The effect of time pressure on overall similarity sorting

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Introduction

Previous work suggests many natural categories are organised around an overall similarity (family resemblance) structure (Rosch & Mervis, 1975).

However, when people are asked to classify stimuli without feedback they tend to sort on the basis of a single dimension (Medin et al. 1987).

Non-analytic versus analytic sorting strategies

Non-analytic processing: Often assumed to be a **quick**, **primitive holistic process** that elicits overall similarity (OS) sorting (e.g. Kemler Nelson, 1984). Evidence supporting this theory comes from a variety of sources:

- Developmental studies (e.g. Kemler, 1982).
- Concurrent load (Smith & Kemler Nelson, 1984).
- Incidental learning (Kemler Nelson, 1984).
- Time pressure (e.g. Ward, 1983).

Analytic processing: An **effortful**, **verbal process** which elicits dimensional responding (e.g. Kemler Nelson, 1984). Often assumed to result in single-dimensional (1D) sorting (e.g. Smith & Kemler Nelson, 1984).

The spatial integration effect

Milton & Wills (2004) showed that stimuli that are more spatially separable elicit higher levels of OS sorting than do spatially integrated stimuli (see Figure 1).

One explanation for this finding is that OS sorting observed was the result of an analytic, dimensional summation strategy.

One prediction of this account is that contrary to previous findings (Ward, 1983), is that time pressure should reduce OS sorting and increase 1D sorting.

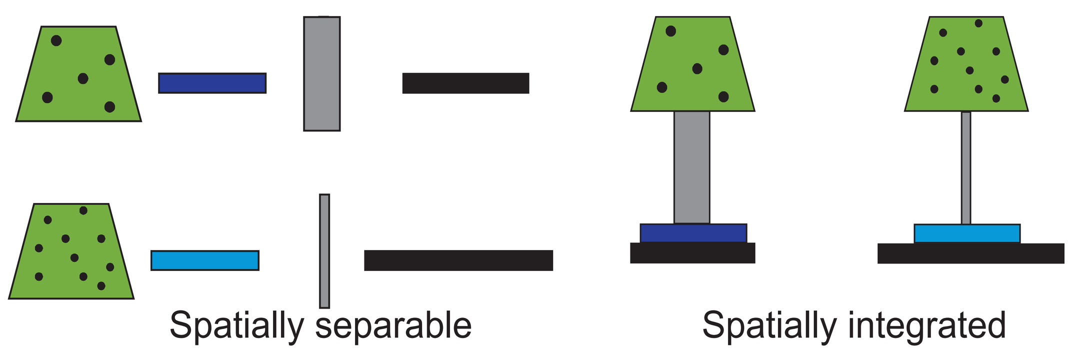

Figure 1

Experiment 1a

Tests prediction of Milton & Wills (2004) that time pressure reduces OS sorting and increases 1D sorting.

Method

28 participants in 2 between-subjects conditions (high time pressure and low time pressure).

Time pressure applied by manipulating the duration stimuli were presented (HTP = 1024 ms; LTP = 4096 ms). Once the stimulus disappears, there is no response deadline (e.g. Lamberts & Freeman, 1999).

Participants asked to categorize the stimuli into two groups in the way that seems most natural. Participants classify 12 blocks of 10 stimuli. See Figure 2 for trial procedure.

