ARE YOU EASILY DISTRACTED?
IMPACT OF SIGHT ON AUDITORY PERCEPTION IN NON-VISUALLY IMPAIRED INDIVIDUALS

Introduction

Interactions between the human senses have been a topic of interest among researchers for years. One interesting phenomenon that has been observed in daily life is that people tend to turn down the volume of their music while driving under stressful conditions, ostensibly to "see" better. This behavior seems to be counterintuitive since music can be an effective stress reliever. However, past research has shown that attention is limited, and when one modality demands it, another modality necessarily loses some of it (Xu, et al. 2017). The purpose of this study is to find out whether things work in the opposite direction as well: specifically, it aims to investigate whether people's hearing abilities are more inhibited when they can see compared to when they cannot see. The results of this study may be beneficial to a wide range of people, especially individuals who may need to concentrate on audio-related tasks in visually distracting environments such as children who need to listen to speech or instructions while being exposed to novel sounds such as toys, music, or animals. Additionally, individuals who work in complicated environments may need to understand how visual distractions can impact their ability to perceive sounds. By shedding light on this topic, our study may help people manage sensory inputs more effectively.

Previous research has been conducted to examine similar sensory relationships. For instance, studies have explored the differences in sensory functionalities between the blind and sighted individuals. It has been found that the blind has better hearing and touch sensory functionalities compared to sighted individuals (Thompson Simon 2015, Pieniak, et al. 2022). However, there have been limited studies conducted on people without disabilities to investigate the effect of visual distractions on auditory perception. This study is necessary to fill the research gap and provide insights into the impact of visual distractions on auditory perception.

Methods

The researchers recruited participants from the university's undergraduate student population using a cold approach method. Before initiating the experiment, researchers provided a detailed explanation of the study's purpose, assured confidentiality of the data gathered, and obtained informed verbal consent from each participant. A 2x2 factorial design was employed in this experiment, investigating two factors: blindfolding (blindfolded vs. not blindfolded) and loudness level (50 dB vs. 70 dB). The complete list of treatments is shown below in Table 1.

Table 1: Complete List of Treatments

		Blindfold	
		Yes	No
Volume	High (70 dB)	Group 1	Group 2
	Low (50 dB)	Group 3	Group 4

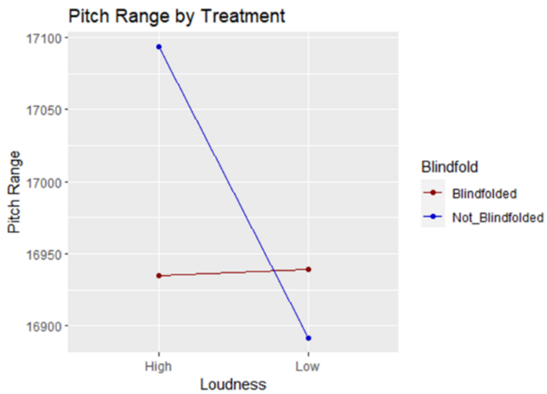
The experiment was conducted throughout the month of April. The trials took place indoors within the controlled environment of a university dormitory with reasonably low noise levels, ensuring minimal external disturbances. Participants were randomly assigned to one of the four treatment groups using the random integer function on a Casio fx-991EX calculator. For the not blindfolded group, participants were explicitly instructed to keep their eyes open to look at a TV screen playing Major League Baseball games during the experiment.

Researchers initiated each trial with a verbal countdown of three seconds, after which the audio was played. The audio consisted of a monotonous and continuous sound emitted from laptop speakers placed approximately 3 feet away from the subject. The audio began at a frequency of 20 Hz and progressively increased to 20,000 Hz. Participants were instructed to indicate two critical junctures during the experiment: the moment they first heard the audio and the moment they could no longer perceive it. These indications were communicated through a single knuckle tap on the table. Upon receiving this signal, researchers promptly recorded the corresponding frequency at which the audio was playing. Following each trial, researchers collected demographic information from the participants, including age, gender, and any hearing-related conditions that might have influenced their performance in the experiment. The data collected during the experiment were thoroughly analyzed using a two-way analysis of variance (ANOVA) test with blindfolding (blindfolded vs. not blindfolded) and loudness level (50 dB vs. 70 dB) as factors. A level of significance was predetermined and set at $p < 0.05$.

Data Analysis

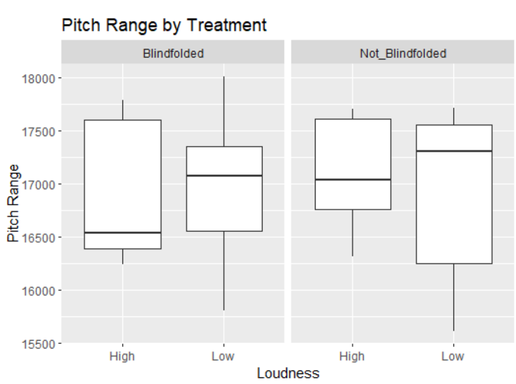
This experiment employed a factorial design to allow for a comprehensive investigation of the combined effects of two independent factors, blindfolding and loudness level, on the participants' hearing abilities. By utilizing this design, the researchers were not only able to examine the main effects, but also explore any potential interactions between them.

