrounds must interact and communicate effectively with each other in a second language. To further complicate this interaction, environmental conditions can be variable

The characteristics of an individual's accent are determined in part by the influence of the phonology of the individual's native language (L1) onto the phonology of the non-native language (L2) - (Piske, MacKay, & Flege 2001). Some accents will have lower intelligibility than others for native English talkers due to the characteristics of that accent (Suter, 1976).

Noise has been found to degrade intelligibility of non-native speech in a non-additive fashion. Rogers (2000) found that accented speech was deemed less intelligible than non-accented speech when noise was added to the signal, even when the talkers had similar baseline intelligibility.

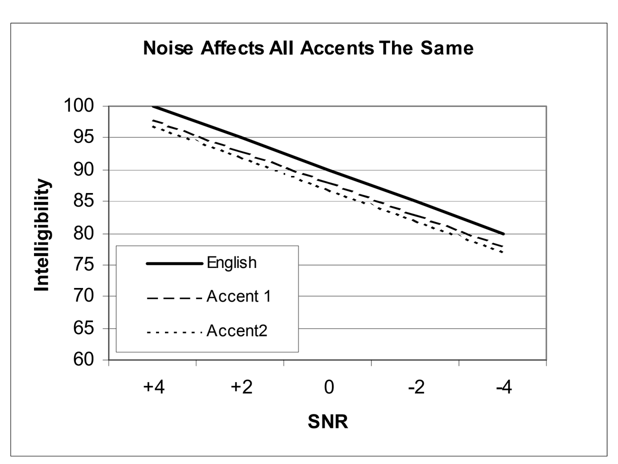

Figure 1a — *Hypothesized Additive Affects of Noise*

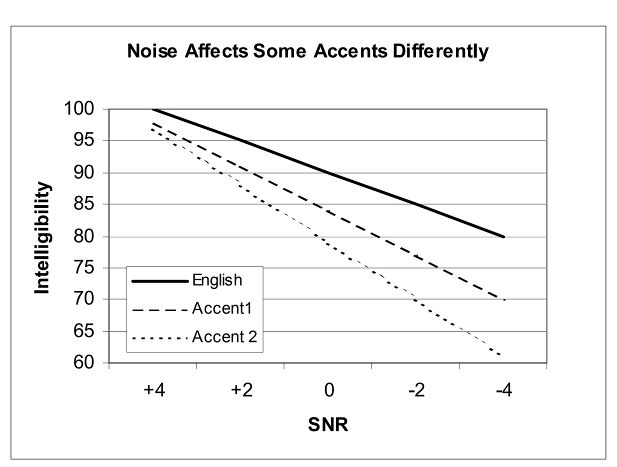

Figure 1b – *Alternative Hypothesis*

Experiment 1 was conducted to determine if some accents are affected by noise to a greater extent than others.

Experiment 1 — Speech Reception Threshold

Task	Verbal repetition of sentences in noise
Dependent Variable	Signal to Noise Ratio (SNR) for Speech Reception Threshold (SRT; Plomp & Mimpen 1979)
Stimulus Materials	Ten groups of 13 English sentences.
Talker Backgrounds	American English, Japanese, Taiwanese Mandarin, Indian English, and Russian
Number of Talkers	Twenty (20); 4 in each accent class. 10 Male/10 Female
Listeners	Forty (40) Native English speaking Ohio State Undergraduates Normal Speech/Hearing - little experience with accented speech

SRT Paradigm:

A sentence is presented to the participant via headphones. The participant makes a verbal response to the experimenter. Noise is added or removed from the next trial based on response accuracy, thereby changing the Signal to Noise Ratio (SNR) for the next trial (Figure 2). The average of the final trials is the Speech Reception Threshold, and indicates the amount of noise that can be added to a signal to make 50% of the sentences unintelligible.

