The automatic recording of aggression in pigeons: A comparison of two methods with live targets

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Three pigeons were exposed to a fixed-time response independent food-delivery schedule and a live target pigeon restrained in a holder mounted on a spring and microswitch assembly. This common method of recording aggression was compared with a photocell system, and both were evaluated by observation of video-tape recordings. Dependent variables included the number of interfood intervals with an attack, attacks per minute, and attack duration. The photocell proved more reliable than the microswitch and correlated highly with observations of both the number of interfood intervals with an attack for three subjects and attack duration for two. Neither apparatus provided accurate information about the rate of attacks. The microswitch apparatus was not sensitive to changes in the subject's attack topography, while both recording devices were susceptible to activation by responses in the attacking pigeon other than discrete pecks or physical blows. In view of these findings, attacks per minute may not be an appropriate measure of aggression in studies using such devices.

When food-deprived pigeons are exposed to an intermittent food-delivery schedule, they will sometimes attack an available target (Azrin, Hutchinson, & Hake, 1966; Dove, Rashotte, & Katz, 1974; Flory, 1969). Frequently, a device similar to that used by Azrin et al. (1966) is employed to record aggression (Chereck, Thompson, & Heistad, 1973; Flory, 1969; Knutson, 1970; Richards & Rilling, 1972), wherein either a live or a taxidermically prepared pigeon is strapped into a restrainer mounted on a microswitch and spring assembly. When sufficient force is applied to some part of the target (Flory, 1969) or holder (Knutson, 1970), the microswitch contacts close; this defines the occurrence of an attack. Aggression is recorded as attacks per minute. Precautions are usually taken to insure that attacks can be directed toward the target from only one angle and that the subjects' normal ambulatory movements within the experimental chamber do not cause accidental microswitch closures (e.g., Knutson, 1970).

Our experience and analysis of video tape recordings of attacking pigeons in an experimental setting and with a recording device similar to that of Azrin et al. (1966) revealed several problems. For example, attack topography varies considerably both within and between subjects. An attack episode may consist of the subject's taking the target's neck or head feathers in its beak and vigorously shaking the target from side to side. This often results in multiple microswitch

closures, when in fact only a few pecks were directed at the target. At the other extreme, a subject may peck around the eyes of the target with short, highly localized jabbing movements. These are sometimes directed horizontally and fail to displace the microswitch assembly, which is designed to activate primarily on downward forces. We also observed, as did Azrin et al. (1966), that microswitch closures occur as a result of strong defensive movements by the target. This usually happens (1) just before an attack as a result of a "threat" by the subject, (2) during an attack, or (3) immediately after the food magazine cycle and independent of an approach by the subject. Furthermore, the microswitch assembly is not designed to measure attack duration. Adjustments must be made in order to estimate the length of an attack episode. For example, a timer may be set to operate from the first microswitch closure until 1 sec elapses without a switch closure (Webbe, DeWeese, & Malagodi, 1974).

The reliability of our spring-switch system, based on designs from the literature, varied considerably with subject attack topography and the defensive movements of the target. Direct observation or video recording and observer scoring are time-consuming alternatives. This report presents one solution to some of these problems and provides data comparing two methods of recording attack behavior in pigeons.

METHOD

Subjects

Three White King pigeons, maintained at 80+ (± 15 g) of free-feeding weights, were used. The subjects had had limited prior experience with an autoshaping procedure (Brown & Jenkins, 1968), in which a briefly illuminated key light signaled the opportunity to attack. Approximately 10% of the trials contained a

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Figure 1. Schematic of two methods of recording attack in pigeons. The entire chamber was 60.9 cm square. Horizontal distance between target restrainer and photocell could be adjusted.

keypeck and 75% of the trials an attack. Two additional non-deprived White King pigeons were assigned to each subject as target birds; they were alternated every other day to allow for recovery from injury received during attacks.

