Free Classification: Evidence for an Analytic System of Overall Similarity Sorting

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Introduction

Previous work suggests many natural categories are organised around an overall similarity (OS) 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 OS sorting (e.g. Kemler Nelson, 1984). Evidence comes from a variety of sources (e.g. Kemler, 1982; Smith & Kemler Nelson, 1984; 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 the OS sorting observed was the result of an analytic, dimensional summation strategy.

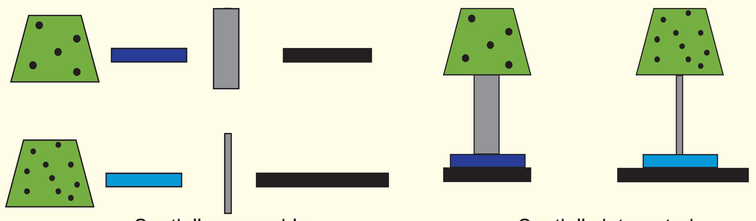


Figure 1

Experimental Overview

Milton & Wills's (2004) dimensional summation hypothesis suggests that disruption of analytic processes (e.g. via a concurrent load) would **decrease** OS sorting, whilst promotion of an analytic strategy (e.g. instructional biasing) would **increase** OS sorting.

Experiment 1

An analytic account of OS sorting predicts a concurrent load task should reduce OS sorting in comparison to no load.

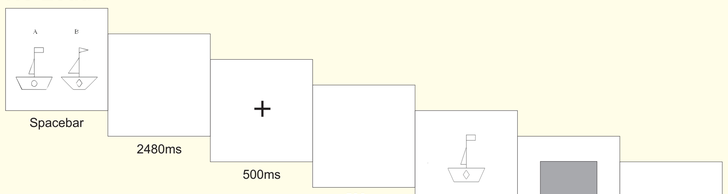
Method

63 participants in three between-subjects conditions (heavy load, moderate load and no load).

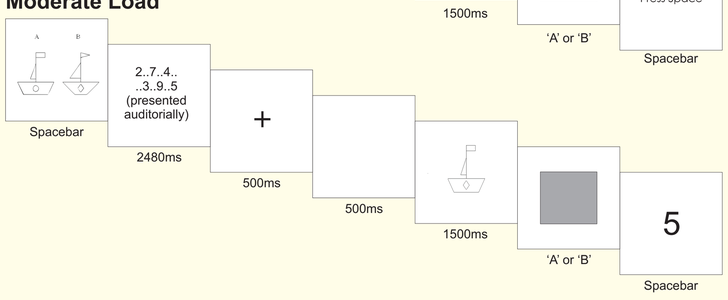
Stimuli were line drawings of boats modeled on Lamberts (1998). Figure 3 shows abstract stimulus structure.

Participants classify 12 blocks of 10 stimuli. See Figure 2 for trial procedure.

No Load

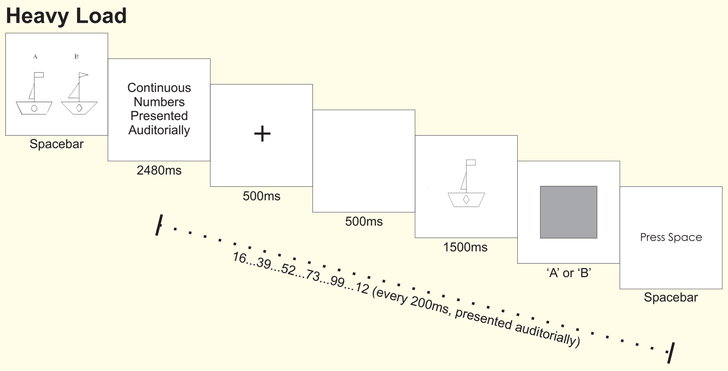


Moderate Load



In the moderate load condition participants are required to perform a digit probe task. Each trial begins with 6 digits presented over headphones which must be remembered through the categorization process. Participants are then presented with a single number on the screen and they must indicate which digit in the sequence came after the presented number.

Heavy Load



In the heavy load condition, digits are presented over headphones every 200ms throughout the trial (except at the start of the trial when the prototypes are presented). Participants are instructed to count the number of even digits they hear. At the end of each block, they have to recall the number of even digits they heard in that block.