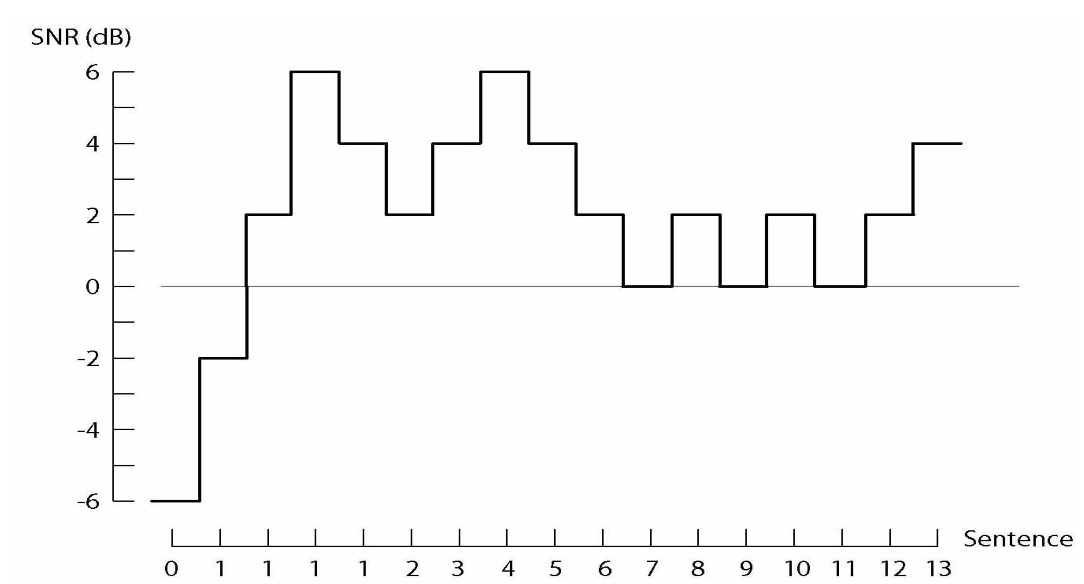

Figure 2 — *Sample Results of the SRT staircase method*

Each participant heard only a subset of the talkers recorded – 1 from each of the 5 accent classes used.

Results:

- The amount of masking noise required to reduce the intelligibility of a native English talker to 50% was greater than the noise needed to reduce the intelligibility of the other accent classes to the same threshold.
- Some accents were intelligible in noise than others. The Russian talkers were less intelligible than the Japanese and Indian talkers (p = .058 and p = .068 respectively). The Japanese, Indian, and Mandarin talkers all had similar intelligibility (Figure 3).

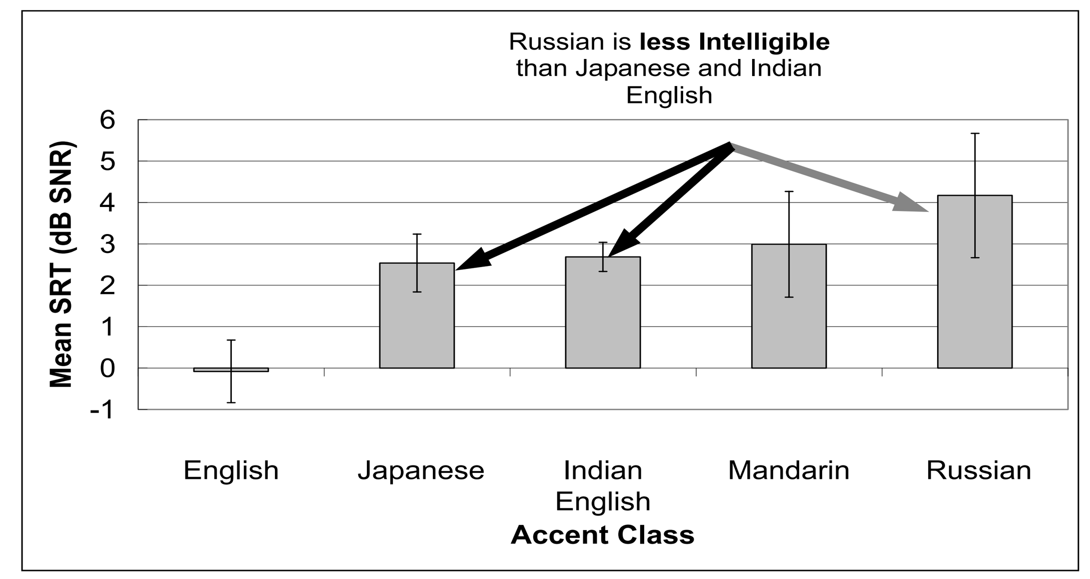

Figure 3 — *Summary of results from Experiment 1*

The results of Experiment 1 suggest some differences in intelligibility in noise among the accents used. The effects of noise cannot be evaluated without comparing intelligibility in noise to intelligibility without noise. A particular accent (e.g., Russian) could have higher than average intelligibility in ideal conditions, but lower that average intelligibility in noise. Alternatively, noise could affect all accents similarly. Experiment 2 provides a baseline to evaluate the results of Experiment 1.

Experiment 2 — Baseline Intelligibility

Task	Sentence repetition
Dependent Variables	Proportion of words missed
Stimulus Materials	Same as Experiment 1, **no noise added**
Talker Backgrounds	Same accent classes as Experiment 1
Number of Talkers	Twenty (20) - Same talkers as Experiment 1
Listeners	Forty (40) new Native English speaking Ohio State Undergraduates – Normal Speech/Hearing - little experience with accented speech

Method:

Participants heard each sentence via headphones, and repeated it verbally. The experimenter transcribed the utterance.

Results:

- Performance on the English materials was superior to performance on the other accents.
- The Russian talkers were less intelligible than the other accents.
- The Indian talkers were more intelligible than the other accents.

