Pool party: Objects rule!

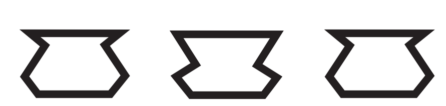
Sarah Rosen[1], Ramakrishna Chakravarthi[2] and Denis G. Pelli[1], 1. Psychology & Neural Science, NYU, 2. CerCo, CNRS & Université Paul Sabatier

Introduction

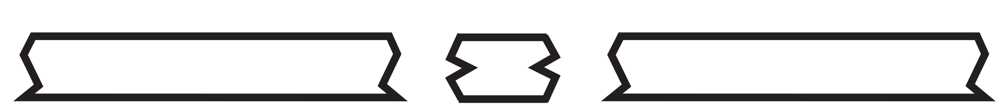
To recognize an object, we first detect its features and then combine or "pool" them. Crowding, the inappropriate combination of target and flanker features, reveals the rules underlying the feature-combination stage of object recognition. Does "objectness" underlie which features combine? How much of this is explained by the Gestalt law of closure?

Demos

Feature location: There are six possible targets: . The target is presented in the periphery, with a flanker on either side. The near side of each flanker remains a constant distance from the target while flanker width varies. This manipulates the distance of the far flanker features from the target. Fixate the plus and try to identify the target. This is easier when the flankers are wide.

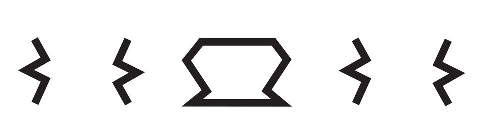


\+ Whole

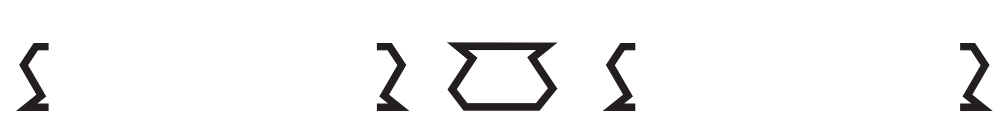


\+ Whole

Breaking closure: We introduce a break in the flankers by completely or partly removing the horizontal bars. Fixate the plus and try to identify the target. This is equally easy at any width when the flankers are broken.

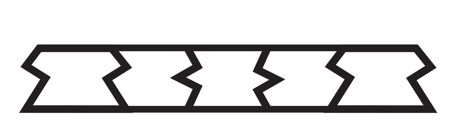


\+ Broken



\+ Broken'

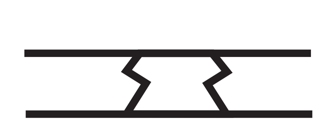
Increasing closure: We increase closure by connecting the flankers to the target. Fixate the plus and try to identify the target. This is nearly impossible when the target and flankers are connected.



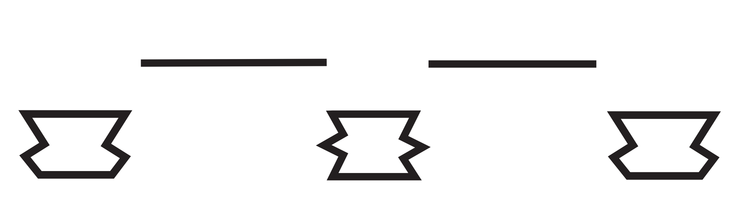
\+ Connected

Controls: In all cases we control for horizontal bar length and ink area. Fixate the plus and try to identify the target. This is easy in all control conditions.

