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WHAT DOES A PIGEON SEE IN A PICASSO?

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The present paper is primarily a response to Watanabe, Sakamoto, and Wakita's 1995 paper "Pigeons' Discrimination of Paintings by Monet and Picasso." Our main criticism is that the key term *concept,* and in particular the way in which a class of stimuli is specified, remains equivocal. We argue that it is only useful to study categorization if the organism in question can be expected to have access to the information that is used in defining the classes, and that evidence for categorization requires selective responses that cannot be attributed to similarity in features that are not essential to the classification.

Key words: concept, stimulus control, pigeon

Watanabe, Sakamoto, and Wakita (1995) presented experiments on pigeons' ability to discriminate between paintings by Monet and Picasso. They demonstrated generalization to new paintings by these artists, to distorted versions of the paintings, and to ones by other artists from the same schools. The results were presented as evidence for learning of abstract concepts by pigeons. Although Watanabe et al. were extremely cautious when drawing conclusions from their findings, the study as a whole raised some points that merit discussion.

The present paper examines several such issues. In particular, the contention that the study by Watanabe et al. (1995) deals with *concepts* is discussed. Although the present paper is written as a response to the above-mentioned one, the points raised are not limited to pigeons and visual art.

The conventional method for identifying performance that could be called conceptual is by demonstrating that there is "generalization within classes and discrimination between classes" (Keller & Schoenfeld, 1950, p. 155). This places a strong emphasis onto the distinction between the classes, both for the subject and for the experimenter.

There can be many reasons for grouping stimuli into classes. One reason may be that the categorization is important for the organism in its natural environment. In that case the classes can be defined in relation to the organism in question. We will refer to such classes as *ecological classes.* Examples are *food* versus *nonfood, possible places to build a nest* versus *impossible places to build a nest, individuals of the same sex* versus *individuals of the other sex.* It is obvious that most (and maybe all) animals have to be able to discriminate between such classes of stimuli.

Several studies have used classes that are obvious to the experimenters but that are not of ecological significance to the organism in question. Examples (for pigeons) are *fish* versus *nonfish* (Herrnstein & de Villiers, 1980) or *leaves of an oak* versus *other leaves* (Cerella, 1979). In these examples the classes are clear to the experimenter but must be considered arbitrary for pigeons (who cannot have been exposed to the underlying taxonomic information). Similarly, the distinction between pictures with and without humans (Herrnstein & Loveland, 1964) looks straightforward, but what if only a foot is visible, or only a shoe? Taking this one step further we reach *synthetic classes,* in which the distinction depends on arbitrary choices made by whoever defined the classes. Two examples are the "pseudoseeds" of Lea, Lohmann, and Ryan (1993) and letters in different typefaces (Morgan, Fitch, Holman, & Lea, 1976). In these cases the question is whether the pigeon can come to respond consistently with respect to the classes as specified by the experimenter.

When one divides a collection of objects by chance into two categories, *pseudoclasses* are created. These are not real classes because

This paper is strongly inspired by what we have learned from Wim Nuboer about the pigeon's view of the world.

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the members have nothing particular in common. The only way to discriminate between such pseudoclasses is by establishing an adequate response to each object. Pigeons can do so remarkably well. They can learn the arbitrarily chosen appropriate responses to hundreds of unrelated slides, and can even respond adequately when members of the pseudoclasses are presented a year after training (Vaughan & Green, 1984). Pseudoclasses are often used as controls in categorization experiments.

For pigeons, the proposed categorization into cubist and impressionist art (Watanabe et al., 1995) can best be considered synthetic. The actual distinction, as described by art historians, is based on the fact that although both impressionist and cubist artists took visual reality as their starting point, the impressionists tried to catch the image of the fleeting moment, whereas the cubists tried to catch the image of all moments (Chipp, 1968; Rosenblum & Janson, 1984). This is of course a theoretical distinction between the two styles, one that is not directly visible to the typical human spectator. How then did the pigeons discriminate between the two styles?

Impressionist paintings are light, with loose brush strokes in pastels, leaving much of the white underground painting visible. The impressionist paintings chosen by Watanabe et al. (1995) are mainly greenish and bluish, and the objects have blurred outlines. They are mainly landscape scenes and still lifes. The objects are clearly recognizable.

Cubists show the object as seen from different positions within a single painting. This results in the characteristic fragmentation. In typical cubist paintings from around 1912, like *Ma jolie, Man with violin,* or *Il Poeta* used in Watanabe et al. (1995), color contrast is reduced to a minimum. They are mainly in brownish and gray colors and have clear outlines. The brush strokes are not very striking. The paintings are figures and still lifes but are heavily deformed.

The many differences between the two groups of paintings should make it easy to discriminate between them. Although fast or easy discrimination could suggest that the stimuli have been categorized (e.g., Aitken, Bennett, McLaren, & Mackintosh, 1996; Herrnstein, 1985; Herrnstein & de Villiers, 1980; Wasserman, Kiedinger, & Bhatt, 1988), it may simply reflect the similarity within and difference between individual stimuli of the various classes (see discussion in Huber & Lenz, 1996). Pigeons' responding must generalize to similar stimuli. Even if one has a very simple stimulus (such as a single light source), it will not always stimulate an organism the same way over repeated occurrences. For instance, if the organism's position relative to the stimulus is not fixed across trials, which it seldom is, the angular extent of the stimulus and its position relative to the organism will vary between trials. In order to respond adequately to any stimulus, the organism must generalize across such changes. Thus, we do not consider a quicker learning of the proposed classes than of the same stimuli divided into pseudocategories to be sufficient to demonstrate categorization (note that the pigeons in Watanabe et al.'s study actually did not learn a distinction between paintings by Picasso and Monet faster than one between two sets of randomly grouped paintings from both categories).