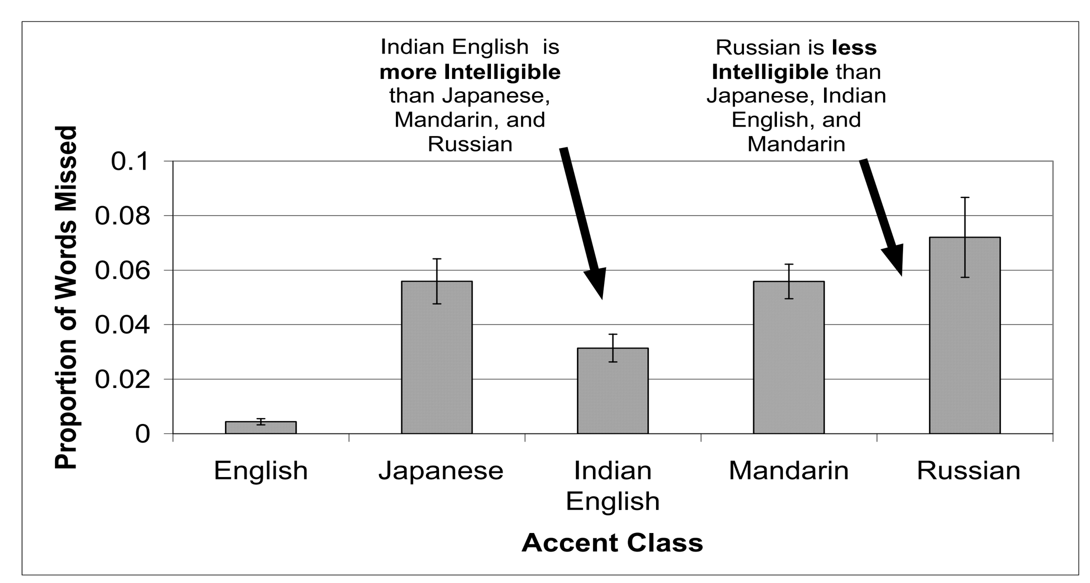

Figure 4 – ***Summary of results from Experiment 1***

Discussion

Major Points

1. Accented speech is less intelligible than non-accented speech both with and without noise.
2. Russian was consistently less intelligible than the other classes, independent of noise.
3. Indian English was more intelligible than the other accents in ideal conditions, but was no different than the other accents in noise conditions. This accent may have been more adversely affected by the addition of noise

Conclusions

The intelligibility of different accent classes varies in part due to the relationship of the native phonology to that of the second language. When noise is added to the signal, this relationship may change, causing some accents to be less intelligible relative to other accents. Gross differences did emerge between the accent classes, and the pattern of results in the noise condition (Experiment 1) differed from the baseline noiseless condition (Experiment 2).

Caveats

It is impossible in the current study to ascribe the results solely to the accent characteristics, rather than to random talker variability. Within an accent class, there will certainly be talker variability, as there is in non-native speech. The type and length of L2 training, the age of L2 instruction, the frequency of L2 use, and idiosyncrasies in the speech of particular talkers may all influence intelligibility. However, there is nothing in the results that contradicts the interpretation that the talker characteristics common to particular accent classes had a major impact on intelligibility.

Future Manipulations

- Reduce the effects of variability within an accent class and due to talker idiosyncrasies by increasing the number of talkers in each accent class.
- Use a task that has a more sensitive measure of intelligibility, such as reaction time.
- Factor demographic and biographical information about the talkers to disambiguate the effects of accent from other effects (e.g., type and length of instruction).
- Investigate fine differences between accent classes by manipulating the stimuli to include phoneme combinations that are predictably confusable in one accent class, but not the others.

Works Cited

Piske, T., MacKay, I.R.A., & Flege, J.E. (2001). Factors affecting degree of foreign accent in an L2. a review. *Journal of Phonetics, 29,* 191-215.

Plomp, R., & Mimpen, A.M. (1979). Improving the reliability of testing the speech reception threshold for sentence. *Audiology*, *18*, 43-52.

Rogers, C.L. (2001, June). *Effects of noise and proficiency level on intelligibility of Chinese-accented English.* Poster presented at the 141st meeting of the Acoustical Society of America, Chicago, IL.

Suter, R.W., (1976). Predictors of pronunciation accuracy in second language learning. *Language Learning, 19,* 245-253.

Acknowledgements

I am indebted to Tim Anderson, Mark Pitt, Vince Schmidt, Scott Grigsby, Lisa Shoaf, Erik Tracy, Melissa Jungers, Flip Phillips and Beren Gayle Weil for their input into the preparation and execution of this study.

This research was supported by the Ohio State University and by the Air Force Research Laboratory (AFRL/HECA, Wright Patterson AFB, OH) through the R&SCSIL contract to Sytronics, Inc.

For more information, please contact:
Shawn Weil - weil.17@osu.edu

ThA37p.1