Distance between Deaf Viewers and Interpreters

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Abstract

In the United States, the Americans with Disabilities Act mandates aural-to-visual access such as sign language interpreters for Deaf and Hard of Hearing (DHH) students who request it.

While sign language interpreters provide visual access to lecture aural information for DHH students, it is difficult to for them to pick an optimal distance for both the lecture slides and the interpreter. The student has to pick his or her preferred distance. If the student sits close by, he or she can see the interpreter's signs clearly, but the lecture slides are likely not clearly visible. Alternatively, the student can sit further away from both visuals, so as to see both the interpreter and classroom visuals, but then the student will not be able to see the interpreter's signs clearly.

We evaluated DHH students' preferences for viewing distance from the interpreter or slides at 5 or 15 feet. The evaluation results showed that DHH students preferred different viewing distances between interpreters and lecture visuals. While viewing interpreters, DHH participants reported that they best understood interpreters at the closer distance of 5 feet rather than 15 feet. On the other hand, the participants reported that they best understood classroom slides when they viewed it at the farther distance of 15 feet rather than at the closer distance of 5 feet.

Keywords

Deaf and Hard of Hearing, Viewing Distance

Introduction

Federal law requires educational institutions to provide equal learning access to deaf and hard of hearing students (Kushalnagar). It is difficult to provide classroom support for DHH students. They are a low incidence population that is uniformly distributed. Surveys have shown that over 95% of post-secondary institutions serve between one to two deaf students. This implies that instructors rarely encounter deaf students and the classroom environment designers are not aware of deaf student's needs. Therefore, there is little research related to accessibility needs of deaf and hard of hearing consumers in higher education.

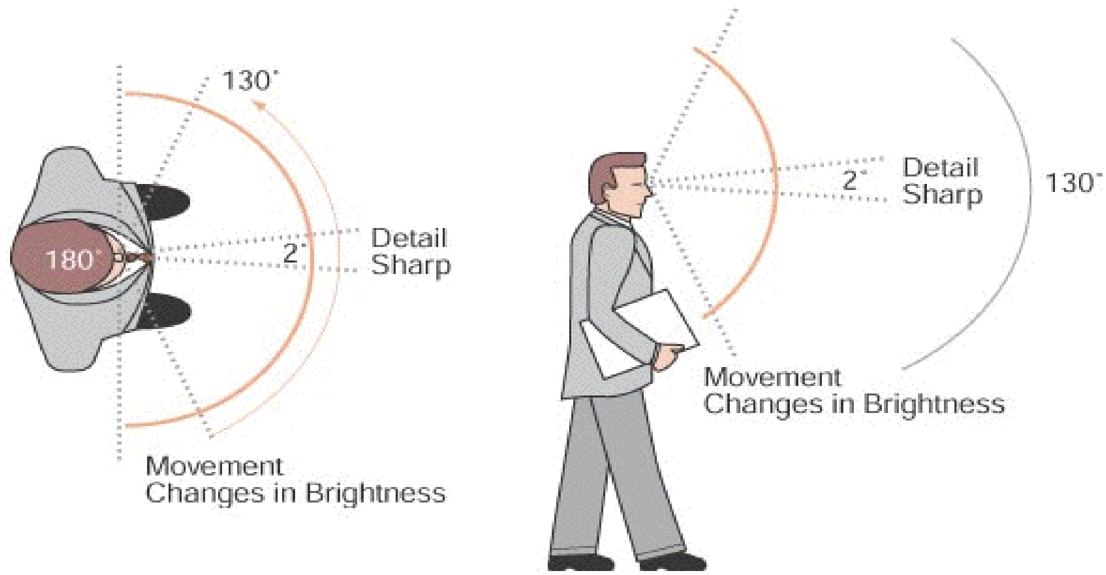

Fig. 1. Field of View.

Another consequence of the lack of accessibility design and effective accessible technology is that less than 25% of DHH students graduate from all post-secondary institutions. Only 16% of DHH students complete a bachelors' degree, far less than the 30% hearing student graduation rate (Erickson, Lee, and Von Schrader). The impact of visual accessibility on learning for deaf students is well documented (Antia, Sabers, and Stinson; Marschark, Lang, and

Albertini; Marschark et al.; Kushalnagar, Trager, and Beiter; Kushalnagar, Kushalnagar, and Manganelli; Kushalnagar et al.).

Visual Accessibility in Classroom

Part of this disparity in graduation rates between deaf and hearing students can be attributed to lack of visual accessibility in the classroom. Lectures today increasingly incorporate multiple visual information sources in addition to the teacher, such as sign language interpreters, captions, white boards, multimedia overheads, and demonstrations. This partly occurs as technology makes it easier to create more visuals, but also because it helps in student learning. Mayer et al. (Mayer, Heiser, and Lonn) analyzed how the distribution of redundancy across two channels (visual and auditory) makes learning easier by processing in parallel in both channels and the effect is complementary. The presenters could either emphasize key terms or to explain in parallel.

