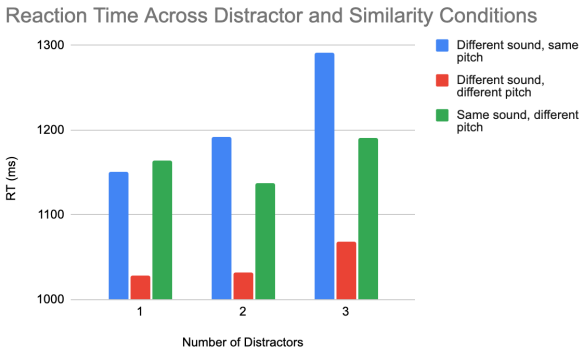
Pop-out Effects in Auditory Search

Thomas Mazzuchi, Class of 2023

This summer, I conducted an experiment studying how humans parse through auditory information. My goal was to use an auditory search task to demonstrate a pop-out effect. The essence of a pop-out effect is that certain properties of a target stimulus can draw attention very quickly, no matter how many distracting stimuli there may be to take attention away from the target. For example, a bright red stone on a rocky beach would stick out amongst the mix of brown and gray pebbles. I aimed to take examples like this from the visual world and translate them into the language of sound.

To do this, I designed and coded an auditory search task. In my design, participants wore headphones and listened to many arrays of sounds. Each array had one target sound (e.g. a violin) and a variable number of distractor sounds (e.g. trumpets). Every sound came from a different direction, and the participant tried to determine where the target sound was coming from. After they made their response, the next trial would begin with a new randomized position for the target and the distractors. Between trials, I manipulated the number of distractors and the similarity between the target sound and the distractor sounds. In each trial, I measured participants' reaction time, and I used those data to analyze how my main variables affected performance on the search task. I predicted that pitch would show a pop-out effect in this task. Specifically, I hypothesized that trials where the target and distractors differed in pitch would see lower reaction times overall, and would also be unaffected by the number of distractors. Contrarily, trials where the target and distractor were the same pitch would see higher reaction times overall, and would also be affected significantly by the number of distractors.



Analysis of the data set as a whole showed strong support for my predictions. Trials with differing pitches had overall lower reaction times, and these reaction times were relatively stable across the number of distractors. However, trials with only one pitch had higher reaction times, and these reaction times increased with the number of distractors. These results support the intuitive idea that the similarity between target and distractors matters in a search task. The more similarity, the more challenging the task will be. Further, this observation lends insight into the cognitive mechanisms involved in completing the auditory search task. The idea that similarity matters suggests that differentiating sounds from one another may be a multi-stage process that sequentially compares certain features of the sounds, as opposed to a holistic comparison. This is a topic that I would love to spend more time exploring in the future. Thank you very much to the Lifson Family for granting me the opportunity to do this work.

Faculty Mentor: Jonathan Schacherer

Funded by the Lifson Family Summer Research Fellowship

References

Dyson, B. J., & Quinlan, P. T. (2003). Feature and conjunction processing in the auditory modality. Perception & Psychophysics, 65(2), 254–272. https://doi.org/10.3758/BF03194798

Lee, M D (2001). Multichannel auditory search: toward understanding control processes in polychotic auditory listening. Human factors (0018-7208), 43 (2), 328.