In the preliminary analysis, the researchers first employed an interaction plot (Graph 1) to assess the data. The plot suggested that both loudness of the audio and the presence of a blindfold may influence participants' hearing abilities. The rationale for this supposition was twofold. Firstly, the plot's lines did not overlap with each other, indicating a potential difference in the outcome depending on whether the participant was blindfolded or not. Secondly, the response value of the lines fluctuated as they moved across the x-axis, further suggesting that the loudness of the audio being played could have an effect on the hearing ability of the participant. Moreover, the plot also hinted at a potential interaction effect between these two factors, implying that that the combinations of different levels of audio loudness and whether the participant was blindfolded could impact hearing ability in unique ways. This was evidenced by the lines intersecting one another within the graph.



Graph 1

A side-by-side boxplot graph (Graph 2) was used to visualize the treatment mean pitch range differences among the four treatment groups. As shown in the graph, there really isn’t a clear pattern to be found: the boxplots look similar to one another in terms of spread and median value. The graph suggested that there may not be a significant difference between the mean value of the different treatment groups. In addition to those findings, the researchers also observed that no outliers.



Graph 2

To empirically investigate the issue at hand, the researchers conducted a 2-way ANOVA test. This statistical test helps determine whether the factors in the experiment (in this case, loudness of the audio being played and being blindfolded) and their interactions have a significant effect on the outcome (pitch range the participant was able to hear). The test revealed that neither loudness of audio nor being blindfolded nor their interaction had a significant impact on hearing ability at the 0.05 significance level.

Discussion and Conclusion

The findings of this research showed that sight did not significantly affect auditory perception. In addition, auditory perception was also not significantly affected by the difference in audio volume levels. These observations align with the theoretical framework of the cognitive load theory (Baddeley and Hitch 1974), positing independent processing of auditory and visual stimuli, thereby reducing the possibility of interference.

This research's implications could be extended to various real-world domains. In educational settings, for instance, the current results suggest that the presence of visual distractions may not hinder college students' ability to receive auditory information, which could alleviate some concerns surrounding visually rich environments on auditory learning.

Notwithstanding, the study had some inherent limitations, primarily in the selection of volume levels and the duration of exposure to the auditory stimulus. The choice of volume levels was constrained by the experimental setting, which was a university dorm room with ambient noise. This background noise rendered the selection of significantly different noise levels challenging. A volume level lower than 50 dB was harder to discern against the background noise, whereas a volume level higher than 70 decibels would exceed the upper limit of the EPA recommended 24-hour average noise level exposure (ONAC 2016). The 20-decibel difference between the two volume levels in this experiment (50 dB vs. 70 dB) may not have been sufficient for differentiating. Moreover, the continuous exposure to the audio for a duration of two and a half minutes might have precipitated perceptual fatigue (Broadbent 1958), which could have compromised the participants' accurate identification of the audio's cessation. Another limitation was the visual element of the experiment: watching Major League Baseball games. This visual stimulus might not have been engaging or stimulating enough for the participants, potentially reducing its impact on the auditory perception. A more dynamic or attention-grabbing visual stimulus might have been necessary to elicit a more pronounced effect on auditory perception.

Future investigations could benefit from conducting experiments in a soundproof environment to eliminate the influence of ambient noise as much as possible. Also, the exploration of a wider range of loudness treatments may yield more pronounced effects on auditory perception, provided participant safety is ensured. Shortening the duration of the audio could be another avenue to prevent perceptual fatigue. Furthermore, incorporating more engaging and stimulating visual elements in the experiment – for example, having the participants watch Major League Baseball game highlight clips – could help better assess the potential influence of visual distractions on auditory perception.

Despite these constraints, the study offers valuable insights into the interplay between visual and auditory senses, suggesting their independent functionality in stimulus processing. Furthermore, it underscores the necessity for more extensive research on this topic and methodology refinement for sensory perception studies. Despite the identified limitations, the current study remains a pivotal reference for future multisensory perception research, with its real-world implications continuing to hold relevance for academic and practical audiences.

Bibliography

Baddeley, Alan D., and Graham J. Hitch. 1974. "Working Memory." *Psychology of Learning and Motivation.* 47-89.

Broadbent, Donald E. 1958. *Perception and Communication.* New York: Pergamon Press.

ONAC. 2016. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.* September 14. Accessed May 7, 2023. https://www.epa.gov/archive/epa/aboutepa/epa-identifies-noise-levels-affecting-health-and-welfare.html.

Pieniak, Michal, Kinga Lachowicz-Tabaczek, Maciej Karwowski, and Anna Oleszkiewicz. 2022. "Sensory Compensation Beliefs Among Blind and Sighted Individuals." *Scandinavian Journal of Psychology* 72-82.

Thompson Simon, BN. 2015. "Sensory Compensation in Children Following Vision Loss after Trauma and Disease." *Journal of Clinical Research and Ophthalmology* 49-53.

Xu, Kitty Z., Brian A. Anderson, Erik E. Emeric, Anthony W. Sali, Veit Stuphorn, Steven Yantis, and Susan M. Courtney. 2017. "Neural Basis of Cognitive Control over Movement Inhibition: Human fMRI and Primate Electrophysiology Evidence." *Neuron (Cambridge, Mass.)* 1447-1458.