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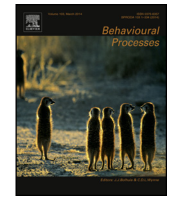

Species-specific response-topography of chickens' and pigeons' water-induced autoshaped responding

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ABSTRACT

Four pigeons and eight chickens received autoshaping training where a keylight (conditioned stimulus) signaled response-independent deliveries of water (unconditioned stimulus). Pigeons drink while keeping their beaks submerged in water and moving their beaks to create suction ("mumbling"), whereas chickens drink by trapping a small amount of water in their mouths and then lifting their heads so the water trickles down. This experiment tested whether these and other species-specific differences in drinking and related behaviors of pigeons and chickens would be reflected in the form of conditioned (autoshaped) responding. Touchscreens and videotapes were used for data recording. Results showed that chickens moved their heads more than pigeons when drinking (unconditioned response). The birds also differed in conditioned responding in the presence of the keylight: Pigeons produced more keyswitch closures and mumbled at the keylight more than chickens whereas chickens scratched more than pigeons. In conclusion, with this unique comparative method that employed identical contingencies and comparable deprivation levels, species-specific differences in unconditioned responses and, more importantly, differences in their corresponding conditioned responses were observed.

1. Introduction

The autoshaping paradigm (e.g., Brown and Jenkins, 1968; Ploog and Zeigler, 1996), mostly applied to birds, has been considered a viable model for Pavlovian/classical conditioning (e.g., Gibbon et al., 1977; Hearst and Jenkins, 1974; Locurto, 1981; Ploog, 2001). In autoshaping, a conditioned stimulus (CS) such as a keylight is followed by an unconditioned stimulus (US) such as grain, regardless of whether the bird pecked at the keylight or not. A typical finding is that after several of such CS–US pairings, the bird will peck at the keylight—the peck being the conditioned response (CR)—even though pecks are not required for the production of the US. The consummatory behavior, eating, is considered the unconditioned response (UR).

While the bulk of research has focused on the acquisition rate of autoshaped pecks (CRs) and the rate of sustained responding following acquisition (e.g., Brown and Jenkins, 1968; Downing and Neuringer, 1976; Gibbon et al., 1977), a smaller body of research has tried to identify the determinants of response topography (e.g., Allan and Zeigler, 1994; Jenkins and Moore, 1973; LaMon and Zeigler, 1988; Ploog, 2001; Ploog and Zeigler, 1996, 1997).

Several factors that affect strength (rate) and topography of the CR have been studied: The quality (food vs. water) of the US (Allan and Zeigler, 1994; Jenkins and Moore, 1973; LaMon and Zeigler, 1988); the magnitude of the US (Allan and Zeigler, 1994; Ploog, 2001); the physical dimensions of the US (LaMon and Zeigler, 1984; Ploog, 2001; Ploog and Zeigler, 1996); US probability (Brown et al., 1983; Ploog, unpublished data, showing that with increased probability of the signaled same-sized pellet US, beak opening increased); the properties of the CS such as location, size, and intensity (Domjan et al., 2004; Kim et al., 1996; Timberlake and Grant, 1975); and the time interval between CS and US (e.g., B. L. Brown et al., 1997).

Depending on these various factors that affect learning under autoshaping/Pavlovian contingencies, different response classes get activated (e.g., Allan and Zeigler, 1994; Brown et al., 1997; Staddon and Simmelhag, 1971; Timberlake and Grant, 1975). For example, Jenkins and Moore (1973) showed that when a food US was presented, the CR (peck at the key correlated with food) resembled the UR of *eating*. In contrast, when a water US was presented, the CR (peck at the key correlated with water) resembled the UR of *drinking*. Among others, Allan and Zeigler (1994), LaMon and Zeigler (1988), and Ploog and Zeigler (1997) reported

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comparable findings. However, within a given response class such as eating or drinking, the form of an individual response (e.g., its gape, latency, or force) can be modified within limits by changing the strength of the association (Ploog, 2001) or by implementing conjunctive response contingencies (Deich et al., 1988). Thus, operant contingencies can modify the effect of Pavlovian contingencies or vice versa. Taken together, these findings indicate that the CR in autoshaping/Pavlovian conditioning is a composite of learned (conditioned) and unlearned, species-specific (unconditioned) elements.

Topographical similarities between the CR and UR, thus some species-specific differences, would also be predicted by Pavlov's (1927) notion of "stimulus substitution." His idea was that an animal's CR occurs in its specific form because the CS substitutes for the US, and consequently the animal behaves with respect to the CS as if it were the US. (See Ploog, 2001, however, for evidence that "stimulus substitution" cannot be considered a sufficient explanation for all aspects of the specific form of the CR.)

