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Learning diagnostic visual category features.

APA peeps

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LEARNING DIAGNOSTIC VISUAL CATEGORY FEATURES

Learning visual categories involves both generalizing within category and discriminating between categories. For example, I call a variety of objects in my garden flowers even though they are visually different from each other, but I distinguish these from other objects in my garden, like squirrels. Mastering this categorization task requires learning the features that are common to flowers and that discriminate flowers from squirrels.

Learning categories like *squirrels* and *flowers* requires learning which features are shared among all flowers and which features distinguish flowers from squirrels. Photo: hardeko/iStock/Thinkstock

Presumably, learning features relevant to categorization requires attention to those features. In humans, this has been tested using eye movements as a measure of overt attention. Castro and Wasserman (2014, *JEP:ALC*) applied a similar logic to pecking in pigeons: They assumed that pigeons are attending to the features they are pecking. In their experiment, they presented pigeons with items consisting of four visual elements, one in each corner of a square. Two of the visual elements were diagnostic of category membership, and the other two features were irrelevant. Pigeons had to peck the stimulus display a set number of times before a categorization screen appeared, at which point pigeons had to make a categorization response by pecking one of two response buttons. Correct responses were reinforced with food.

Behavioral Neuroscience

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At the beginning of training, pecking was distributed equally to all visual features. However, as learning progressed, pigeons increasingly concentrated their pecks on the features that were relevant for categorization, and categorization accuracy was higher on trials where the pigeons spent more time pecking the relevant features. Moreover, increased pecking of category-relevant features persisted in a subsequent test phase in which the irrelevant features were novel and no reinforcement was provided. These results suggest that pigeons not only learned to categorize complex visual stimuli, but they also learned which features were relevant for solving the task and devoted more attention to those features accordingly.

Thus, category learning in pigeons and humans depends on learning diagnostic or category-relevant features. This raises the question of whether category learning can be improved by procedures that enhance attention to category-relevant features. In a series of experiments by Pashler and Mozer (2013, *JEP:LMC*), participants learned to categorize visual stimuli by trial and error in one of two conditions. In the fading condition, the feature critical to categorization was exaggerated at the beginning of categorization training and then gradually faded to the normal, more difficult to discriminate values for the two categories. For example, if line length was the diagnostic category feature, Category A lines were 120 pixels long and Category B lines were 80 pixels long at the start of training, and they then gradually decreased to 104 and 96 pixels, respectively, by the end of training. In the control condition, the values of the diagnostic features were held constant throughout training (e.g., 104 and 96 pixels in this example). All stimuli were shown with their normal values in a subsequent test phase. There was no difference in test categorization performance between the fading and control conditions when the stimuli were defined by one feature (e.g., lines of varying length). However, when stimuli were multidimensional (e.g., alien faces) such that a relevant feature (e.g., horn length) was presented with other features that were not predictive of the correct category (e.g., skin brightness, eye size, presence or absence of a nose), test performance was superior in the fading condition. This advantage for fading was eliminated when participants were told what feature was relevant at the beginning of categorization training. This suggests that fading produces benefits in category learning by helping participants determine which feature is relevant.

In summary, category learning depends on learning which features are relevant, a process that can be facilitated by procedures like fading that draw attention to relevant features.

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