A key issue in categorization is that it results in a distinction that is on a nominal scale. As a consequence, the generalization should be very specific. Most of the studies using complex stimuli with pigeons show a more or less continuous range of responses (e.g., Herrnstein & Loveland, 1964), making it difficult to point out where the transition between the classes occurs. However, even an abrupt transition in responding need not support categorization, because the crucial question is whether the ''correct'' aspect of the stimulus gained control over the behavior. An obvious requisite for studying categorization is therefore that the organism has access to the information required to make the correct distinction.

Imagine training human subjects to distinguish between photographs of girls called Jenny and ones of other girls. If all Jennys in the training set had dark hair and all other girls were blond, subjects would quickly learn to discriminate between the photographs. However, the categorization would have nothing to do with the girls' names. One experiment with a blond Jenny would suffice to demonstrate this. The subjects could not learn to categorize the girls according to their names, because they had no access to the critical information. Learning to catego-

rize the girls by the color of their hair obviously does not demonstrate an understanding of the concept of ''girls called Jenny.'' This example illustrates that the features that the subjects are expected to use to distinguish between the members of the two classes depend on the concept one wishes to study (in this case the girls' names rather than the color of their hair).

In the case of cubism versus impressionism, pigeons could never point out the ''correct'' aspect of the stimulus, because the critical distinguishing feature is historical rather than a physical aspect of the stimuli. Even human subjects would never be able to discover the critical historical distinction from the paintings alone. However, many aspects that are quite conspicuous to humans could result in reasonably correct classification. Undoubtedly there are also many aspects by which pigeons could categorize the stimuli. What these aspects are, and which will ultimately govern their behavior, depends both on the pigeon's individual experience and on specific aspects of the pigeon's visual system (Nuboer, 1986). Watanabe et al. (1995) examined two of these aspects (color and spatial frequency) and found that both contributed to the distinction made by the pigeons.

Watanabe et al. (1995) also presented paintings by Delacroix to their pigeons. They found responses that were between those to a Picasso and those to a Monet. However, in what way can one speak of a Delacroix as being ''between'' cubists and impressionists? Historically, this assignment makes little sense. The responses to paintings by Delacroix and to the deformed cubist and impressionist stimuli do provide an indication of the factors that gained control over the pigeons' behavior. Before this can tell us anything about categorization, however, it remains to be shown that the set of factors that gain control is in some way essential to the categorization in question (art historians are aware of the problem of misleading superficial resemblance and refer to it as *pseudomorphosis*; Panofsky, 1964). Considering the differences between artists of the same movement, and the changes that took place within each of the movements (and even within the work of a single artist; Picasso being a case in point), there probably is no such set of factors.

Even if one could determine such a set of factors, however, the classification would not be evident. Most attributes one can rely on when making distinctions can be placed on many different physical scales (e.g., for color, one could use wavelengths, standard colorimetric units, or cone excitation ratios), and they can take an infinite number of values on each scale. To switch to the nominal scale that is required for classification, there must be a reason for the boundary being at the chosen position on the stimulus scale.

The position of the boundary may be evident for the concept in question, but this need not be so. It could even be completely arbitrary, as when introducing a reference on a size scale allows one to examine the relational concepts of larger than and smaller than. Moreover, the position of the boundary need not even be known in advance. One could start an experiment without knowing where the boundary is, hoping to find a consistency between subjects that could be considered as evidence for categorization, and that might even indicate why the position one finds is critical for the concept in question. For instance, consistency between pigeons in changing their response at a certain wavelength of light suggests that they categorize wavelengths into ''colors,'' and the wavelength at which their response changes may even tell us something about the way in which the responses of different types of photoreceptors are combined (giving us a better understanding of the concept itself).

What consequences does this reasoning have for setting up experiments to study conceptual behavior of animals? We believe that some stimulus classes, such as larger than, are suited for nearly any kind of subject. It is relatively straightforward to identify members and nonmembers of the class and therefore to select items that are suitable to include in training and testing sets. Other stimulus classes, such as ''yellow objects'' or ''food,'' are more subjective in the sense that class membership depends on characteristics of the organism (e.g., the spectral sensitivity of its photoreceptors, or its eating habits). If items are selected for training and testing sets without regard to such factors, one is likely to misinterpret the results. Yet other stimulus classes, such as ''impressionist art,'' are defined by features that only humans have access to (such as historical information). Thus it

makes no sense to describe the performance of nonhuman organisms relative to such classes in terms that suggest human-like conceptual behavior.

We summarize the criteria we propose for selecting stimuli and classes in categorization tasks as follows:

1. It must be possible to divide the stimuli into mutually exclusive nominal categories (the classes).

2. All stimuli must belong to a class associated with a specific response.

3. The classes must be defined in terms other than the individual pigeons' responses.

4. The distinction between the classes must be possible on the basis of the stimuli that are presented in the experiment alone.

5. It must be ensured that no other factor (or set of factors) that is not essential to the categorization in question could account for the performance.

The distinction between same and different (Cook, Cavoto, & Cavoto, 1995; Wasserman, Hugart, & Kirkpatrick-Steger, 1995; Zentall & Hogan, 1974), which can be defined in simple objective terms, qualifies by these criteria, as does the concept of symmetry (Delius & Nowak, 1982). The categorization into cubist and impressionist paintings does not qualify by these criteria; therefore, pigeons' responses to such stimuli cannot tell us that they have grasped these concepts.

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