Detection of Human Simultaneity Thresholds Using Cross-Modal Stimuli

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Introduction

An important topic in experimental psychology concerns the detection of simultaneity. This is defined a the ability to determine that two events have taken place at the same time even if the information has arrived via more than one sensory input. Determination of human simultaneity detection has important implications in vision because simultaneity indicates that two events might have arisen from one object. This, in turn, helps to define grouping relationships in the real world. For example, a sound associated with a movement helps us localize and identify sound sources. It is also important to know when two events are not simultaneous. This determination allows us to make temporal order judgments, which can help us form predictive relationships between events. This is seen, for instance, in the learning of new words. If we were unable to predict that the syllable “for” preceded “ess,” we would be unable to learn the word forestry.

Methods

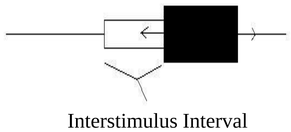
Cross modal stimuli were presented with a varied inter-stimulus interval.

Subjects chose whether a flash or a beep occurred first.

This information was used to determine the next interval.

This process was continued until the limit of detection was identified.

This stair-step (QUEST) approach uses 82% correctness as the location of the threshold.

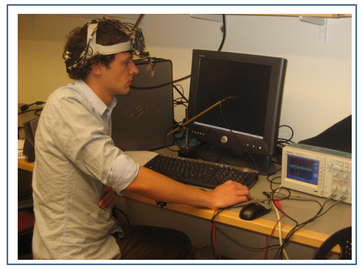


Interstimulus Interval

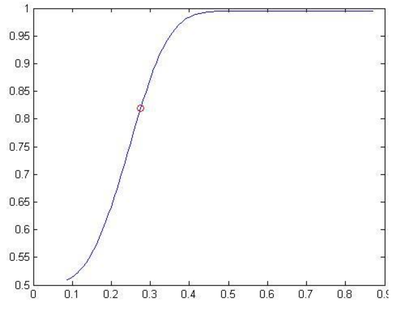
The interstimulus interval is shown here as the amount of separation between sound and light measured in milliseconds. Sound both preceded and followed light in this experiment.

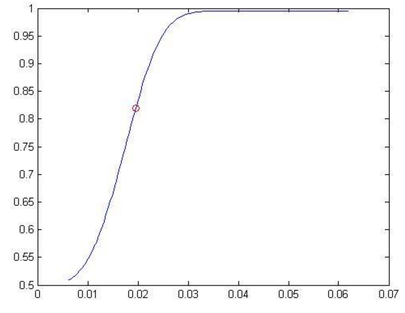
Results and Discussion

Subjects were positioned in a dark room with a pair of circumaural headphones and a 19 inch LCD monitor. Visual stimuli were presented in the middle of a black screen, with sound stimuli presented through an ASIO sound enabled pair of dell speakers.



Though development of the program and calibration took a substantial amount of time and limited the number of trials that could be completed, there are still some noteworthy results worth reporting. Early data shows that there is a significant asymmetry between the detection of simultaneity when sound precedes light, compared to light preceding sound. As the graphs below illustrate, there was a much smaller threshold when flash preceded sound. This shows that the human mind is more finely tuned to events in which light precedes sound. This would make sense as the brain routinely receives that faster light input before any corresponding sound input. Just as the sound of a jet lags behind its position, perhaps the detection of sound has been tuned in accordance with this lag. The mind may have been trained to discriminate more finely between sounds when light comes first. The data also show that the thresholds can vary widely between individuals, but additional testing is needed to confirm the extent of this difference.

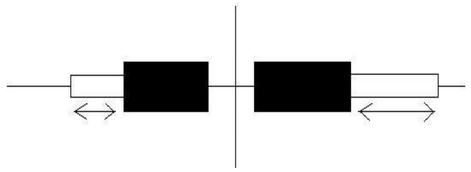




These two graphs show the plots of the QUEST function found in the presentation code for this experiment. Thresholds for sound before flash is found on the left, and flash before sound on the right.

Conclusions

Presentation of cross-modal stimuli not only allowed us to identify the threshold of human simultaneity detection, but also illuminated an interesting separation between the two scenarios. This could have important consequences in human visual development by defining the interrelatedness of two events, and how the temporal order of events is used to determine simultaneity. This topic has many avenues for future work, including the basic expansion of this experiment itself. More evidence is needed to corroborate the data found here. Investigations in sound only and flash only simultaneity would also be useful in the analysis of the cross-modal data.



The threshold for detection is smaller when light (white) precedes sound (black)

References

Levitin, Daniel J. "The Perception of Cross-Modal Simultaneity." *University of British Columbia*. Interval Research Corporation. Web. 05 Aug. 2009.

Acknowledgments

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