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THE INTERRELATION BETWEEN PIGEONS' SCHEDULE-INDUCED AGGRESSIVE BEHAVIOR AND THE RECIPIENTS' COUNTER-BEHAVIOR

LA INTERRELACIÓN ENTRE LA CONDUCTA DE AGRESIÓN INDUCIDA POR EL PROGRAMA EN PALOMAS Y LA REACCIÓN CONDUCTUAL DEL RECEPTOR

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Abstract

The present experiment was conducted to investigate whether an experimental pigeon's shield-peck responses toward a target pigeon could be induced by a food reinforcement schedule consisting of continuous reinforcement (CRF) and extinction. Further, the interaction between experimental and target pigeons' shield-peck responses was investigated. The experiment was an ABAB design consisting of alternating phases of nonreinforcement (A) and CRF-extinction (B) of the experimental pigeons' key-peck responses unrelated to their shield-peck responses. The

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experimental pigeons' shield-peck responses were induced by the CRF-extinction schedule. Further, there were positive correlations between the experimental and the target pigeons' shield-peck responses revealing a similar trend in both their response rates. Thus, the experimental pigeons' shield-peck responses were controlled by variables including the reinforcement schedule and social stimuli including ontogenic and phylogenic variables derived from their target pigeons. Moreover, the pigeons' responses could be classified as an aggressive behavior derived from the interlocking contingencies of the responses of the pigeons of the dyads.

Keywords: pigeons, schedule-induced aggressive shield-peck responses, interlocking contingencies

Resumen

El presente experimento se realizó para investigar si las respuestas de picoteo de una paloma experimental hacia una placa de acrílico (escudo) de otra paloma objetivo podían ser inducidas por un programa de reforzamiento continuo (RC) y extinción. Además, se investigó la interacción entre las respuestas de las palomas experimentales y las palomas objetivo al escudo. El experimento utilizó un diseño ABAB que consta de fases alternas de no reforzamiento (A) y RC- extinción (B) de las respuestas de picoteo de las palomas experimentales no relacionadas con sus respuestas de picoteo al escudo. Las respuestas de las palomas experimentales al escudo fueron inducidas por el programa RC-extinción. Además, hubo correlaciones positivas entre las respuestas de las palomas experimentales y las respuestas de las palomas objetivo al escudo que revelaron una tendencia similar en sus tasas de respuesta. Por lo tanto, las respuestas de las palomas experimentales de picoteo al escudo se controlaron mediante variables que incluyeron el programa de reforzamiento y estímulos sociales que incluyeron variables ontogénicas y filogénicas derivadas de sus palomas objetivo. Además, las respuestas de las palomas podrían clasificarse como un comportamiento agresivo derivado de las contingencias entrelazadas de las respuestas de las palomas de las díadas.

Palabras clave: palomas, agresión inducida por el programa, respuestas de picoteo al escudo, contingencias entrelazadas

Social behavior is defined as "the behavior of two or more people with respect to one another or in concert with respect to a common environment" (Skinner, 1953,

p. 297). Social behavior, however, is not limited to human behavior. Most nonhuman animals living in groups also engage in behavior patterns fitting the above definition. Furthermore, social behavior includes behavior toward not only conspecifics but also heterogeneous organisms sharing the same environment. Thus, the above definition of social behavior can be revised as the behavior of an individual that affects the behavior of other living organisms sharing the same environment. In this case, the behavior of other living things constitutes the social environment for one organism's social behavior.

As a method of investigation into the contingencies of reinforcement, Skinner (1953) suggested that "We may analyze a social episode by considering one organism at a time. … We then consider the behavior of the second organism. … By putting the analyses together, we reconstruct the episode" (p. 304). From his suggestion, interactions between individuals' behavior in the social environment should be investigated to account for social behavior. The experimental procedure of schedule-induced aggression could be suitable for such an investigation.

Aggressive behavior is a form of social behavior because the behavior harmfully affects the behavior of other living organisms sharing the same environment. As for its controlling variables, aggressive behavior can have either a phylogenic or an ontogenic origin (Skinner, 1969). Relatively stereotyped aggressive behavior is elicited or released by unconditioned stimuli or releasers based on phylogenic contingencies that are related to food supplies, breeding, population density, and protection of offspring. Ulrich, Hutchinson, and Azrin (1965) reviewed a series of studies (e.g., Azrin, Hutchinson, & Hake, 1963; Azrin, Hutchinson, & Sallery, 1964; O'Kelly & Steckle, 1939; Ulrich & Azrin, 1962) that demonstrated a variety of aversive stimuli could induce aggressive behavior derived from phylogenic contingencies.

Aggressive behavior based on ontogenic contingencies is shaped and maintained by such consequences as many positive or negative unconditioned or conditioned reinforcers mediated by the targets of such behavior (e.g., Kuo, 1930, 1938). It is well known that aggressive behavior also is induced during a reinforcement schedule in which a reinforcer is delivered following another, unrelated, operant response. This phenomenon has been labeled schedule- or extinction-induced aggression.