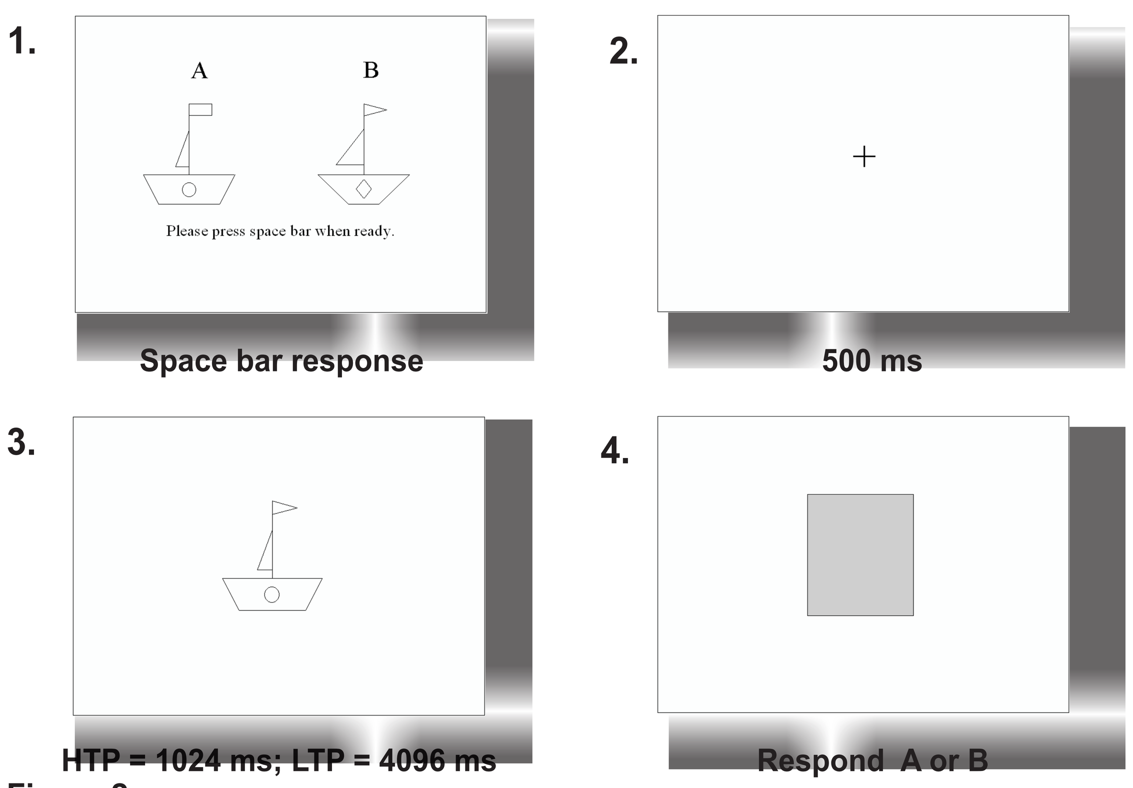

Figure 2

Stimuli were line drawings of boats modelled on Lamberts (1998). The two category prototypes are shown in Figure 3. Figure 4 shows abstract stimulus structure.

