

Reduced attentional competition between objects that follow real-world regularities

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Introduction

Many well-control studies using low-level stimuli have revealed severe capacity limitations in visual perception, for example in visual search¹. In contrast to this, performing similar tasks in real-world situations is remarkably effective². This fact is surprising because real-world scenes often contain hundreds of objects that compete for attention³. Here, we offer a novel explanation for real-world perceptual efficiency: Objects in the real world are not placed in random locations, but are appearing in predictable locations relative to other objects. Such regularities could enable us to effectively group objects, and thereby reduce the number of objects within a scene. Here, we show neural and behavioral evidence that attentional competition is reduced if objects follow such regularities, indicating more efficient processing.

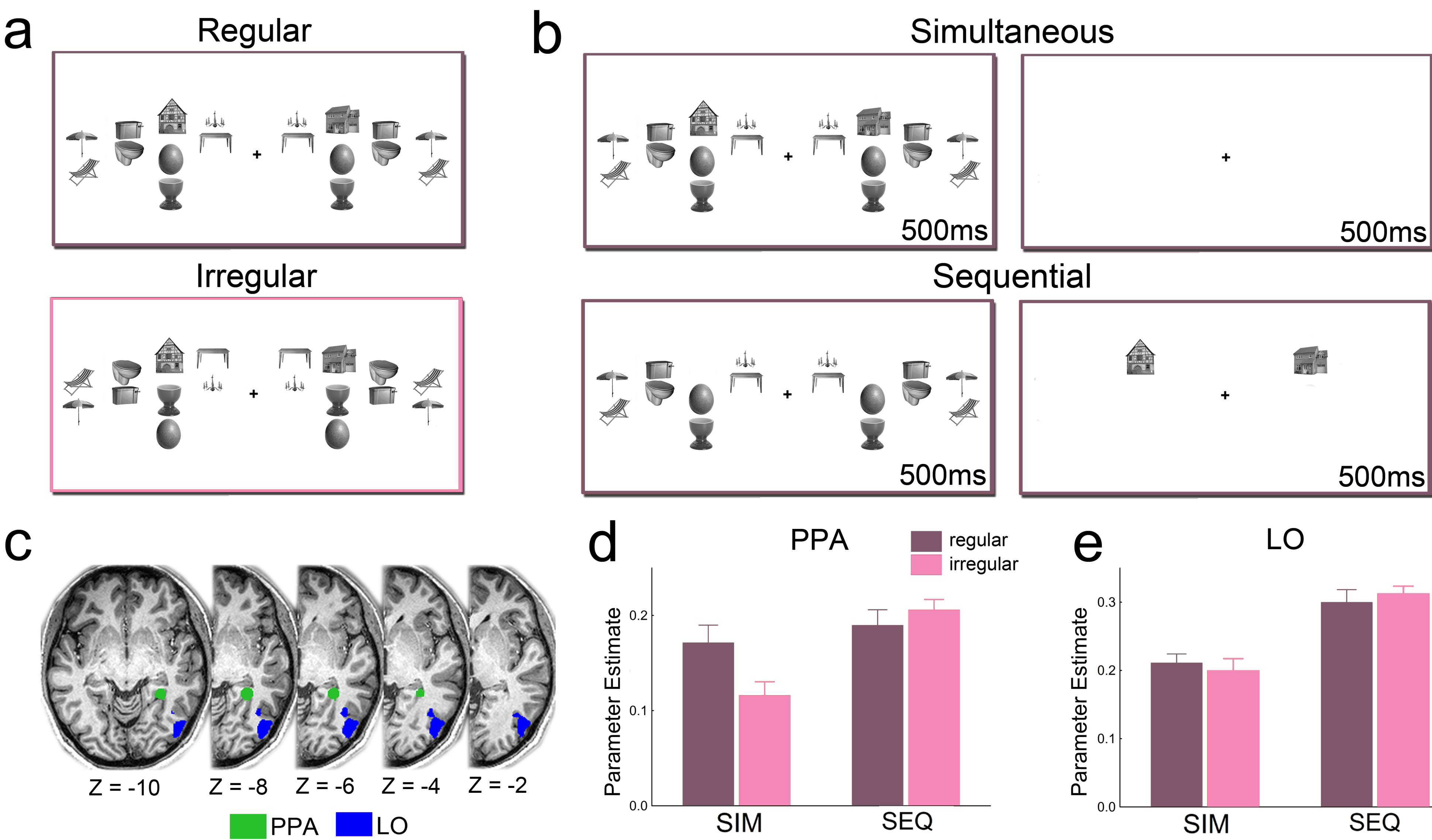
What's the set size of scenes?



