Auditory and visual stimulus features, and their crossmodal correspondence, resolves ambiguity in the bounce/stream illusion

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INTRODUCTION

The bounce/stream illusion can be biased towards bouncing by introducing a brief tone near the point of visual coincidence (Sekuler et al., 1997). However, not much is known about how the sensory features constituting the illusion can modulate perception. This study investigates the impact of auditory (high/low pitch) and visual (light/dark) stimulus features, along with their crossmodal correspondence (high-light / low-dark; Melara, 1989), on perception of the bounce/stream illusion.

METHODS

Participants

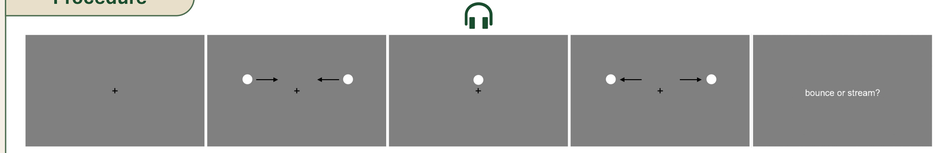
- 27 participants (5 male)
- Aged 19-31 (22.6, SD ±3.6)
- Right-handed

Stimuli

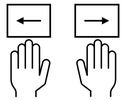
Auditory stimulus
- Pure tone, 10ms duration
- 1800Hz or 600Hz

Visual stimulus
- Circular disk, 0.8° in diameter
- 80.6 cd/m^2 or 4.6 cd/m^2

Procedure



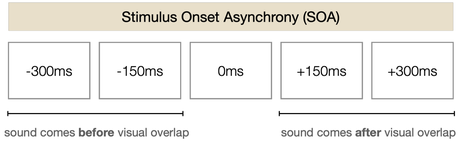
- Participants responded with arrow keys whether they perceived the two discs as “streaming past” or “bouncing off” each other, using their left and right index fingers.
- Half of the participants(13) used the right arrow key to respond “bounce,” and the other half(14) used the left arrow key to respond “bounce.”



Conditions

Pitch \ Lightness	dark	light
low	**low-dark**	*low-light*
high	*high-dark*	**high-light**
no sound	ns-dark	ns-light

*coded: **crossmodally congruent**, *crossmodally incongruent*, unimodal

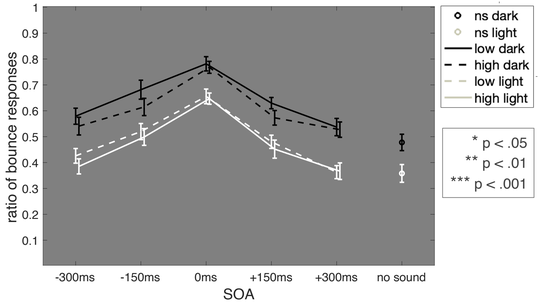


- 30 repetitions of each pitch x lightness x SOAs
- 660 trials in total, completely randomized in order

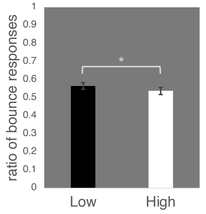
RESULTS

- Percentage of ”bounce” responses for each condition was calculated for statistical analysis (repeated measures ANOVA).
- Data from the two groups with opposite response-key mappings were pooled, because they did not show statistical differences.

Main effects of Pitch, Lightness, and SOA

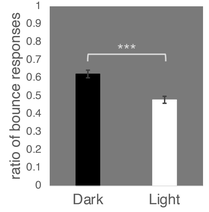


- Consistent with prior studies, there was a main effect of SOA irrespective of auditory or visual stimulus features (p<.001).
- Of more relevance to the purpose of this study, there were main effects of pitch and lightness:



Pitch

participants reported more bounces when the sound was low-pitched than when it was high-pitched (Left, p= .010).

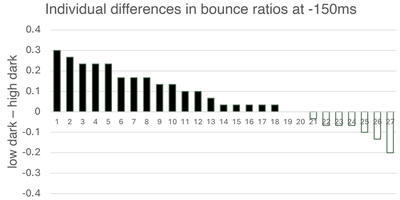


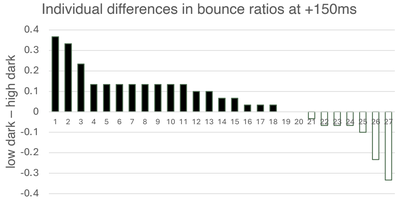
Lightness

and when the disks were dark than when they were light (Left, p <.001),

Effects of Lightness-Pitch Crossmodal Correspondence

- There was no significant interaction effect of pitch and lightness (p= .218).
- Post-hoc analyses did not reveal any significant differences in ratio of bounce responses caused by crossmodal correspondence.
- However, individual data plots hint that crossmodal correspondence may have come into play when SOA did not sufficiently resolve ambiguity in the illusion.





- ±150ms are less clear than 0ms and ±300ms in terms of indicating the temporal relationship (i.e. simultaneity) between visual and auditory stimuli.
- At ±150ms, more than half of the participants showed enhanced bounce-perceptions in the crossmodally congruent case(low dark) compared to the incongruent case(high dark).

CONCLUSION

Findings from this study suggest that beyond the temporal relationship between audiovisual information, the sensory features of auditory and visual stimuli can perceptually resolve an ambiguous motion stimulus. Crossmodal correspondence tended to aid disambiguation when the audiovisual temporal relationship was unclear.

References
- Sekuler, R., Sekuler, A. B., & Lau, R. (1997). Sound alters visual motion perception. *Nature*, 385(6614).
- Melara, R. D. (1989). Dimensional interaction between color and pitch. *Journal of Experimental Psychology: Human Perception and Performance*, 15(1), 69.