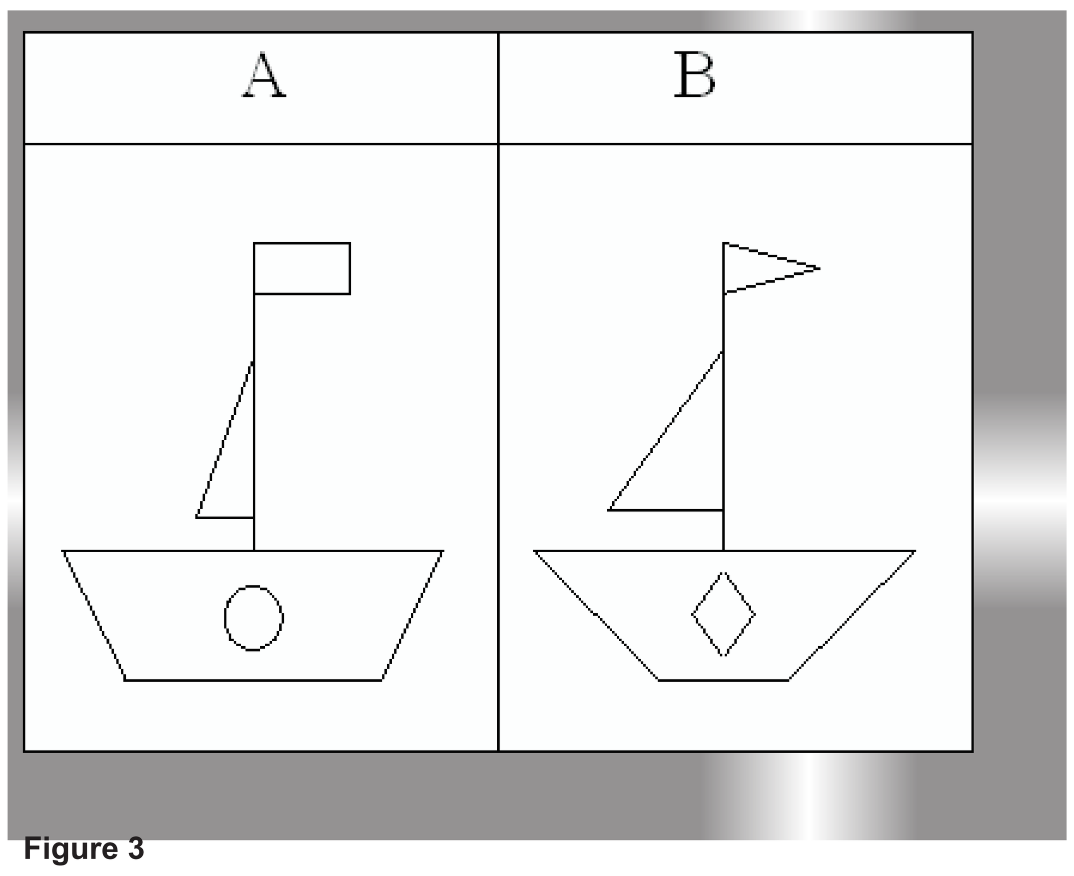

Figure 3

Category							
A				B			
D1	D2	D3	D4	D1	D2	D3	D4
1	1	1	1	0	0	0	0
1	1	1	0	0	0	0	1
1	1	0	1	0	0	1	0
1	0	1	1	0	1	0	0
0	1	1	1	1	0	0	0

Figure 4

Results

OS sorting was significantly lower in the high time pressure condition than the low time pressure condition ($p < .01$).

1D sorting was significantly higher in the high time pressure condition than the low time pressure condition ($p < .05$).

First demonstration in free classification procedure that time pressure can reduce OS sorting.

Findings provide evidence that OS sorting can be the result of an effortful, analytic, dimensional summation strategy.

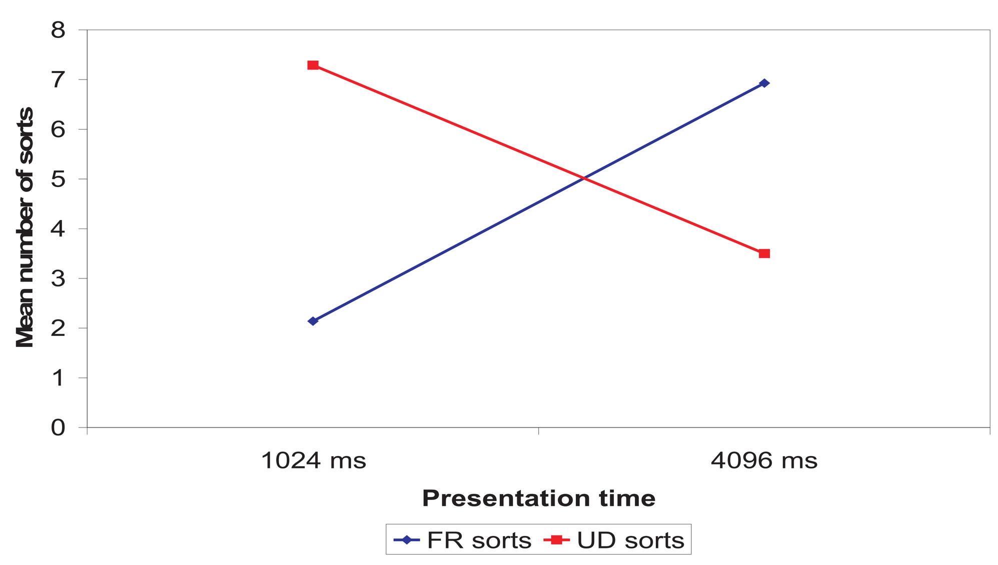

Figure 5

Experiment 1b

Attempts reconcile the discrepancy between results of Exp. 1 and previous work (e.g. Ward, 1983). Exp. 2 uses multiple time points to examine time course of OS sorting.

Predictions

At 64 ms OS sorting will be low and 1D sorting will dominate. Prediction based on stochastic sampling models (e.g. EGCM, Lamberts, 1998) which propose object's representation involves gradual accrual of perceptual information.

At 256 ms, overall similarity sorting will rise. OS sorting the result of a quick, non-analytic process (e.g. Ward, 1983).

At 384 ms, overall similarity sorting will fall. Analytic processing begins, stimuli are separated into constituent dimensions and permits dimensional responding (Ward, 1983) but insufficient time available for dimensional summation strategy (Milton & Wills, 2004).