Although these multiple sources of information aid in information acquisition and retention, DHH students find it difficult to find an optimal position to view these multiple sources. An optimal view for some visuals does not necessarily translate to an optimal view for other visuals especially an aural-to-visual accommodation. In general, students usually get the best view by being opposite and close enough to each of the multiple sources of information.

Visual noise is less important than bad acoustics for hearing participants as they rely on auditory context to fill in their gaps in visual learning, but this is not the case for DHH participants, who rely far more, if not exclusively on visual learning. We investigate viewer preferences for video capture distance for people. Even with visible accessibility, the viewing distance may be an impediment to learning.

Visual Accessibility of Lecture Visuals and Interpreters

While visual accommodations improve accessibility for DHH participants, these accommodations are not entirely functionally equivalent. Though these accommodations can go a long way in improving deaf students' inclusion and outcomes in higher education classrooms, it is not sufficient, because of poor visual accessibility. Research has shown these individuals lose substantial lecture information due to two main factors largely unaddressed by the accommodations: cognitive limits on processing the visual translation of audio simultaneously with other visual information sources, and poor viewing accessibility. As a result, they lag behind hearing peers, and miss a substantial amount of information (Kushalnagar and Trager; Marschark et al.).

Most people have both a wide field of view of up to 180^o with relatively low resolution, and a high-resolution focus of about 2^o. The visual perceptual process temporally multiplexes the fovea information over the field of view and overtime to give the illusion of high-resolution focus everywhere, as shown in Figure 1. Most people focus on the interpreter using their fovea, which has high resolution, but has a narrow field of view. They also monitor the classroom using their peripheral vision, which has a wide field of view with low resolution (Eli Peli). Visual Dispersion is displayed on Figure 3.

- If FOV < 10˚, usually eye movements are enough to switch between visual information sources.
- If FOV > 10˚, usually head movements are needed to switch between visual sources.

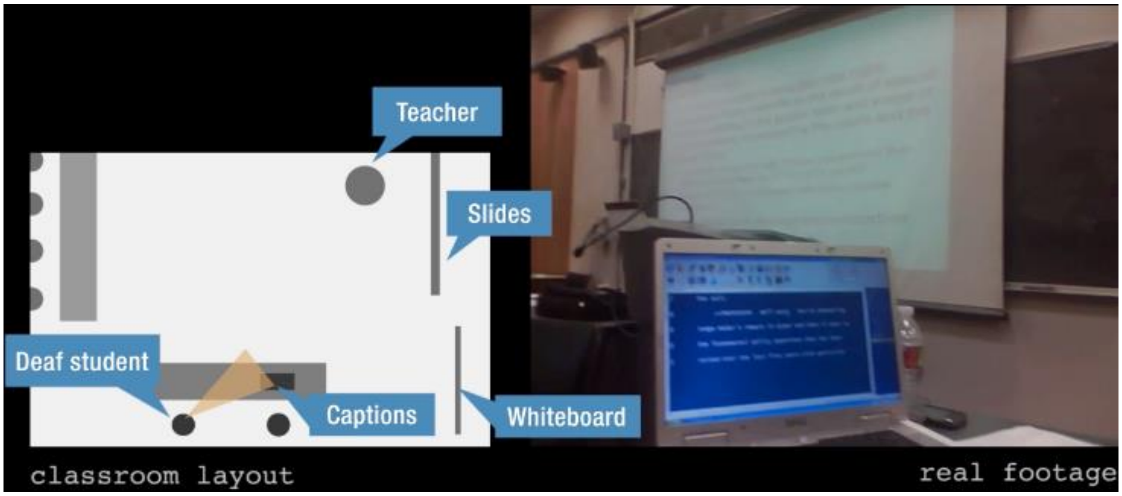

Fig. 2. Example of a classroom with visual access issues.

Most classrooms have visuals spread around and at varying distances, which reduces visual access as shown in Figure 2. The spread and varying distance of visuals can be an impediment to learning (Cavender, Bigham, and Ladner). The deaf student has to keep all visuals in their peripheral vision and choose and switch between them.

The naïve way for the student to keep all visuals within the peripheral vision is to be positioned further away. Then the student can see all visuals, but the distance often prevents students from reading the slides or understanding fingerspelling consistently. As a result, the signer will sign with more restrictions to be clearly understood.

If there is too much information, “tunnel vision” is induced which reduces sensitivity to the changes occurring within the periphery (Schwartz et al.; Williams). We explore an alternate approach in which the goal is to increase the visual resolution and to reduce the amount of visual information presented.

Moreover, by sitting up front, their field of vision narrows so they cannot even take in the whole panorama. The interpreter (and DHH student) has to also deal with a lot of depth change, which leads to eye-fatigue. For example, the general presentation style of art courses tends to have much more visuals that students have to analyze and examine for some time; which means interpreters have to pause for a while and then summarize when the student is ready to look at the interpreter again.

