Categorization and conceptual behavior in nonhuman primates
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Animals often behave adaptively in response to a novel stimulus, because it resembles others for which the appropriate response is already known. Such an adaptation expresses an ability to categorize. In effect, in the absence of categorization, each object or event would be perceived as unique and generalizations would be impossible. Therefore, it is not surprising to find categorical abilities in various animal species, although most of the empirical evidence concerns birds (mainly pigeons) and primates. Categorization being a fundamental aspect of information processing, its study is thus crucial to increase our understanding of animals' cognitive abilities. This chapter is devoted to a presentation of some of the studies that were carried out in the last five years with two species of baboons both in laboratory controlled conditions (*Guinea baboons*) and in outdoor settings (*Olive baboons*). These studies aimed to describe different levels (and their underlying processes) of categorical behaviors in the monkeys confronted to various tasks. Furthermore, we were interested in comparing monkeys and humans tested with similar stimuli and procedures.

A useful general framework for the investigation of these behaviors was provided by Herrnstein (1990), who described categorization abilities in animals in five levels of increasing abstractness, including 1) discrimination, 2) categorization by rote, 3) open-ended categorization (namely category formation resting on perceptual similarity between individuals that belong to a given class), 4) concepts, and 5) abstract relations. Two criteria are retained by Herrnstein (1990) to define conceptual categorization (level 4). The first criterion is met when a rapid generalization over class members of classificatory items is observed. The second criterion, related to conceptual processing, implies categorization abilities that go beyond similarity between exemplars of a class. Thus, level 4 is more complex than open ended classification, the latter being related to the use of perceptual dimensions of stimuli (see Schrier et al. 1984, for an example in macaques, D'Amato and Van Sant 1988, for an example in cebus monkeys, and Vauclair and Fagot 1996, for an example in Guinea baboons). Level 5 of Herrnstein's categorization is attained when a subject is able to use abstract relations not only between objects but also between concepts, such as in conceptual matching or in conceptual identity (for example the mastery of "sameness" relation). The evidence for capacities to perform the first three levels of categorization is large for several animal species (see Zayan and Vauclair 1998 and Thompson and Oden 2000 for reviews). It is however much less clear concerning levels 4 and 5.

Laboratory studies with Guinea baboons

Several experiments were conducted with baboons in order to assess the abilities of these monkeys to discriminate objects on the basis of their categorical membership, and to study the nature of the categorical representations they formed. In all the experiments reported in this section, we used a video-task requiring the manipulation by the baboons of a joystick which controlled the movements of a cursor on the screen (Vauclair and Fagot 1994). Briefly, with this technique, the subject was required to manipulate the joystick so as to "touch" with the cursor a response stimulus that matched the sample stimulus on an arbitrary (experimenter-defined) basis. In one of our studies, we examined our monkeys' abilities to categorize artificial stimuli (Vauclair and Fagot 1996). More specifically, we explored how baboons categorize alphanumeric characters displayed in various typefaces. To this purpose, baboons were first trained in a symbolic matching-to-sample task with 21 different fonts of the characters "B" and "3" as sample forms, and color squares as comparison forms. After training, novel fonts were displayed. The monkeys showed positive transfer of categorical performance to the novel stimuli of the characters used in original training. Such results demonstrate that the original learning was not achieved by rote learning, because in that case, the animals would have