At 640 ms overall similarity sorting will rise again. OS the result of an analytic, "majority features", dimensional summation strategy (Milton & Wills, 2004).

Method

Same stimuli and procedure as in Experiment 1.

56 participants in four between-subject conditions (64 ms, 256 ms, 384 ms, and 640 ms).

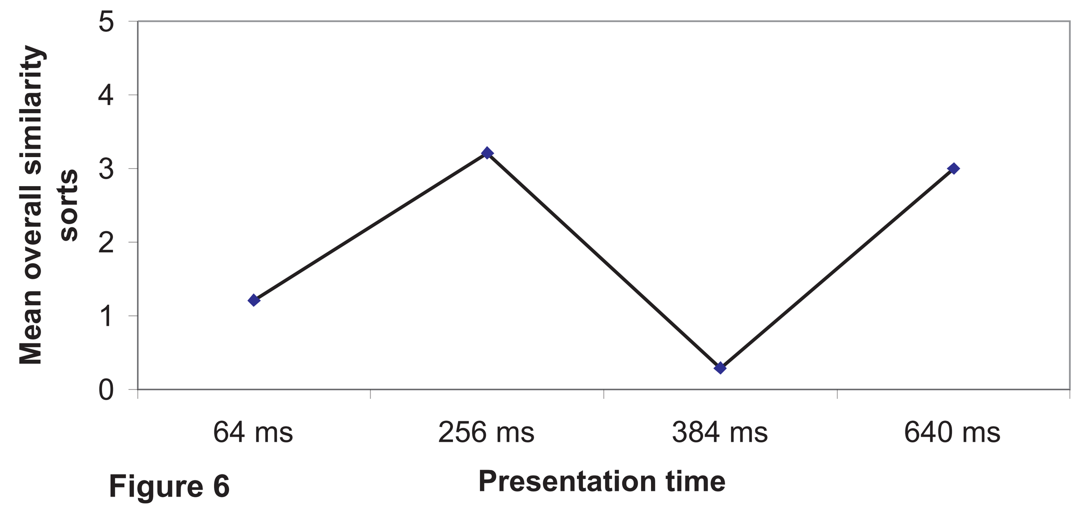

Figure 6

Results

A significant effect of time pressure on OS sorting (See Figure 6). OS starts low (64 ms), rises at 256 ms ($p < .07$), before falling at 384 ms ($p < .01$), and rising again at 640 ms ($p < .02$). Also a significant effect of time pressure on 1D sorting, which starts high at 64 ms, falls at 256 ms ($p < .02$), rises again at 384 ms ($p < .005$) and then falls again at 640 ms ($p < .02$).

Experiment 2

The results of Experiments 1a and 1b indicate that the time course of OS sorting is non-monotonic and suggests that OS sorting can be the result of both non-analytic and analytic processes, depending on the level of time pressure applied.

However, previous research suggests OS sorting in a triad task rises as time pressure decreases (e.g. Ward, 1983). Exp 2 investigated the time course of OS sorting in a triad task.

Method

Two dimensional boats and used the abstract structure presented in Figure 7.

150 participants in five between-subjects conditions (640 ms, 1024 ms, 2048 ms, 3072 ms, and 7500 ms).