On the other hand, engineering courses have tend to use and discuss detailed visuals, but usually focus on parts of the whole, so the interpreters have to wait less for the student to re-establish eye contact and to repeat smaller summaries.

Auditory Cues

Unlike hearing students, deaf students cannot depend on auditory cues to decide when to switch from the overhead slides to the interpreter or vice-versa. The participants also lose auditory context, and have to scan for visual information. Due to the inability to distinguish auditory cues, deaf participants cannot tell when and which other participants are talking. They have to rely on indirect visual cues that indicate that someone is talking such as simultaneous face turning toward the speaker.

The classroom-related barrier to full visual access is problematic for the deaf participant who depends on visibility of interpreter in addition to presenter and slides or demonstrations. In order to see everything in the classroom, the deaf student would have to sit in the back of the classroom to position everything within their peripheral vision. A problem with this set up is the need for sign language interpreters to remain within instructor’s proximity so to maximize their ability to clearly hear spoken information and see the slides.

Clearly, deaf students who choose to sit in the rear to keep the multiple information sources within their field of view will nevertheless experience difficulty reading or comprehending sign language interpreters at a distance.

Another issue is that the team (DHH participants and interpreter) often sit separately in the front row of the classroom next to the instructor, which often leads to awkward viewing angles to the slides or whiteboard. The team can feel vulnerable sitting apart in this space physically separated from the other students; the seating arrangements for accessibility can emphasize the accommodation and difference.

Discussion

To evaluate the optimal distance for interpreters and for the lecture visuals, we compared DHH students' preferences at two distances, either from the interpreter, or from the lecture slides. We picked the following distances: 5 or 15 feet.

We minimized perceptual variables in terms of lighting, zoom, angle and compression quality by recording the lecture for use in the evaluation. We recorded a 13-minute long video of a teacher presenting a mathematics lecture on sequences, using slides from 5 or 15 feet. Next, we also recorded a video of the sign language interpreter, who listened to the teacher's explanation.

We chose to record and use a lecture on mathematical sequences, because it was an accessible and comfortable concept for most deaf and hard of hearing college students. The minimum entry requirements meant that these students would be familiar with numerical sequences, Moreover, the topic is not very technical, and is highly visual. We then divided the 13-minute long video into two equal segments so that we could show the videos on a large, life-sized monitor at four distances in a balanced, repeated measures design without modifying the actual order of the lecture. The participants were also shown a short 30 second introductory video to familiarize themselves with viewing at the four pre-defined distances. A certified sign language interpreter listened to the speaker and conveyed the translation clearly.

Evaluations

We recruited 47 DHH participants, ages 20-45 (24 female) for a study. All participants could not understand audio alone, and all preferred to follow classroom lectures via sign language. We also screened for students who typically requested accommodations in the classroom.

After completing a short demographic questionnaire to determine eligibility for the test, the participants watched the lecture slides and interpreter, using two life-sized, 60 inch TV screens. One of the two TV screens displayed the interpreter at the same size and proportion they had in real-life. The other TV screen displayed the slides at the same size and proportion in a standard classroom.

For one quarter of the participants, we set the distance of the slides and interpreter screens to five feet away. For the second quarter of the participants, we set the distance of the interpreter screen and slide screens to 15 feet each. For the third quarter, we set the distance of the slides screen to 15 feet, and the distance of the interpreter screen to 5 feet. For the final quarter of students, we set the distance of the slides to five feet, and the interpreter screen to 15 feet.

Analysis

The participants rated the near and far views by answering the questions: “What is your rating of how easy was it to understand the signer?”, and “What is your rating of how easy was it to understand the slides?”

We also asked students an open-ended question to solicit their thoughts and feedback at the end of each video, and then enforced a one-minute break to ensure that they were not mentally fatigued from the previous video.

Results

We used a chi-square test to evaluate the students' preferences at varying distances, as the sample size is large enough, and the variance was normal.

For first question on how easy it was to understand the interpreter, there was a significant preference difference for viewing at 5 feet versus 15 feet: $\chi 2 = 16.81$, $p < 0.001$.

For the second question on how easy it was to understand the slides, there was a significant preference for viewing at 15 feet versus 5 feet: $\chi 2 = 10.37$, $p < 0.005$.

In the open-ended question, one common theme (12 of 18) reported that they felt that it was too tiring to change focus from near to far between the interpreter display and slides display.

Conclusions

The results of this study on optimal distance for lecture visuals has implications for signers, whether teachers or interpreters. Students clearly prefer to have the signer at a close distance, but on the other hand, they prefer to have the slides at a distance, in order to be able to read easily without being overwhelmed.

Acknowledgements

We thank our participants for their time and feedback. This was supported in part by the National Science Foundation IIS-1218056.

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