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 3

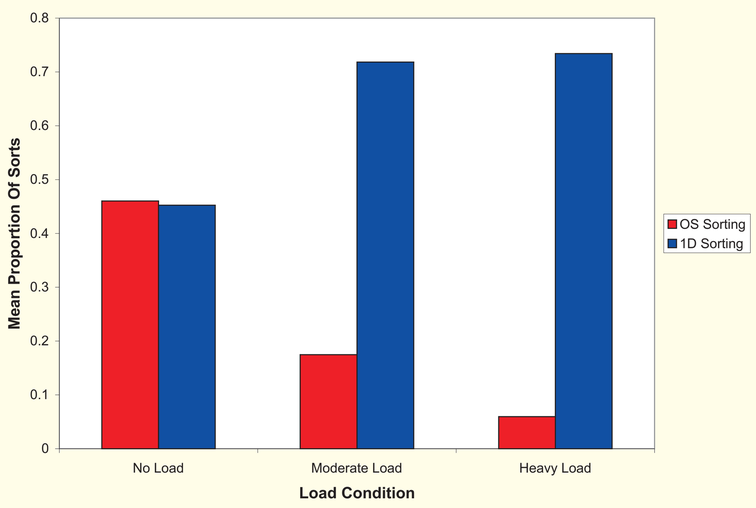


Figure 4

Results

The results are shown in Figure 4. OS sorting **decreased** significantly with a moderate load ($p < .025$) and heavy load ($p < .001$). 1D sorting **increased** significantly with a moderate load ($p < .05$) and heavy load ($p < .025$).

Supports the idea that OS sorting can be the result of an analytic process.

Experiment 2

If participants are given instructions that encourage an analytic sort strategy then it is expected that this will increase OS sorting in comparison to a control group given neutral instructions.

Method

28 participants in two between-subject conditions

Participants told to sort the stimuli in the way they felt most natural. Those given analytic instructions also told to be meticulous and careful in their sorting.

Participants classify 8 blocks of 10 stimuli. Stimuli were spatially integrated lamps used by Milton and Wills (2004) with same abstract structure as Experiment 1.

A match-to-standards procedure was used in which participants were required to classify the unmarked lamp as either category "A" or "B" (see Figure 5).

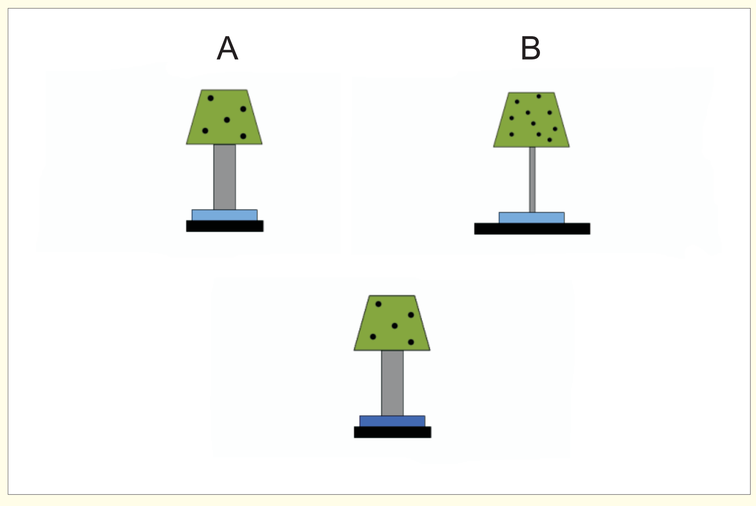


Figure 5

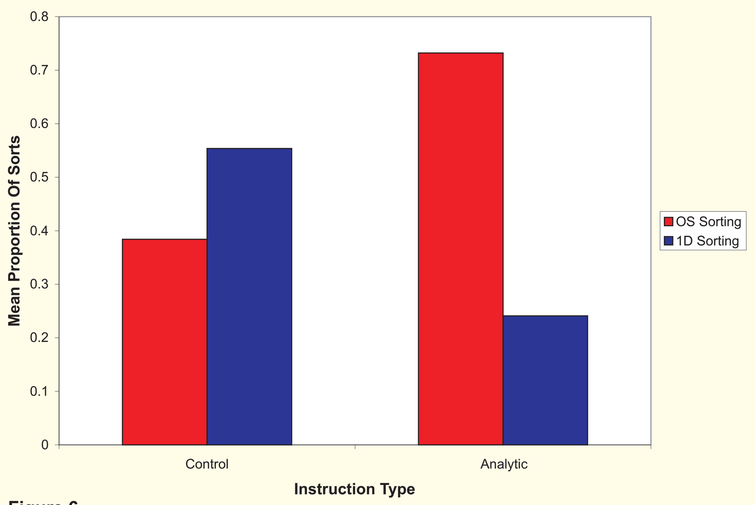


Figure 6

Results

The results are shown in Figure 6. OS sorting **increased** significantly when analytic instructions were given ($p < .025$). 1D sorting **decreased** significantly with analytic instructions ($p < .025$).

