TECHNIQUES FOR THE CONTROL OF MONOCULAR AND BINOCULAR VIEWING IN THE PIGEON¹

A. CHARLES CATANIA

SMITH KLINE AND FRENCH LABORATORIES

A series of experiments on interocular transfer (Catania, 1963) required that one eye of a pigeon be covered, and that the uncovered eye see only stimuli in particular locations. The goggles developed for limiting the field of view of the pigeon are shown in Fig. 1. One type (lateral stimuli) eliminated the small region of binocular overlap in the pigeon, whereas the other (anterior stimuli) did not. The in-place views illustrate the extent to which the visual field was limited by each type of goggle (the exact specification of these limits depends on placement of the goggles, the shape of the pigeon's head, and the position of its eyes).

With the caps, matched to each goggle, an eye could be covered or uncovered in a few seconds. The lateral caps and goggles, made of aluminum, were threaded. A pressure fit was used for holding the bakelite caps on the anterior goggles, which were made from brass tubing. The insides of the goggles were painted flat black to minimize reflections.

Goggles were mounted on the pigeon's head with flexible collodion (available in any pharmacy). An initial coating on the feathers providing a strong base for holding the goggles. During mounting, the pigeon was restrained to prevent the collodion from getting into its eyes, to avoid covering its ears, and to insure that the goggles were held firmly in place while the collodion dried (about 10 min).

After the goggles were in place, the pigeons appeared agitated and sometimes scratched at the goggles. This behavior disappeared within

a day or two, and some pigeons wore their goggles for as long as nine months. The growth of feathers beneath the collodion base apparently had no ill effects. The use of collodion also permitted short-term use of the goggles, because the goggles could be cut away from the collodion without injuring the pigeon.

The anterior goggles, because of their small surface area along the forward edge, occasionally pulled slightly away from the head. This was corrected by applying several extra coats of collodion where the forward edge of this goggle was attached to the head.

Fig. 1. Two types of goggles and caps used for controlling the visual field of the pigeon and for covering one or the other eye.

¹The working out of these techniques was begun with Dr. H. M. Jenkins at the Bell Telephone Laboratories during the summer of 1958. It was continued thereafter at the Psychological Laboratories, Harvard University, where it was supported by NSF Grant G8621 to Prof. B. F. Skinner. Reprints may be obtained from the author, at Neurology and Cardiology Department—F60, Smith Kline and French Laboratories, 1500 Spring Garden St., Philadelphia 1, Pa.

Modifications of the technique include caps which only partially cover the eye, for limiting more severely the available visual field, and translucent hemispheric goggles, for eliminating pattern vision without eliminating stimulation of the eye by light.

A modified front panel, shown in Fig. 2, was used in the experimental chamber for the goggled pigeons. Different intensities, colors or forms were projected directly on the translucent response-key (anterior stimuli) or on translucent screens at either side (lateral stimuli). In other experiments, discriminations of diffuse stimuli were studied by varying the intensity or color of the house-lights in a standard experimental chamber (cf. Ferster and Skinner, 1957).

Pigeons with lateral goggles could see neither the key while pecking nor grain in the feeder while eating, and required extensive training both before and after the mounting of the goggles. In order to peck the key, these pigeons had to learn to orient themselves with respect to stimuli in the lateral field. This orientation had to be relearned when the cover was transferred from one eye to the other. The pigeons apparently also had to

learn to orient their heads properly to see the lateral discriminative stimuli. During variable-interval reinforcement, feedback clicks for pecks and an increased duration of reinforcement helped to maintain key pecking in these pigeons.

It was impossible to establish discriminations of form with lateral stimuli; this and several lines of evidence suggest that the pigeon is near-sighted for anterior stimuli and far-sighted for lateral stimuli. With the apparatus used (Fig. 2), lateral stimuli were only 1 to 3 in. from the pigeon's eye (depending on the location of its head). The failure to obtain discrimination was not due to characteristics of the goggles, because the same difficulty was encountered with a procedure for monocular presentation of lateral stimuli to pigeons without goggles. In the apparatus in Fig. 2, each peck on the key produced a $\frac{1}{2}$ -sec stimulus flash on only one side of the pigeon's head. One schedule of reinforcement was in effect with one stimulus, and a second schedule with a second stimulus. Thus, a discriminative stimulus was available to the pigeon only while it pecked, and so only while its head was in a position such that the stimulus was in the lateral field of one eye. No form discriminations could be established with this procedure, implying that the pigeon cannot accommodate for lateral stimuli that are very close to its eye.

Much of the operant research with pigeons provides evidence that the pigeon is near-sighted for anterior stimuli, in that stimuli presented directly on the response-key exert powerful control over pecking (e.g., Ferster and Skinner, 1957). It has also been shown (Chard, 1939) that the pigeon's acuity for distant stimuli is good, but falls off rapidly with decreasing distance; the description of this experiment, however, implies that the pigeon observed the stimuli by cocking its head to one side, and was therefore observing the stimuli laterally. Levine's description of the behavior of pigeons on a modified Lashley jumping stand is also consistent with the present interpretation (Levine, 1945a, 1945b). Finally, the conclusion is not contradicted by the anatomical characteristics of the pigeon's eye (Polyak, 1957). If correct, this conclusion indicates that stimuli for lateral discriminations must be placed at some distance from the pigeon's eye.

Fig. 2. Modified front panel of the experimental chamber used with pigeons wearing the goggles and caps illustrated in Fig. 1.

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