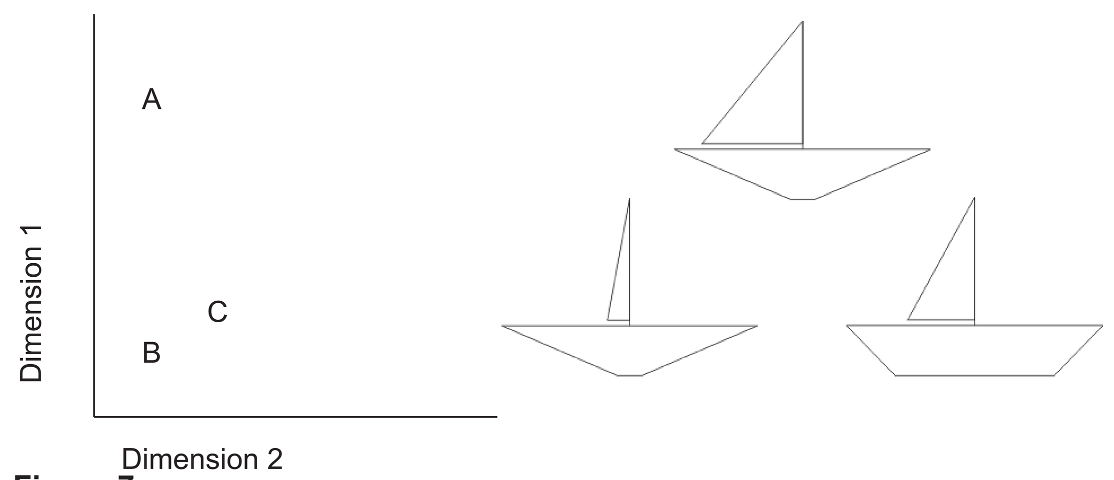

Figure 7

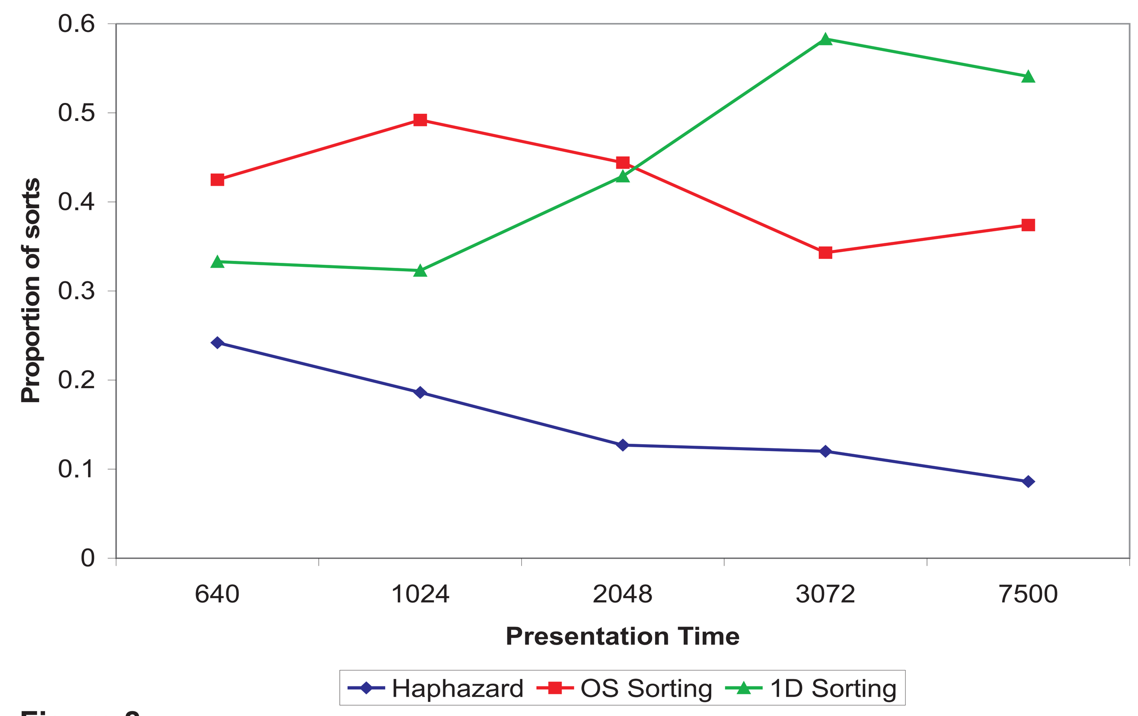

Figure 8

Results

A significant main effect of OS sorting ($p < .02$). OS sorting rises between 640ms and 1024ms ($p < .01$) and falls between 2048ms and 3072ms ($p < .05$). 1D sorting also yields a main effect ($p < .001$). 1D sorting rises between 1024ms and 2048ms ($p < .02$) with a further (near significant) rise between 2048ms and 3072ms ($p < .08$).

Conclusions

Evidence that the time course of OS sorting is **non-monotonic**.

The findings presented are not immediately explicable by current models of categorization.

Seems unlikely that a single-process model would be able to account for the non-monotonic time course of overall similarity sorting in Experiments 1b and 2.

Results provide support for the idea that overall similarity sorting can be the result of both **analytic** and **non-analytic** processes depending on the task demands.

References

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