Stimuli

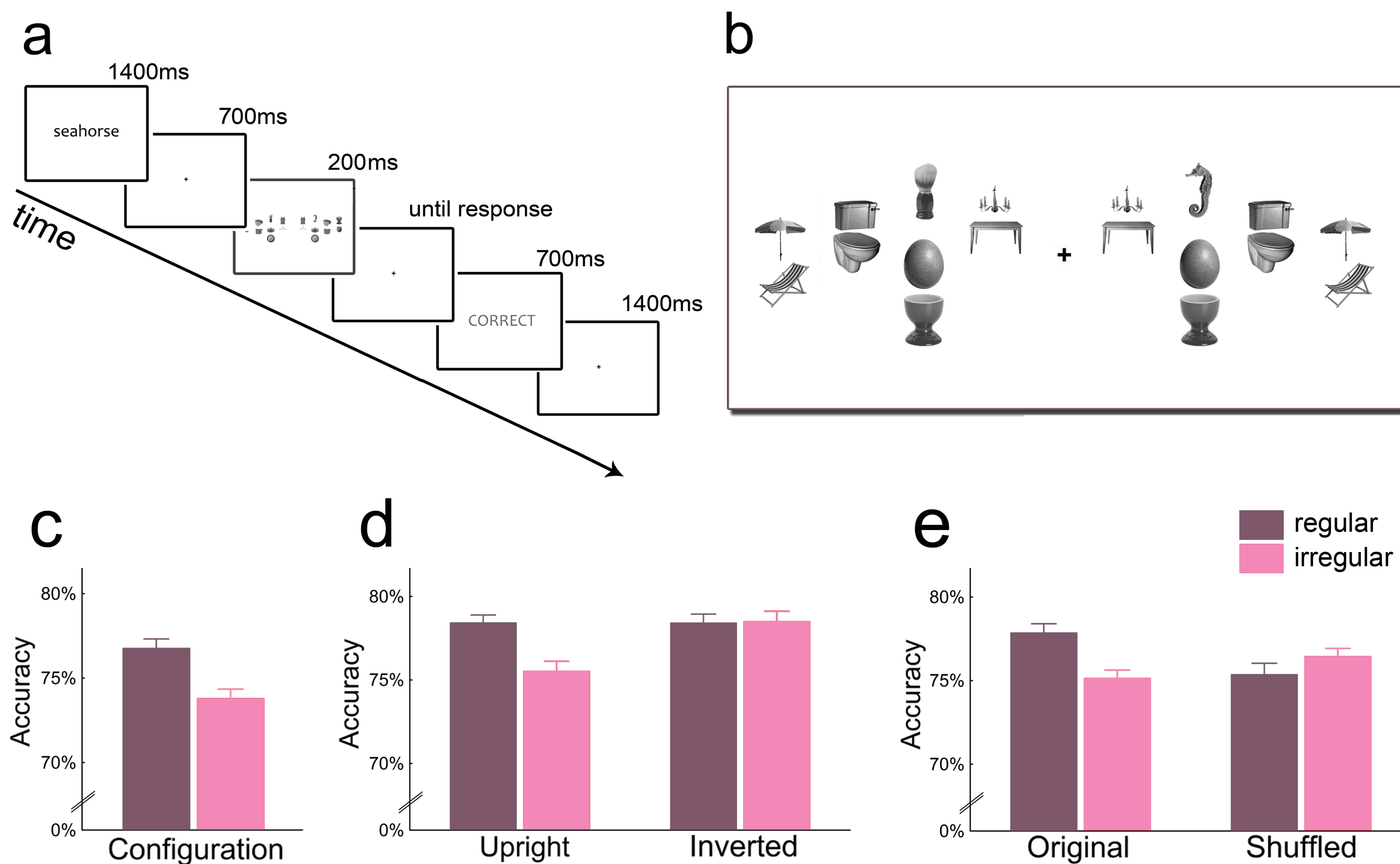


fMRI Experiment



a) Each display consisted of two house stimuli that were surrounded by a total of eight object pairs presented in regular or irregular configurations. b) Competition was manipulated by presenting the houses and the surrounding pairs sequentially or simultaneously. c) Location of right-hemispheric PPA and LO in a representative participant. d) When houses and object pairs were presented simultaneously (SIM), house-selective PPA showed stronger responses when the object pairs were positioned according to real-world regularities. No such effect was observed for sequential presentation (SEQ). e) Contrary to house-selective PPA, object regularity did not modulate activity in object-selective LO.

Visual Search Experiment



a) Participants had to decide whether the target (indicated by a word cue) was on the right or on the left side of a briefly presented cluttered visual display. b) Search arrays were the same displays as in the fMRI experiment, but houses were replaced by the search target and a single distracter. Regular distracter pairs led to higher accuracy than irregular pairs (c), which was not true when the distracter pairs were inverted (d) or when the top and bottom objects of the pairs were shuffled between pairs (e).

Conclusions

We interpret our findings as reflecting the grouping of objects based on higher-level spatial-relational knowledge acquired through a lifetime of seeing objects in specific configurations. The grouping reported here effectively reduces the number of competing objects, leading to more efficient visual perception. Because scenes contain a large number of single objects, many occurring in regularly positioned groups of two or more objects, such grouping might operate on many objects at the same time to dramatically enhance the efficiency of real-world perception.

References

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