\+ Bars



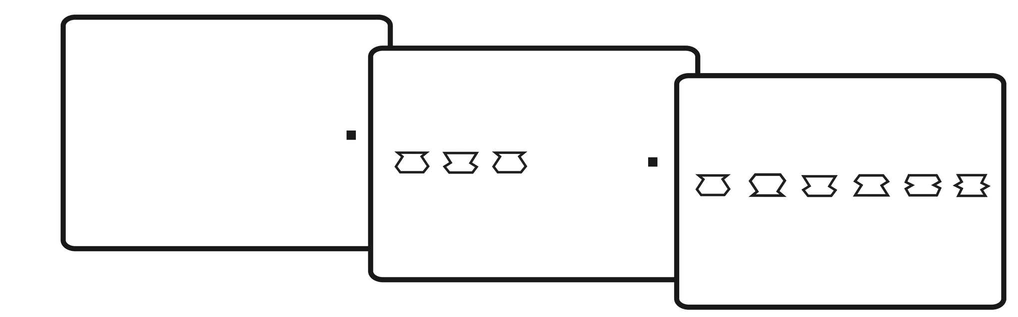
\+ Bars connected



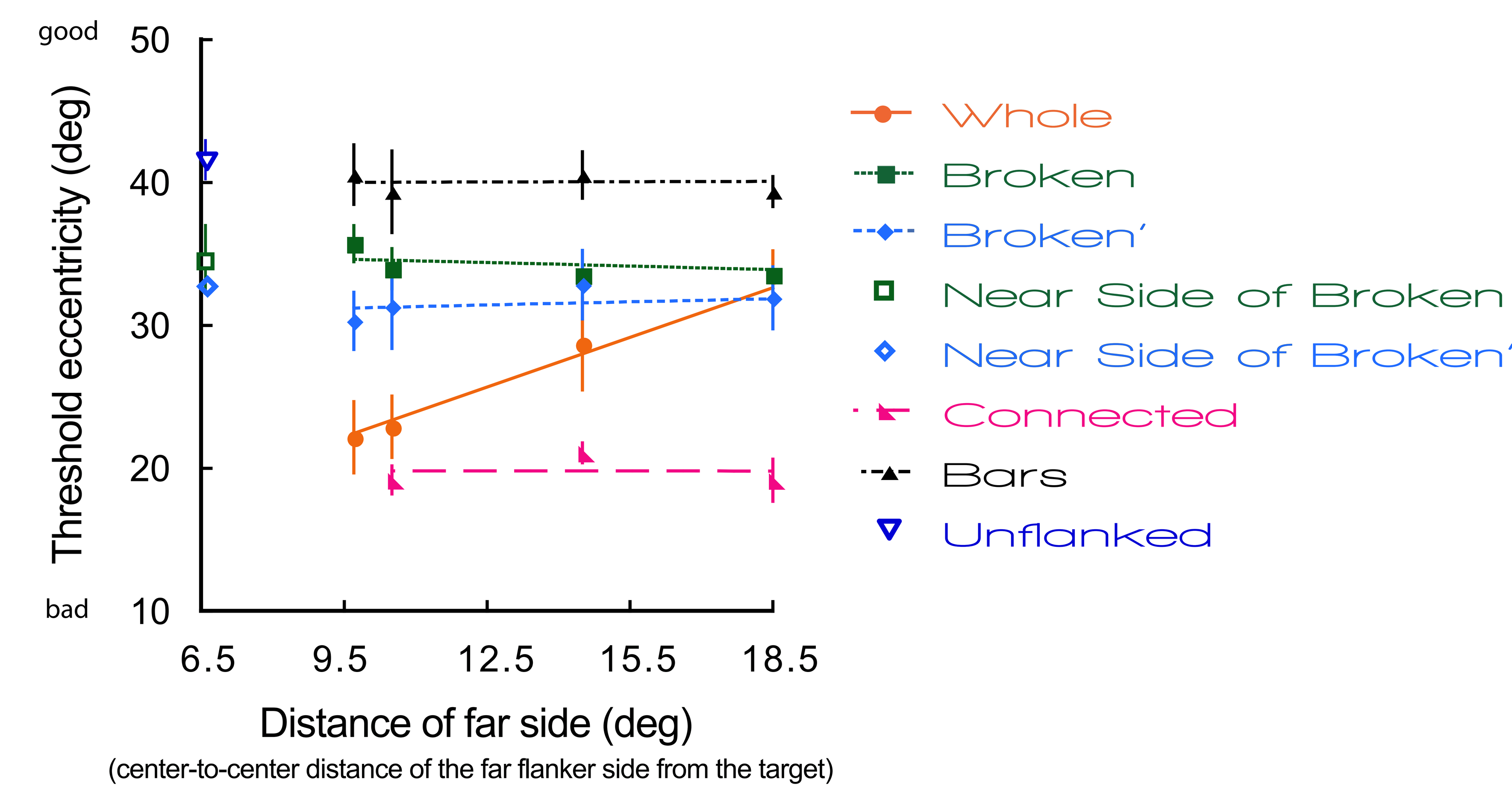
\+ Offset

Methods

Observers peripherally view a crowded target and then identify it by selecting it from a display of all possible targets. Fig. 1: we use Quest to vary the eccentricity at which each target-flanker set is presented. We find threshold eccentricity for each target-flanker set. Fig. 2: We present each set at 25 deg eccentricity and measure accuracy.



