The Role of Intra-Stimulus Variance in Perceptual Category Learning

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Categorization without rote memorization

Category learning is usually based on repeatedly presenting a finite training set of exemplars. It is hence difficult to determine whether participants are learning the underlying structure of the stimuli or simply memorizing the limited number of exemplars and rote-associating them all with their respective category names.

Partly to prevent this rote-associative strategy, Pevtzow & Harnad (1997) designed a task in which computer-generated textures were constructed out of 4 unrelated arbitrary micro-elements, distributed randomly in a rectangular array to form an overall texture. The spatial distribution of the micro-elements varied from one example to another, making each stimulus different and unique. Category membership was based on the proportion of two of the four micro-elements. Pevtzow & Harnad found that participants could learn the two categories. No stimulus was presented more than once, either in training or in testing.

Towards a difficulty continuum

Using this condition as a starting point to create a categorization difficulty continuum (intended for use in later studies on learned categorical perception), we constructed a similar task using controlled rather than arbitrary micro-elements: Gabor patches of equal spatial frequency but differing orientation (i.e., angle) were used.

Category A stimuli were composed of an equal proportion of patches at each of the angles used; Category B stimuli were created by removing two of the angles from the set used for Category A and doubling the proportion of two of the other angles. Three presumptive difficulty levels were generated on the hypothesis that the task should become harder as the micro-elements that are removed and doubled become more and more similar.

A second difference between the levels, however, was that although the average angle in each stimulus was 90 degrees for all categories at all levels (to avoid a general orientation effect), the intra-stimulus variance of Category B was significantly different from that of Category A only at the Easy level. If the differences in angles had a direct influence on difficulty, the performance level would worsen as the hypothetical level of difficulty increased. However, if the intra-stimulus variance was the crucial factor, performance at the Easy level would be significantly better than at the other levels, with no difference between the Intermediate and Difficult levels.

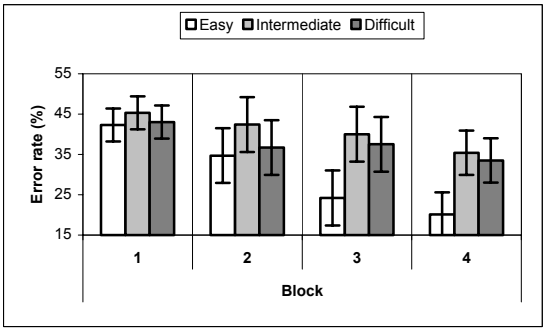

Figure 1: Error rates. Each block contains 300 trials.

Results

Overall, and during the last learning block, performance proved significantly better for the Easy level than for the other two levels, but did not differ between the Intermediate and Difficult Levels. This suggests that differential intra-stimulus variance had a greater influence on performance than the hypothetical difficulty levels we had calculated a priori. Further attempts to construct a difficulty continuum using randomly generated grid-like stimuli with micro-elements will accordingly need to take into account this further constraint on categorization behaviour.

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