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Color preference shift in hungry and thirsty pigeons

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Spontaneous behavioral color preferences for green and blue were demonstrated in hunger and thirst motivated pigeons using an operant technique. Response preferences under thirst appeared shifted towards the shortwave end of the spectrum as compared with preferences under hunger. The possibility that this shift may be due to a motivation induced change of visual adaptation is considered.

A number of studies have revealed that animals often show marked spontaneous color preferences when responding behaviorally to chromatic stimuli (Ilse, 1941; Tinbergen & Perdeck, 1950; Curtius, 1954; Hess, 1956; Muntz, 1962; Kear, 1964; Quine & Cullen, 1964; Hailman, 1967). The preference patterns in most cases cannot be related in any simple way to the spectral sensitivity of the receptors (Thompson, in press) and in a given species they appear to vary with the type of behavior the animal responds to the colored stimuli. The response and the color preference shown in such cases depends on the motivational state the animal is in when facing the stimuli (Impekoven, in press) and on the stimulus context in which color is presented (G. Thompson, unpublished). The experiment reported here was aimed at establishing motivation-dependent color preferences in the pigeon, an animal which lends itself to further experimental manipulation including electrophysiological recording. Hunger and thirst were used as suitably controllable motivational variables.[2]

APPARATUS

The apparatus used was a brightly lit, octagonal Skinner box with eight transparent pigeon pecking keys, one on each wall. Exchangeable stimulus cards could be slid into these keys. Rewards were offered at the center of the box floor and were either grains delivered with a hopper for 4 sec, or water injected into a well by a pump and available for 4 sec. The box was programmed using conventional relay equipment so that pecks to each key were counted separately on eight counters, but a peck to any of the keys produced a reward. While the reward was being offered, however, no further pecks were counted, this ensuring that if the pigeons gave a burst of pecks, as they sometimes did, to a key before going to the center of the box for the reward, only the first response registered so that each response recorded was an independent key choice. Another counter shut down the trial after a preset total of 50 choices had been reached.

METHODS

Three pigeons (*Columba livia, var. domestica*) of mixed breeds and from various sources, were used in the experiment. After having been gradually deprived to 80 per cent of their normal weight they were pretrained for 10 to 15 trials with neutral grey stimulus cards, by which time they pecked indiscriminately any of the keys for grain hopper access. The key cards were then replaced by a set of eight color cards: purple, red, yellow, orange, yellow-green, green, green-blue, and blue, and after four pretrials in which the animals settled down to responding in this situation they were run for two blocks of eight trials each. Within each block the colored cards were randomly allocated one by one to each and all keys, the animals being maintained at 80 per cent body weight throughout the experiment. After eight days recovery in which they regained their full weight, they were deprived of water for 18 h before each trial, while having ad lib food, and after four pretrials run for two blocks of trials replicating the conditions mentioned above except that the birds were thirsty and gained access to water rather than food.

RESULTS

Fig. 1 presents the results. Both under hunger and thirst there is a significant preference for the yellow-green to blue end of the spectrum (binomial, purple[3] to yellow against yellow-green to blue, $p < .001$) and this applies to all birds under both conditions ($p < .01$) except one, which when hungry showed only a nonsignificant preference. When thirsty, however, the pigeons increased their relative preference for blue-green and blue, the percentage choice for the other colors decreasing. This shift is significant at $p < .0001$ (median between green and blue-green, chi-square) and applies for every single bird ($p < .01$).

DISCUSSION

The predominance of the shortwave end of the spectrum cannot be easily related with the known spectral sensitivity of the pigeon's eye (Ikeda 1965), this suggesting that also in the pigeon a central, selectively sensitive mechanism mediates this choice behavior.

The functional significance of the preferences is somewhat obscure. The food taken by pigeons tends generally to be of reddish to yellowish color and so one would expect, under hunger, a weighting for this spectral area, but hardly one for blue. Under thirst the preference of green-blue and blue may be more meaningful as water surfaces will often reflect in this region of the spectrum. The ontogenetic origin of the preferences by pigeons must also remain hypothetical until more specific information is available. They could be learned response patterns or virtually experience independent preferences as have been repeatedly demonstrated in newly hatched avian chicks (Curtius, 1954; Hailman, 1967) or some intermediate between the two.

The shift towards the blue end of the spectrum found when switching the pigeons motivation from hunger to thirst can, of course, not as yet be ascribed specifically to this motivational change, particularly as a similar blue shift in color preferences has been observed with other motivational changes in gull chicks (Impekoven, in press). It could be due, for example, to varying degrees of motivational arousal rather than to qualitative differences of motivation. Whatever the precise motivational factor controlling this blue shift may be, I suggest

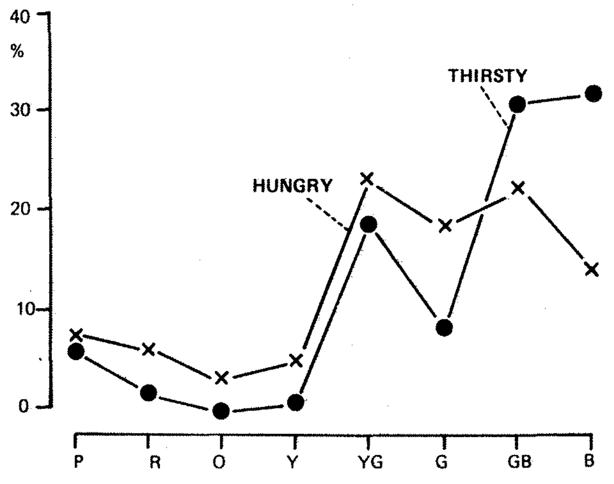

Fig. 1. Spontaneous color preferences of hungry (crosses) and thirsty (dots) pigeons. Choices for purple, red, yellow, yellow-green, green, green-blue, and blue in percentages of 800 choice trials in each condition.

that a possible mechanism for it could be a motivation-dependent change of visual adaptation from predominantly photopic to predominantly scotopic vision, with a consequential increased sensitivity in the blue end of the spectrum. This is supported by the fact that similar shifts to blue preferences occur when chromatic stimuli are presented on a dark background rather than on a light background (Curtius, 1954; Hailman, 1967), the change of background clearly affecting the overall brightness and hence the visual adaptation state. That central factors, neuronal or metabolic, are capable of modulating adaptation has been recently suggested. Frontal lobe stimulation in the monkey for example, changes the receptive field organization of retinal units in a manner analogous to dark adaptation (Spinelli & Pribram, 1966). Flicker fusion in man is affected by intake of ethanol in a manner similar as by the onset of scotopic vision (Granger & Ikeda, 1968). It could be that at least in the case of the pigeon efferent pathways to the retina (Holden, 1968) are involved. Experiments in progress are intended to clarify these and other issues.

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NOTES

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3. Purple has been included with the long wave colors because the pigment used reflects predominantly in that region. However, leaving purple out does not affect any of the conclusions or statistics.