The present study took the unique, comparative approach of employing identical CS and US conditions with two different species of birds, pigeons and chickens, which differ in their unconditioned, species-specific drinking behavior, instead of the approach of manipulating the properties of the CS or US as is customary in order to analyze the determinants of the various components of the CR within one species. If indeed the US, and consequently the UR, contributes specific characteristics to the CR, then at least some characteristics of the CR should differ for the two different species even if an identical experimental paradigm with identical CS, US, and contingencies is employed. Specifically, a pigeon drinks by dipping its beak into water and then, by rapidly moving its upper and lower beaks ("mumbling"), some suction is created which allows the pigeon to drink without having to raise its head (Bout and Zeigler, 1994). In contrast, an adult chicken drinks by dipping its beak into water to trap a small amount of water in its mouth. Then, it raises its head ("tip phase") and lets the water flow into its throat by gravity (Heidweiller and Zweers, 1992). Thus, two important differences are that pigeons "mumble" but do not move their heads much during drinking whereas chickens do not "mumble" but engage in clearly identifiable head movements in order to raise their heads for the water to flow down. There are also differences in other species-specific search behaviors related to consummatory behaviors: Scratching the ground in search of hidden consumables is typical for chickens, whereas sweeping the beak when sifting through debris in search of consumables is typical for pigeons.

The goal of the present study was to identify differences between pigeons and chickens in the autoshaped CR: With touchscreen recordings (i.e., beak contact with the CS), pigeons were predicted to exhibit more keyswitch closures than chickens because of their rapid movements of the upper and lower beak ("mumbling") while maintaining contact with the CS, without head movement, which is typical for pigeons' drinking behavior. With video recordings, pigeons were also predicted to exhibit more "mumbling" and fewer head movements directed at the CS than chickens, again, because of their specific drinking behavior. In addition, with video recordings, scratching and beak sweeping, both related to search and consummatory (appetitive) behavior, were analyzed during the intertrial interval (ITI) and CS in order to identify species-specific differences between pigeons and chickens in their conditioned responding. A pilot experiment, identical to the present one except that a superimposed response contingency was in effect, with different birds, produced results comparable to those of the present study, and thus will not be reported further.

The present experimental paradigm represents a unique comparative approach to investigate the correspondence of species-specific unconditioned and conditioned behavior. Its utility will be examined in the Discussion according to Bitterman's (1975) suggestions for how to properly conduct comparative research. His points that are particularly relevant for the current study are: The problem of comparability when employing different experimental paradigms that are deemed most suitable for studying different species; the problem of identifying comparable deprivation levels when working with different species; the need to conduct parametric studies when doing comparative work because one point on a variable's continuum is not sufficient to allow for a proper behavioral comparison; and the difficulty with identifying functional relationships between the hypothesized behavioral determinants and the observed behaviors because the same or different causes may result in the same or different behaviors in different species.

2. Method

2.1. Subjects

Four White Carneaux pigeons (undetermined sex; denoted by the letters PI) and eight Seabright Bantam chickens (hens; denoted by the letters CH) served in the present experiment. All birds were within a weight range of 350–550 g (thus of similar size), were experimentally naive, and were maintained at their free-feeding weight, with unlimited access to grain and grit in their home cages. The water deprivation schedule consisted of approximately 22.5 h with no access to water, 1 h with access to water earned during experimental sessions, and then, following each experimental session, 30 min with free access to water in their home cage. Sessions were conducted six times a week. After an experimental session, when no session was scheduled for the following day, the birds had free access to water until the following day. On that day, the water was removed such that each bird, again, did not have water for 22.5 h before the next autoshaping session. This added approximately 24 h of free access to water on the seventh day, which functioned as a safeguard to allow each bird to completely rehydrate in case the water rations earned during an experimental session and the daily 30-min post-session water rations were not sufficient. Furthermore, this allowed for a recalibration of the standard deprivation regimen. A common occurrence was that toward the end of an experimental session the birds stopped pecking and drinking, which indicated that the amount of water the birds obtained during a session was more than enough to overcome the water deprivation within one session. Thus, each bird typically went from standard deprivation to satiation within each experimental session, which was critical for an assessment of varying deprivation levels throughout the study (as discussed below). The birds were treated according to the ethical guidelines of federal, state, and local laws.

2.2. Apparatus

The experiment was carried out in four identical sound-attenuated enclosures. White noise was added to mask extraneous noises. Each enclosure contained a customized operant conditioning chamber of 42-cm height with a 38.5-cm × 31.0-cm wire mesh floor, elevated by 6 cm. The front and rear walls and the ceiling were made of clear acrylic; the two sidewalls were made of aluminum. There was a 22.0-cm × 12.5-cm rectangular cutout in the right-side aluminum wall for a LCD monitor, equipped with a touchscreen, which was mounted from behind the cutout. The equivalents of pecking keys, displayed on the monitor, consisted of three gray circular outlines on the screen, 2.5 cm in diameter, on a black background, 25.5 cm above the mesh floor, 5.5 cm apart from the sidewalls, and with 9-cm center-to-center distance between the keys. Color and shape stimuli could be presented in the key