Emergence of features in visual stimuli

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It has been suggested that new perceptual features can be "created" when they are necessary for a particular task. For instance, by "unitization" (Goldstone, 2000), components which were previously processed separately become represented as a wholistic unit. Certain associative theories (McLaren, Kaye and Mackintosh, 1989) explain unitization as the establishment of connections between reliably co-occurring elements of a stimulus. By this account, after unitization, sampling a subset of featural elements causes retrieval of the whole feature. Given that the model assumes that only a proportion of elements are sampled on any presentation, unitization could lead to an increase in subjective salience of a feature.

This account does not require that the feature is necessary for a task (e.g., diagnostic of a category) for unitization to occur, merely that its elements co-occur. Experiments 1 and 2 indicate firstly that features emerge through simple pre-exposure as well as when they are diagnostic, and secondly, that the process of emergence may increase the collective salience of the feature's components.

Method

Our stimuli consisted of 75% trial-unique random noise, and 25% "feature", which could occur in any of the four corners of a stimulus. There were four "non-obvious" features (NOF condition) and four "control features" (control condition), which were horizontal lines, vertical lines, and two types of square. Figure 1 shows an example of each, with the feature in the top left.

Forty-eight undergraduate students from Exeter University participated in each of Experiments 1 and 2, for course credits or 4 GBP. In both experiments, half of the participants were in the NOF condition and half in the control condition. Every participant completed a training phase followed by a test phase. The training phase consisted of repeated exposure to two of the four features (of the participant's feature type condition). Stimuli were displayed one after another on a computer monitor, and each stimulus contained one feature, in variable location. In Experiment 1, the training phase was a binary choice category learning task in which each feature was diagnostic of a category, and in Experiment 2, participants had to judge the aesthetic appeal of each stimulus on a 9-point scale.

The test phase (identical for both experiments) involved all four features (two trained and two untrained) from that participant's condition. In the first task, pairs of stimuli containing a common feature (the remainder of each stimulus was independently randomly created) were presented for 2 seconds each, after which a similarity judgment was made on a scale of 1 (not at all similar) to 9 (very similar). This was followed by a triad task, in which

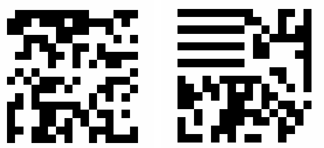

Figure 1: Non-obvious feature stimulus (left) and control stimulus (right)

participants were presented with three stimuli (X, Y and Z) simultaneously, and had to decide which two were the most similar. X and Y shared 25% in the form of one of the "features", and X and Z shared 75% but in the form of trial-unique, randomly created noise. Of principle interest are differences in test phase performance with features that have been trained as opposed to untrained.

Results and discussion

In the NOF condition of both experiments, the number of times that the X and Y pair in the triads task was chosen as more similar than the X and Z pair was significantly greater for trained than untrained features. Contrastingly, training had no effect on control features' salience. The sequential similarity judgment task showed similar results. In the NOF condition of both experiments, similarity judgments were higher for pairs of stimuli containing trained than untrained features. This was not seen for the control features, whose salience significantly *decreased* with training in Experiment 2 (and did not change in Experiment 1). For both test phase tasks, effects of training were not significantly different for the two experiments.

The results indicate that novel features, which are presumably not represented prior to the experiment, became more salient through training. This is not dependent on their explicit usefulness. Theories of the allocation of attention to existing attributes (e.g., Kruschke 1996) would have trouble accounting for the increase in salience due to simple pre-exposure of a feature, and the McLaren et al. model can predict that the unitization process itself may be responsible.

References

Goldstone, R.L. (2000). Unitization during category learning. *Journal of Experimental Psychology: Human Perception and Performance, 26,* 86-112.

Kruschke, J.K. (1996). Dimensional Relevance Shifts in Category Learning. *Connection Science, 8, 225-247.*

McLaren, I.P.L., Kaye, H. and Mackintosh, N.J. (1989). An Associative Theory of the representation of Stimuli. In *Parallel Distributed Processing* (ed R.G.M. Morris). Clarendon Press, Oxford.