Apparatus

The experimental chamber, 60.9 cm high x 35.5 cm wide x 10.9 cm deep, was enclosed in a fan-ventilated, sound-attenuating shell. The hopper wall, ceiling, and two walls were of burnished aluminum; one wall was clear Plexiglas. A food magazine opening was centered in one wall 10.1 cm above the floor. The target bird was placed behind a 15.2 x 15.2 cm opening (with the lower edge 12.7 cm above the floor) in the wall opposite the food magazine; a 20-W houselight in the center of the ceiling provided constant illumination.

The target bird was restrained in a U-shaped plastic restrainer mounted on a spring-and-microswitch assembly patterned after Azrin et al. (1966). A daily adjustment was made for each individual target such that a downward force of 100 g (0.98 N) against the target's head activated the microswitch. The target bird could move only its head and neck, and when positioned, its head was approximately 5.0 cm behind, and directly in the center of, the target wall opening (see Figure 1).

The photocell was located 1.2 cm below and in the center of the lower edge of the target wall opening. The target bird could not operate the photocell. A 7.5-W light mounted 15 cm above the target wall opening provided additional illumination in the target bird's compartment. The sensing device consisted of a photoelectric cell (Radio-Shack No. 276-677) connected to one input of a locally designed and constructed operational amplifier (Figure 2). The other amplifier input was used as the reference and adjusted once each day. The circuit was a voltage comparator, and was operational over a wide brightness range.

Events were programmed by conventional relay circuitry and attacks were recorded on impulse counters and a four-pen event recorder. Both microswitch and photocell outputs were pulse-formed to obtain attack totals. Activities within the chamber were recorded with a Sony AV-3600 video tape camera and recorder. The camera, with 1:18 lens, was mounted on a tripod 3 ft in front of the chamber.

Procedure

The subjects were immediately exposed to a fixed-time 2-min response-independent food-delivery schedule with the target in place. Microswitch and photocell definitions of attack were obtained for every session. Only the photocell recorded attack

duration. Video tape from each session was randomly assigned to one of three observers for scoring. The observers were instructed to press and release a push button for each separate peck at the target. Each buttonpress accumulated on an impulse counter and a running time meter. When the observer could not differentiate discrete pecks either because of rapid head movements or because the pigeon was engaged in behavior that could not clearly be classified as target pecking, such as pulling and jerking head or neck feathers, the observer kept the button depressed. For all except the last five sessions, the observer merely determined the number of interfood intervals containing an attack. During the last five sessions, total attacks per session and total attack durations were also defined and scored by the observer.

Sessions began with a 2-min interval and terminated after 30 hopper presentations, each consisting of 3-sec access to Purina Pigeon Chow. Sessions were conducted at approximately the same time each day, 7 days per week.

RESULTS AND DISCUSSION

Photocell records of interfood intervals with an attack and attack duration were fairly consistent with those of observers (Figure 3). For any one session, there was never more than a 10% difference in reporting the percent of interfood intervals with an attack.

Microswitch definitions of the percent of interfood intervals with an attack were typically inaccurate and

Figure 2. Diagram of the photocell operational amplifier.

varied considerably both within and between subjects. For Subjects P1 and P3, there were fewer microswitch reports than observer reports, and the microswitch did not reliably follow changes in the direction of attacks (e.g., P1, Sessions 6 through 8). For P2, the microswitch was more sensitive than it was for P1 and P3 in terms of the percent of interfood intervals with an attack. However, the typical error in the first nine sessions was due to the struggling movements of the target. For example, during Session 3, no attacks were reported by the observer or photocell, but 33% of the interfood intervals contained an attack according to the microswitch. This error was not as prevalent for P1 and P3, since their targets were less active.

In order to index the reliability of the photocell and microswitch, correlation coefficients were calculated between the observer and microswitch data and the observer and photocell data. Analysis of variance (Table 1) showed that for the photocell, there was no significant difference in recording the number of interfood intervals with an attack and total attack duration. Photocell definitions of the number of interfood intervals with an attack correlated nicely with the observer's for all three pigeons. With data obtained from the microswitch, this was true only for P2.

