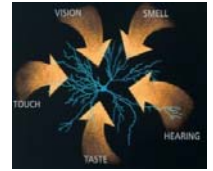


Dual-Tasking with Complex Stimuli Within and Between Sensory Modalities



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Introduction

- Research into whether it is harder to divide attention within or between sensory modalities has elicited different answers.
- Some argue for independence between sensory modalities (Duncan, Martens, & Ward, 1997; Treisman & Davies, 1973), while others support the existence of a common attentional resource (Spence, Nicholls, & Driver, 2001).

- Rapp and Hendel (2003) have suggested that attention can be selectively directed to perceptual or to semantic levels of representation.
- The studies investigating these issues have typically used simple stimuli (i.e., alphanumeric characters, flashes or vibrations).

- In this study, we used a target detection paradigm with complex stimuli and varied the number of tasks (single vs. dual), task modality (auditory vs. visual), and task level (perceptual vs. semantic).
- We tested for a dual task cost, crossmodal interference, and whether there are separate attentional resources for perceptual and semantic levels of representation.

Methods

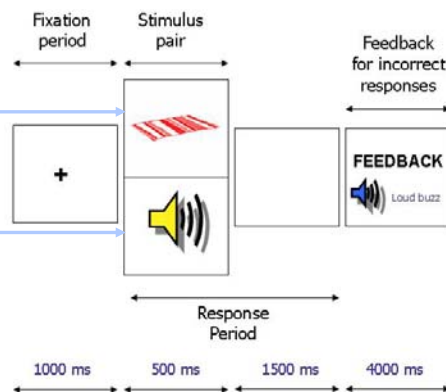
- In a speeded target detection task, participants (N = 16) were presented with a bimodal stimulus and had to detect one or two of the four types of target (Table 1).

- Participants responded by pressing the "m" key when there was a target and the "c" key when no target was present.

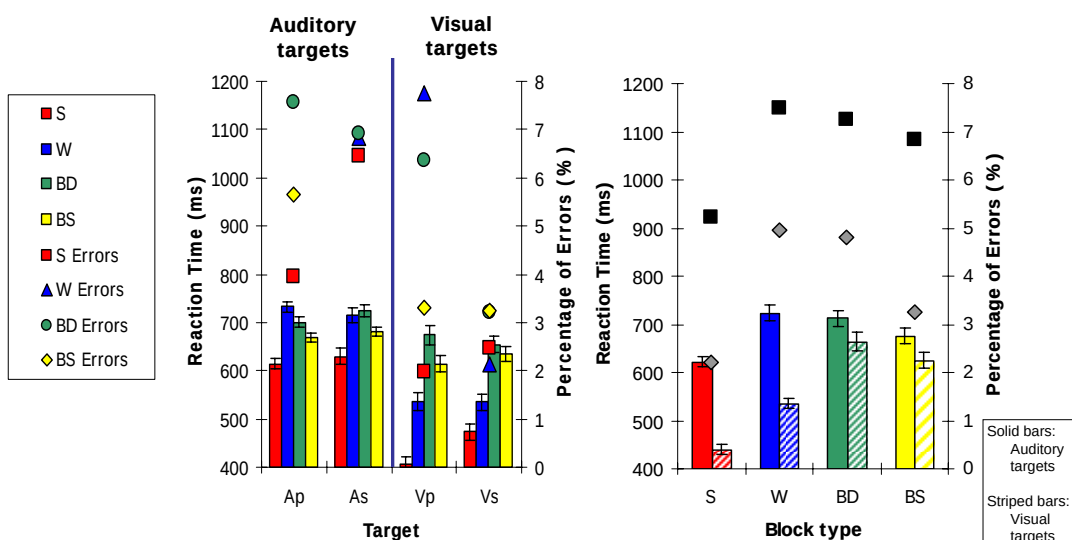
The visual stimuli consisted of 10 pictures in each of two semantic categories (food & household items), which were edited to create two perceptual colour categories (red & green).

The auditory stimuli consisted of 10 sounds in each of two semantic categories (living creatures & machines), which were edited to create two perceptual rhythm categories (one beat vs. two).

10 combinations of tasks: 4 single task & 6 dual task blocks; 20 practice trials & 64 test trials per block. The ratio of target present trials to target absent trials was 1:1. The response keys were counterbalanced and the order of blocks was randomised. There was a maximum of 1 target per trial.



Target Abbrev.	Target	Block Abbrev.	Block type	Task Targets to detect
Ap	Auditory perceptual 2 beat sound	S	Single task	Ap
		W	Within modality	Ap As
		BD	Between modalities Different levels	Ap Vs
		BS	Between modalities Same level	Ap Vp
As	Auditory semantic Living creature sound	S	Single task	As
		W	Within modality	Ap As
		BD	Between modalities Different levels	As Vp
		BS	Between modalities Same level	As Vs
Vp	Visual perceptual Red picture	S	Single task	Vp
		W	Within modality	Vp Vs
		BD	Between modalities Different levels	As Vp
		BS	Between modalities Same level	As Vp
Vs	Visual semantic Food picture	S	Single task	Vs
		W	Within modality	Vp Vs
		BD	Between modalities Different levels	Ap Vs
		BS	Between modalities Same level	As Vs



Results

- There was better performance:
 - In Single vs. Dual task conditions
 - In Within modality blocks vs. Between modality blocks
 - Same vs. Different levels of representation blocks
- Faster RTs for visual targets than auditory targets.
- Faster RTs for perceptual targets than semantic targets.

Discussion

- Our results show that
 - doing two tasks is harder than one
 - dividing attention across modalities is harder than within
 - dividing attention across levels of representation is harder than within

These findings support the notion of a common attentional resource.

Our finding of crossmodal interference may have been caused by our use of complex, meaningful stimuli as opposed to simple stimuli (c.f. Duncan et al., 1997). Grill-Spector & Kanwisher (2005) have shown that object recognition occurs at the same time as object detection. Hence, interactions among the object representations of the visual and auditory stimuli could provide a mechanism for crossmodal interference.

In future studies will replicate this paradigm with simple stimuli, and also investigate what types of commonality between stimuli cause crossmodal interference.

References

- Duncan, J., Martens, S., & Ward, R. (1997). Restricted attentional capacity within but not between sensory modalities. *Nature*, **387**, 808-810.
- Grill-Spector, K., & Kanwisher, N. (2005). Visual Recognition: As Soon as You Know It Is There, You Know What It Is. *Psychological Science*, **16**, 152-160.
- Rapp, B., & Hendel, S. K. (2003). Principles of cross-modal competition: Evidence from deficits of attention. *Psychological Bulletin and Review*, **10**, 210-129.
- Spence, C., Nicholls, M. R., & Driver, J. (2001). The cost of expecting events in the wrong sensory modality. *Perception & Psychophysics*, **63**, 330-336.
- Treisman, A., & Davies, A. (1973). Divided attention to ear and eye. In S. Kornblum (Ed.) *Attention and Performance IV*. Academic Press, 101-117.