

Cross Modal Object-Based Attentional Guidance

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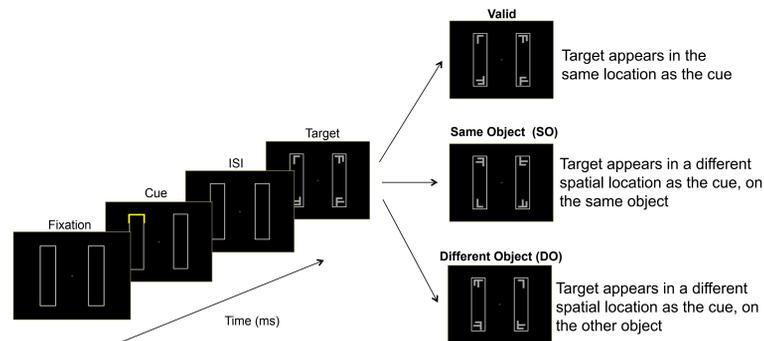
Introduction

- In the visual system, attentional selection is organized preferentially around objects, a phenomenon known as object-based attention (Egly, Driver, & Rafal, 1994).
- While our understanding of object-based attention within the visual modality is well articulated, little is known about the guiding role of objects across modalities (e.g., visual and auditory).
- If the human visual system is organized around the perception of objects, we hypothesize that the sensory interactions between vision and audition may function similarly (Spence & Driver, 1997).
- In addition, we hypothesize that this object-based guidance is a result of attentional prioritization, similar to that observed in the visual system (Shomstein & Yantis, 2002; Drummond & Shomstein, 2010).

Object-Based Attention

Adapted a standard object-based attention paradigm (Egly, Driver, & Rafal, 1994):

Conditions:



Typical Result: RTs for Valid << SO < DO

Purpose

To investigate the cross modal nature of object-based attention within the visual and auditory modalities

Apparatus

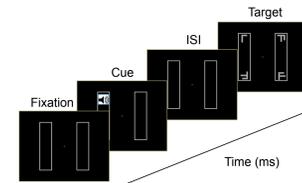


- Visual images are projected onto a 51" x 37" cloth screen
- Speakers strategically placed behind the screen at 2 diagonal locations

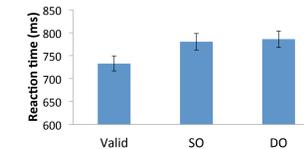
Experiment 1: Auditory Cue, Visual Target

QUESTION: Do auditory cues elicit object-based effects in response to visual targets?

Experimental Setup:

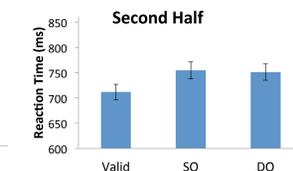
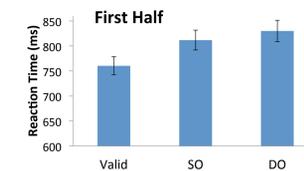


- Fixation:** 1000ms
- Auditory Cue:** 4500hz tone, 250ms
- ISI:** 260ms
- Visual Target:** T or L, along with three T/L hybrid distractor shapes, 2000ms
- Conditions:** Target appears at Valid, SO, or DO locations
- Task:** T/L target discrimination



- Space-based effect: Valid is faster than Invalid
- Object-based effect: SO and DO not significantly different

Stability of the effect over time: split data into half:



- Both: Valid faster than Invalid
- First Half: SO and DO are different
- Second Half: No difference between SO and DO

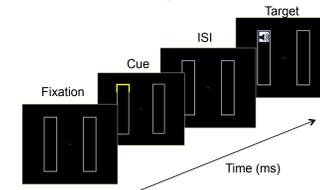
ANSWER: Yes! When the task is new and difficult (first half), object-based effects emerge.

CONCLUSION: Object-based effects observed in first half of trials, suggesting that objects guide attention when the task is difficult. When the task is familiar, objects no longer exert an influence.

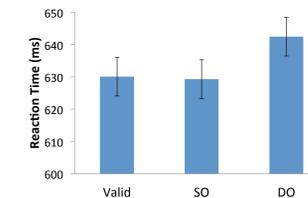
Experiment 2: Visual Cue, Auditory Target

QUESTION: Do visual cues elicit object-based effects in response to auditory targets?

Experimental Setup:



- Visual Cue:** 140ms
- Auditory Target:** 4000hz or 4050hz tone
- Conditions:** Target appears at Valid, SO, or DO locations
- Task:** High/Low frequency discrimination



- Space-based effect: No difference between Valid and Invalid (Spence & Driver, 1997).
- Object-based effect: SO and DO are different.

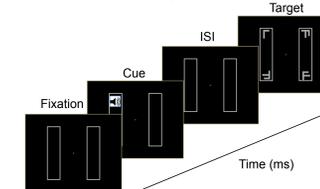
ANSWER: Yes! Visual cues elicit object-based effects in auditory targets.

CONCLUSION: Objects guide attentional selection when an auditory target is preceded by a visual cue.

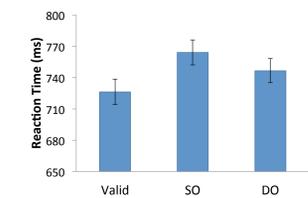
Experiment 3: Auditory Cue, Visual Target (Biased)

QUESTION: When different object targets occur more frequently than same object targets, are different object targets prioritized?

Experimental Setup:



- Setup:** Identical task to Exp. 1
- Bias:** Twice as many DO targets as SO targets



- Space-based effect: Valid faster than invalid.
- Object-based effect: SO and DO are different
- Prioritization: DO targets faster than SO targets

ANSWER: Yes! Different object targets are prioritized when frequency of different object targets increases.

CONCLUSION: Attentional guidance accommodates subtle changes in input in order to perform the task more efficiently, suggesting that object-based orienting is a default setting.

References

- Drummond & Shomstein (2010). Object-based attention: Shifting or uncertainty? *Attention, Perception, & Psychophysics*, 72 (7), 1743-1755.
- Egly, R., Driver, J., & Rafal, R. (1994). Shifting visual attention between objects and locations: Evidence from normal and parietal lesion subjects. *Journal of Experimental Psychology*, 123 (2), 161-177.
- Shomstein, S. & Yantis, S. (2002). Object-based attention: sensory modulation or priority setting?. *Perception and Psychophysics*, 64 (1), 41-51.
- Spence, C. & Driver, J. (1997). Audiovisual links in exogenous covert spatial orienting. *Perception and Psychophysics*, 59 (1), 1-22.

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Conclusions

- Object-based attention is utilized cross-modally.
- Auditory cues elicit object-based effects in visual targets; visual cues elicit object-based effects in auditory targets.
- Attentional selection combines information from both the auditory and visual modalities to create a complete, multisensory representation of the external world.
- Object-based attention, even cross-modally, acts as a default setting that can be overridden in the presence of an alternate, more effective strategy.