The compression of bound and unbound features in visual short-term memory

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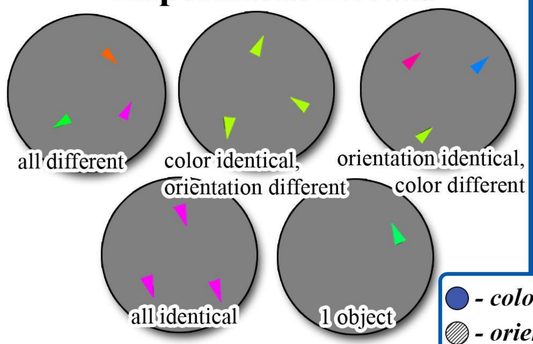
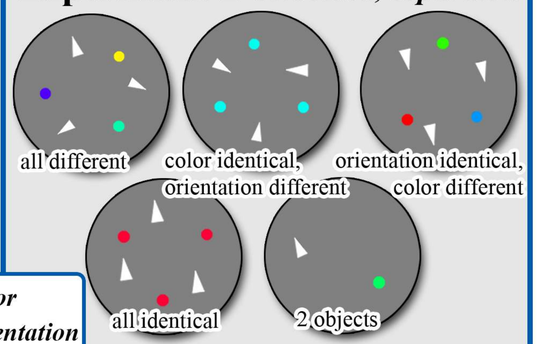
In numerous studies, it is well documented that the visual system exploits regularities of multiple objects for the more efficient perception and storage of large chunks of information, thus struggling the severe limits of processing bottleneck. In terms of information framework, this can be called compression. It was shown that visual short-term-memory (VSTM) uses regularities in object features to compress the data (Brady, Konkle, & Alvarez, 2009). Also, it is likely that VSTM can store features of an object bound together, although at some cost of binding (Fougnie, Asplund, & Marios, 2010; Luck & Vogel, 1997). We tested how compression is carried out for separable features bound in objects, unbound and spatially separated, and unbound and overlapped.