However, high correlations could occur independently of agreement with the locus of attacks in the interfood interval as defined by the observer. Thus, the event recorder tapes containing the photocell, microswitch, and observer definitions of attack were analyzed (see Figure 4). The interfood intervals of the last five sessions for each bird were divided into eight 15-sec bins. The apparatus was considered accurate for each bin in which it agreed with the observers. The photocell and microswitch agreement with the observer for P1 was 98.6% vs. 51.7%, 94.4% vs. 89.7% for P2, and 99.4% vs. 27.9% for P3. This analysis suggests that the significant correlations in Table 1 for the number of interfood intervals with an attack did not necessarily occur due to accidental apparatus closures in which there was also an observer-defined attack.

The photocell also correlated significantly with observations of attack duration for P2 and P3, and the

Figure 3. Percent of interfood intervals with an attack, attacks per minute, and attack duration as a function of sessions for each subject, obtained from the photocell, microswitch, and observer.

Table 1
Correlation Coefficients and Comparison of Means Between the Observer and Photocell and the Observer and Microswitch

Subject	Comparison	Number of IFIs With an Attack		Attacks Per Minute		Attack Duration	
P1	OBS-PHOTO	N = 13	.97*	N = 5	-.35	N = 5	.70
	OBS-MICRO		.20†		-.64		
P2	OBS-PHOTO	N = 14	.99*	N = 5	.43	N = 5	.98*
	OBS-MICRO		.93*		.48†		
P3	OBS-PHOTO	N = 13	.97*	N = 5	.84*	N = 5	.99*
	OBS-MICRO		.65*†		.29		

Note—N is the number of sessions upon which each statistic is based.

*For R, $p < .05$, one-tailed test.

†For Tukey, $p < .05$.

Figure 4. Event recorder tape containing examples of the types of errors characteristic of the two recording systems. Example A: microswitch and photocell outputs not contiguous with reports by the observer. Example B: microswitch closure in the absence of an attack.

attack rate for P3. Attack rate proved to be the most unreliable dependent measure with either system, since the correlation coefficients were negative (P1), nor statistically significant (P2 and P3), or showed a significant difference between means (P2). Figure 4A illustrates some possible sources of these discrepancies. Frequently, when the microswitch and photocell were activated, multiple outputs were produced, while both microswitch and photocell outputs were not always contiguous with attacks reported by the observer. While part of this error may have been due to the observer's inability to discriminate discrete pecks, the attacks in Figure 4A consisted only in part of pecking the target. The majority of the two episodes consisted of behavior that could not be described clearly as pecking the target, i.e., pulling and jerking the head and neck feathers. Thus, both apparatuses were susceptible to activation by responses other than discrete pecks. Movements of the target sometimes confounded this problem for the microswitch, during as well as in the absence of attacks, as in Example B of Figure 4.

Although the percent of interfood intervals with an attack for P1 and P3 suggest that the operating force of the microswitch may have been set too high, lowering the force requirement may have resulted in an even greater discrepancy in the rate measure, as occurred for P2. However, we do not believe that the discrepancy in P1's and P3's data was simply a function of the force requirement per se, but was in fact due to variability in the force requirement

necessary to activate the microswitch as a function of the locus of pecks across the frontal area of the target.

In the present study, the photocell proved to be a reliable method of recording aggression for both number of interfood intervals with an attack and attack duration. With the current level of recording device sophistication and the complex and variable nature of the pigeons' attack repertoire, attacks per minute may not be an appropriate measure of aggression, either in terms of the reliability of the measurement or the behavior exhibited by the subject. Indeed, Azrin et al (1966) warned against several of the problems discussed in this paper and did not use attacks per minute as a dependent measure of aggression. We must concur, and urge future researchers in this area to publish reliability data for their apparatus with respect to the dependent measures examined.

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