Results



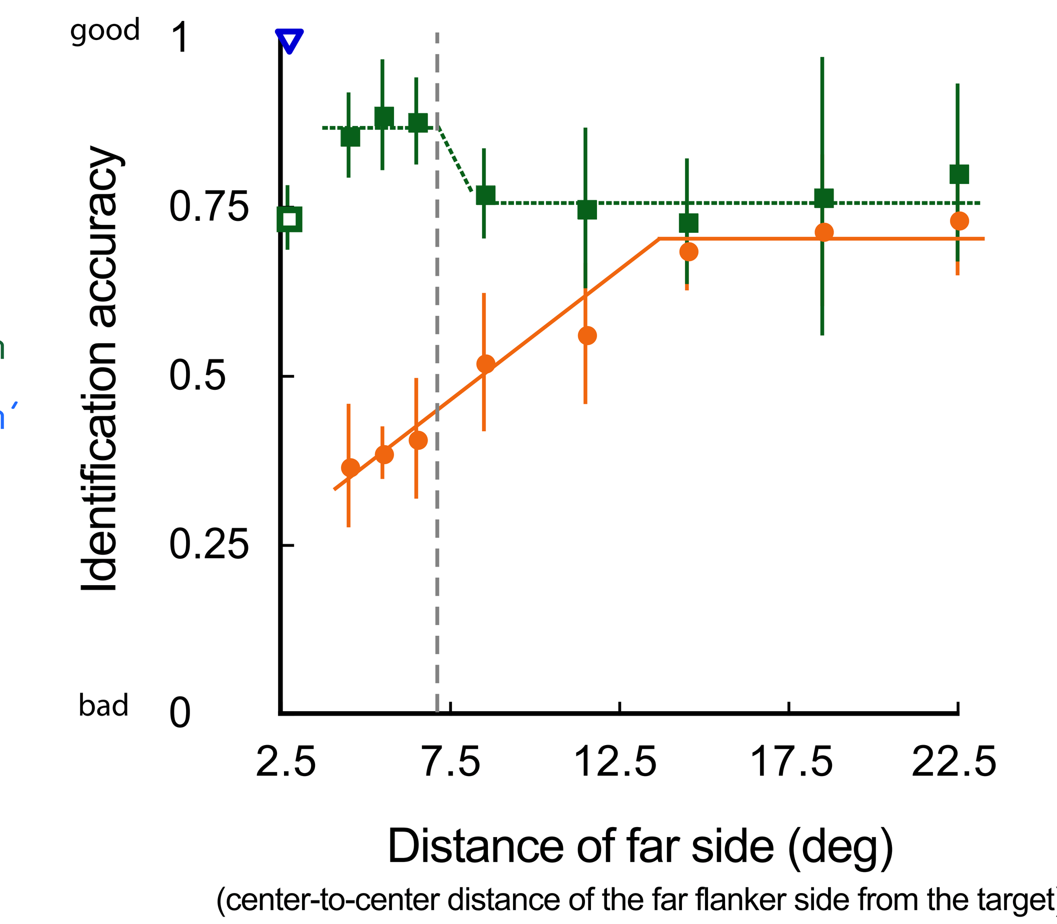


Fig. 1. Effect of far-side distance on crowding. The vertical scale (threshold eccentricity) measures strength of crowding. When crowding is strong, the target-flanker set must be moved closer to fixation to achieve 85% correct. We increase the width of the flanker, which increases the distance from the target to the flanker's far side. All lines in the graph are flat except one. That sloped line is the Whole condition. The farther the far flanker side is from the target, the less it crowds. All other conditions show no effect of distance, indicating no crowding by the far side. The far side crowds the target when the flanker is Whole, but does not when the flanker is Broken. For small distances, crowding increases with connectivity.

Fig. 2. Effect of far-side distance on crowding: critical spacing. We measure accuracy for identifying the target as a function of the distance of the far flanker side. The dashed line is critical spacing for crowding by a single side. For Broken objects, the far side affects crowding only out to critical spacing. For Whole objects (orange), accuracy increases with the distance from the target to the flanker's far side. Accuracy increases until it reaches the accuracy of the Near Side Only. For Whole objects, the far side affects crowding out to twice critical spacing. In other words, a Whole object crowds only while its center is within critical spacing. Thus, the region over which features are pooled is larger for Whole objects than for Broken objects.

Conclusion

Breaking flanker closure reduces crowding by the far features. Increasing flanker closure increases crowding. Feature location alone does not determine crowding. Instead, feature pooling depends on the location of the center of the entire group (object) that the feature belongs to. If a feature is isolated, it acts as an object.

Rosen, S., Chakravarthi, R., and Pelli, D.G. (2010). Pool party: Objects rule. Vision Sciences Society. Naples, Florida. May 7-12, 2010.

http://www.psych.nyu.edu/pelli/posters.html