Provides further support for the idea that OS sorting can be the result of an analytic process.

Experiment 3

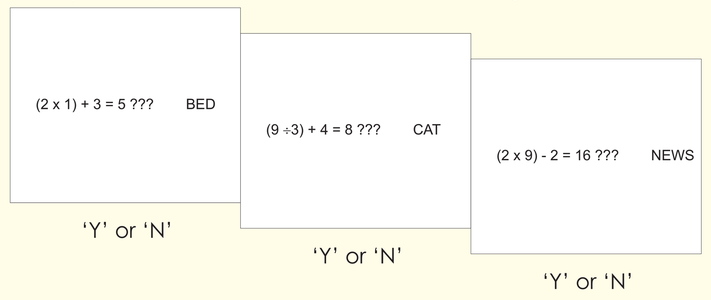
If the effects of the concurrent load manipulations of Experiment 1 are due to a limiting of working memory (WM) capacity, then individuals with a high working memory capacity should find a dimensional summation strategy easier and be more likely to sort by OS than those with a lower working memory capacity.

Method

46 participants sorted the stimuli used in Experiment 2, then completed the Ospan WM task (Figure 7).

Example of a span of 3 task

Participants first perform mental arithmetic whilst remembering words



They are then asked to recall the words in order

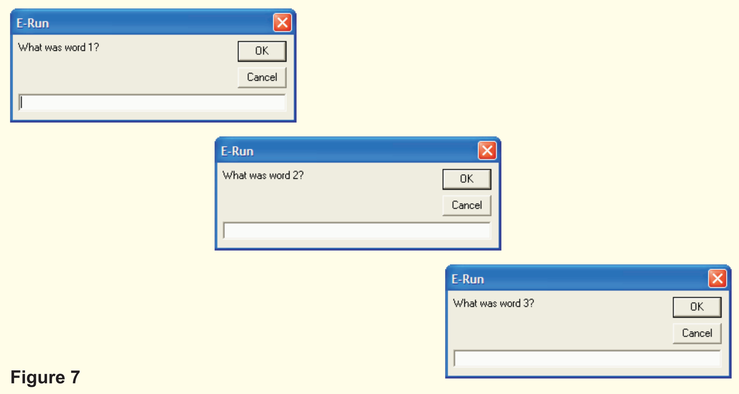


Figure 7

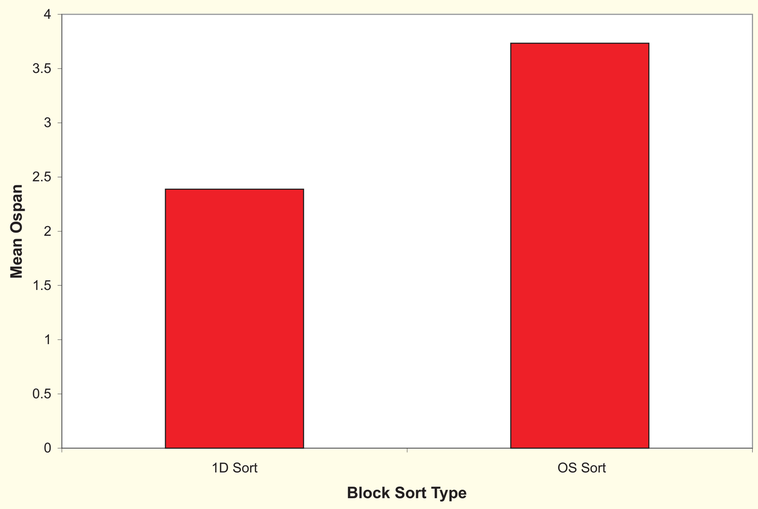


Figure 8

Results

The results are shown in Fig 8. OS sorters were found to have significantly higher Ospan scores than 1D sorters ($p < .025$).

Conclusions

Previous work suggests OS sorting is the result of a quick, non-verbal, non-analytic process (e.g. Kemler Nelson, 1984).

The current work provides strong evidence that under certain conditions OS sorting can also be due to an **effortful, verbal analytic** process. Our results showed:

- Decreasing available WM resources via a concurrent load task **reduces** OS sorting.
- Encouragement to perform an analytic strategy **enhances** OS sorting.
- Participants with a greater WM span more likely to sort by OS.

References

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