

BACKGROUND

The workplace presents many challenges for individuals with hearing loss. Communication on the job involves written or spoken English about 80% of the time, whether with or without sign (Kelly et al., 2015). Job-related demands cause even more difficult communication situations for those who are deaf compared to those who are hard-of-hearing (Boutin & Wilson, 2009). To gain upward mobility, a wide array of flexible strategies is essential for communicating with people who have typical hearing (Foster & Walter, 1992).

OUR QUESTIONS

Given the spoken-language communication requirements of the workplace, to what extent does current speech recognition technology, especially as available in mobile apps, enhance access by deaf and hard-of-hearing individuals?

Are speech recognition apps usable tools to enhance exchanges between deaf or hard-of-hearing persons and individuals who have typical hearing, whether it be a coworker or a boss?

OUR TRIALS AND PARTICIPANTS

To investigate the capabilities of newer Automatic Speech Recognition (ASR) applications/software as tools to support auditory access of spoken communication, we asked deaf and hard-of-hearing college students to use a variety of applications and software in everyday, job-related and social settings and to provide evaluative feedback on their experiences.

Participants were undergraduate and graduate students enrolled in one of these courses or activities:

Freshman Seminar
Organizational Communication and the Deaf Employee
Individual speech-language instruction

Fall 2013

GROUP 1 = 15 students tested in quiet settings

- Office meetings with professors
- Computer Help Desk

Spring 2015

GROUP 2 = 11 students tested in crowded group settings

- Classroom
- Career Fair

Fall 2015

GROUP 3 = 21 students tested in a variety of day-to-day settings

- 1:1 and group social conversations with friends & family

PARTICIPANT CHARACTERISTICS AND OVERVIEW OF EXPERIENCES

		Group 1 (n = 15)	Group 2 (n = 11)	Group 3 (n=21)
Location/use setting		Quiet, 1:1	Large crowded open area	Various settings, 1:1 & group social conversations
Self-rated speech intelligibility	"All or most of my speech is intelligible"	n = 8	n = 5	n = 13
	"Some or none of my speech is intelligible"	n = 7	n = 6	n = 8
Predicted on-the-job communication	Speech alone	n = 8	n = 6	n = 13
	Writing	n = 7	n = 5	n = 8
App Ratings on a scale of 1-5 (1 = poor; 5 = outstanding)				
Apps for iPhone users (range and mean of overall ratings)	Dragon Dictation	n = 7 Rated 3.0-4.0; M = 3.5	n = 7 Rated 2.0-4.0; M = 3.0	
	Siri (in Notes app)	n = 4 Rated 3.0-4.0; M = 3.5	n = 3 Rated 2.0-4.0; M = 3.0	n = 11 Rated 2.5-5.0; M = 3.2
	Ava (BETA app)			n = 12 Rated 1.8-5.0; M = 3.6
Apps for Android users (range and mean of overall ratings)	DEAFCOM	n = 2 Rated 3.0-4.0; M = 3.5		
	Google Translate		n = 1 Rated 3.0	
	Virtual Voice	n = 2 Rated 3.5-4.0; M = 3.75		
	Google Now (in Memo app)			n = 8 Rated 2.0-3.8; M = 2.8
	Ava (BETA app)			n = 9 Rated 1.0-4.8; M = 3.1

A CLOSER LOOK AT ASR APP RATINGS

GROUP 3 DATA	Siri (in Notes app) iOS Users	Google Now (in Memo app) Android Users	Ava (BETA app) iOS Users	Ava (BETA app) Android Users
Ease of use	Rated 3.5-5.0 M = 4.1	Rated 2.5-3.8 M = 3.0	Rated 3.8-5.0 M = 4.2	Rated 2.5-3.5 M = 3.0
Usefulness in making communication happen	Rated 2.8-4.0 M = 3.4	Rated 2.0-3.0 M = 2.3	Rated 2.8-4.0 M = 3.6	Rated 1.8-2.8 M = 2.0
Latency or lag time	Rated 2.5-3.0 M = 2.8	Rated 2.0-3.5 M = 3.0	Rated 1.8-3.0 M = 2.9	Rated 1.0-3.5 M = 2.5
Accuracy of the text when people spoke	Rated 3.0-3.5 M = 3.3	Rated 2.0-3.0 M = 2.3	Rated 3.5-3.8 M = 3.6	Rated 2.0-3.5 M = 2.8
Accuracy of the text when deaf users spoke	Rated 2.8-3.0 M = 2.9	Rated 2.0-3.0 M = 2.5	Rated 3.3-4.0 M = 3.4	Rated 2.5-3.3 M = 3.0

STUDY RESULTS

Students who relied on ASL:

- Found key word reception to be an "amazing" and "awesome" benefit of ASR.
- Ava performed "Better than Google. Helped me a lot."

Students who relied on Spoken English:

- Found issues with accuracy and latency, especially in noise.
- Even though many had highly intelligible speech, Ava/built-in ASR failed to recognize all deaf users' speech.

Overall:

- Ava performed slightly better than Siri for ALL iOS users.
- Perceived benefit of ASR apps is highly individual.
- Perceptions of ASR apps ranged all along a continuum of claims: "Not worth it to my family. We are very oral". "Had the best conversation with a hearing family member in past 5 years because we were able to talk in deeper context".

FUTURE DIRECTIONS

- Improve algorithms for increased accuracy and decreased latency, especially in noise and when experiencing poor internet connectivity.
- Investigate directional and Bluetooth microphones to improve performance in noise.
- Improve recognition of deaf talkers' speech.
- Develop user training in the area of persuading hearing individuals to use ASR apps.
- Explore the possibility of using Ava/built-in ASR to support video transcription.

ADDITIONAL APP RESOURCES



<http://bit.ly/AppleAppsNTID>



<http://bit.ly/AndroidAppsNTID>



<http://bit.ly/WindowsAppsNTID>



REFERENCES

Amlani, A. (2015). *Improving patient compliance to hearing healthcare services and treatment through self-efficacy and smartphone applications*. *Hearing Review*, 21(2):16.

Boutin, D. L., and Wilson, K. B. (2009). *Professional jobs and hearing loss: A comparison of deaf and hard of hearing consumers*. *Journal of Rehabilitation*, 75(1): 36-40.

Cauchon, D. (2010). *Driest spell yet for summer work*. *USA Today*, 9/7/10.

Childress, T. (2015). *Apps for Kids (and Adults) with Hearing Loss*. Used with written permission.

Foster, S., & Walter, G. (1992). *Deaf students in postsecondary education*. Accessed from <http://scholarworks.rit.edu/books/5>

Harris, R. (1989). *Deaf people as entrepreneurs*. *The Deaf American*, 39 (4), 6-16.

Kelly, R., Quagliata, A., DeMartino, R., & Perotti, V. (2015). *Deaf workers: Educated and employed, but limited in career growth*. In Proceedings of the 22nd International Conference on Education of the Deaf. Athens, Greece.

Ludden, LaVerne (2013). *Job Savvy*. New York: Just Publishing.

MacLeod-Gallinger, J. (1992). *The career status of deaf women: A comparative look*, *American Annals of the Deaf*, 137 (4), 320.

Pressman, S. (1999). *A National Study of Deaf Entrepreneurs and Small Business Owners*. Doctoral dissertation. Virginia Technical Institute