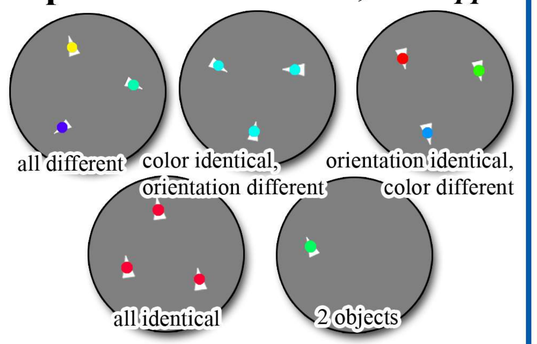
Experiment 1 *Bound*



Experiment 2 *Unbound, separated*

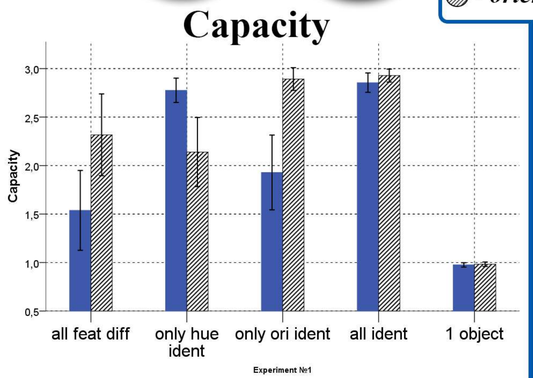


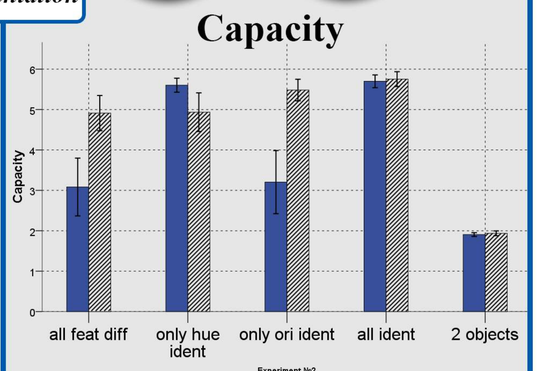
Experiment 3 *Unbound, overlapped*

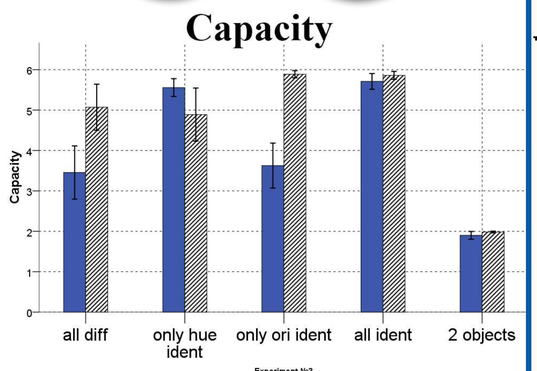


- *color*
- *orientation*

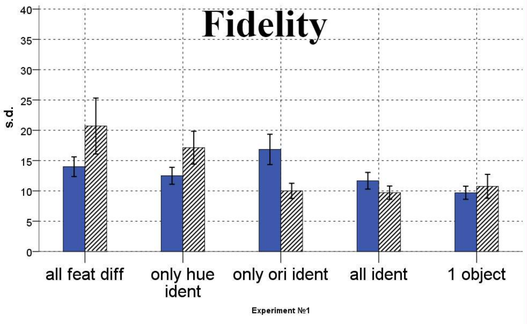
Capacity

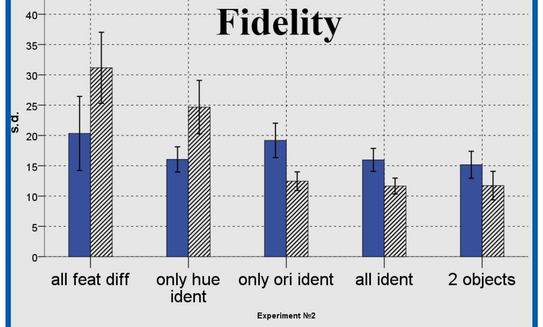


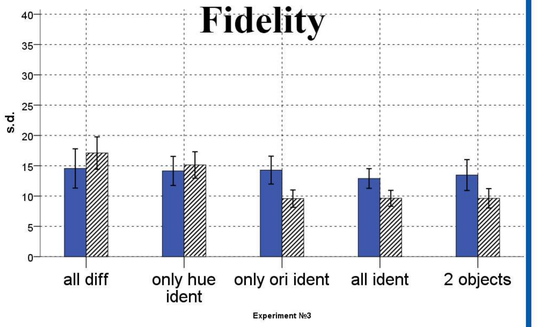




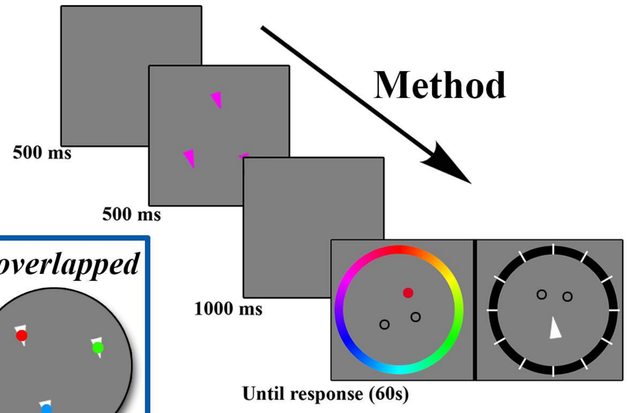
Fidelity





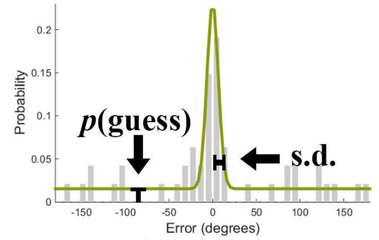


Method



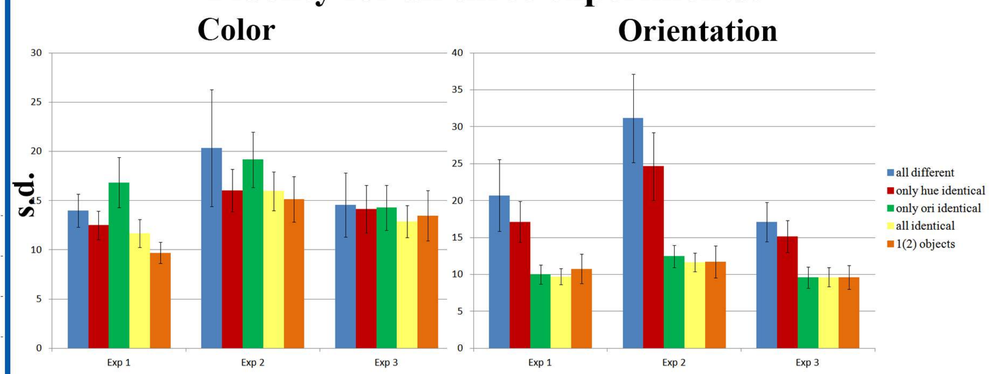
capacity = (1 - *p*(guess)) x set size

fidelity ~ 1 / s.d.



Mixture model (created by Memtoolbox)

Fidelity for all three experiments:



Using the mixture model algorithm (Zhang & Luck, 2008; Suchow, Brady, Fougnie & Alvarez, 2013), we estimated the capacity and fidelity of VSTM.

Conclusions:

- **Feature compression in VSTM can occur independently for each dimension, even when those features are bound in objects: A feature shared by multiple objects inflates VSTM capacity for that feature and does not affect another dimension.**
- **Compression also increases the fidelity of VSTM for orientation, but has no systematic effect on the fidelity of VSTM of color.**
- **The fidelity of VSTM for the features of bound objects is greater than that of unbound ones. The difference is more pronounced for orientation.**