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# Learning Ambiguous Features within a Categorization Task

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## Background

A fundamental assumption of nearly all high-level categorization models is that the viewer uses a fixed set of features to analyze each object or stimulus. Recent work has demonstrated that manipulating the order of training trials (Schyns & Rodet, 1997), category structure (Goldstone 2000) and feature diagnosticity (Goldstone, 1994) can facilitate the learning of novel feature detectors. This learning fundamentally changes how new stimuli are represented, in contrast to scaling existing feature representations.

The work presented here explores aspects of the distribution of features over stimuli that enable either perceptual learning of features or learning to differentially weigh existing features. Participants learned to separate line drawings of simple closed forms into two categories. We subsequently tested their performance on whole-part judgments containing segments of the stimuli from the category training. This revealed how the set of features used changes after subjects learn a complicated category structure.

## Method

Data from forty-seven participants was included in the analyses presented below. Stimuli were curvilinear outlines of closed forms consisting of three equally sized segments. One of two random curves was assigned to each section. Each stimulus was a conjunction of three binary features connected to create an amorphous curved form with no clear starting or ending point (Fig. 1).

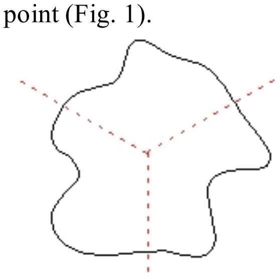

Figure 1: A training stimulus with dashed lines added showing the three segments that compose each stimulus.

Participants learned a two-category exclusive-OR category structure that involved two features, and the third feature was never diagnostic. Participants learned to categorize the eight stimuli into two categories and were required to achieve a consistently high accuracy level to move to testing.

Each test trial consisted of a two-image pair. The first was of a complete closed form (the “whole”), constructed from three segments similar to the training stimuli. The second image (the “part”) was a curved line that consisted of one or two segments. Participants judged whether the part had been present in the previously seen whole.

## Results and Discussion

Participants were significantly more accurate on one-segment whole-part judgments ($M = 0.67$, $SD = 0.12$), than two-segment whole-part judgments ($M = 0.47$, $SD = 0.25$) according to a two-tailed paired-samples t-test ($t(46)=4.214$, $p<0.0005$). This effect could be due to the difference in stimulus complexity.

We also found a significant negative correlation of accuracy on whole-part judgments containing either one or two diagnostic segments given the same whole stimulus ($r=-0.428$, $p<0.01$). This result is consistent with our prediction that participants would have conflicting interpretations of the stimuli. Participants who use two small features that must both be present would have higher accuracy when judging one- versus two-segment parts. Participants who use a large feature that spanned two segments would show the opposite behavior: higher accuracy when making judgments containing two- versus one-segment parts.

The negative correlation between performance on one- and two-segment parts cannot be explained only by contending that detecting two segments is more difficult than detecting a single segment. Instead, these results suggest that having a stronger holistic two-segment feature increases the interference with using a feature that contains information from only one of those segments.

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