Frederiksen and Peterson (1977), Looney and Cohen (1982), Soares and Goulart (2015), and Wallace and Singer (1976) reviewed studies of schedule-induced aggression. The general paradigm for schedule-induced aggression has involved schedules of intermittent reinforcement (e.g., Yoburn, Cohen, & Campagnoni, 1981) or extinction (e.g., Azrin, Hutchinson, & Hake, 1966) of a simple operant response such as key pecking or bar pressing. The subject is exposed to any of several schedules (e.g., extinction, fixed- and variable-ratio, fixed- and variable-interval, fixed- and random-time, differential-reinforcement-of-low-rate schedules) and simultaneously allowed the opportunity of attacking a target. The target has been either a live restrained conspecific (Azrin, et al., 1966; Gentry, 1968; Knutson, 1970; Pitts, Hughes, & Williams, 2019, *this issue* for pigeons; Hutchinson & Renfrew, 1978; Knutson & Schrader, 1975; Thompson & Bloom, 1966 for rats), an inanimate target such as a taxidermically stuffed bird (Azrin et al., 1966; Flory, 1969a, 1969b), a mirror image (Cohen & Looney, 1973), a slide image (Flory & Ellis, 1973), or a picture of a conspecific (Looney & Cohen, 1974; Looney, Cohen, & Yoburn, 1976). When given intermittent access to a reinforcer or extinction, many species including humans (e.g., Frederiksen & Peterson, 1974; Harrell, 1972; Hutchinson, Pierce, Emley, Proni, & Sauer, 1977; Kelly & Hake, 1970) engage in aggressive behavior toward a target.

The most common finding among those studies is that aggressive behavior occurs immediately after removal of the reinforcer and decreases thereafter. Staddon (1977) also has suggested that schedule-induced aggression results from a reduction in reinforcement probability following a reinforcer. Those findings led to the suggestion that schedule-induced aggressive behavior is a unique behavior class different from operant and respondent. Frederiksen and Peterson (1977) suggested that Falk's (1971) view on *adjunctive behavior* offers a much more comprehensive theoretical analysis of schedule-induced aggression. Falk (1966) suggested that schedule-induced polydipsia (cf., Falk, 1961) occurs as an adjunct to a reinforcement schedule and called such behavior "adjunctive." He went on to argue that schedule-induced aggressive behavior is also adjunctive behavior (Falk, 1971). He suggested that the behavior is neither under the direct control of the reinforcement schedule (i.e., the behavior is not operant behavior) nor elicited by unconditioned stimuli (i.e., the behavior is not respondent behavior). However, based on her thorough reexamination of many studies about adjunctive behavior, Wetherington (1982) concluded that schedule-induced aggressive behavior is not unique and argued the necessity of mapping functional relations between behavior and various procedures for presenting response-independent stimuli within the Skinnerian framework.

Skinner (1969) suggested that the important variable for aggressive behavior is its effects on others in the form of harm or threat. Moreover, he suggested that the actual stimuli reinforcing aggressive behavior could be found in the recipient's behavior and any phylogenic or ontogenic conditions that provide the opportunity to act aggressively. Considering his suggestions, a given instance of aggression generally can be traced to both phylogenic and ontogenic contingencies for aggressive behavior.

However, as Looney and Cohen (1982) suggested, except for a few studies (e.g., Azrin, 1970; Cole and Litchfield, 1969; Rashotte, Dove, & Looney, 1974; Reynolds, Catania, & Skinner, 1963), little is known about the effect of ontogenic contingencies on schedule-induced aggression. Certainly, these investigators studied ontogenic contingencies of aggressive behavior, but they used nonsocial consequences such as food or electric shock to elicit or revoke the aggressive behavior. As aggressive behavior is a form or type of social behavior (see also Pitts, Hughes, & Williams, 2019, *this issue*), we should consider it in terms of social contingencies that include another organism's behavior. Most specifically, to clarify the variables of the behavior, we should investigate not only the aggressive behavior of the aggressor but also that of the recipient and the interactions between the aggressive behavior and recipient's behavior. In some studies, counter-aggressive behavior by a target has been discussed (e.g., Azrin, et al., 1966; Looney & Cohen, 1982). Nonetheless, most studies of schedule-induced aggressive behavior have not investigated the interrelation between aggressive behavior and the recipient's behavior.

In this case, the problem is the environment in which the target is located. The target in most early studies of schedule-induced aggressive behavior was a live, restrained conspecific. The target was frequently attacked and injured by the attacker. To avoid this ethical problem, in the present experiment, a 2-mm thick clear plastic shield was used to separate an experimental pigeon and a target pigeon, based on the apparatus of Macurik, Kohn, & Kavanaugh (1978). Using this procedure, we measured not only the number of shield pecks by experimental pigeons but also by target pigeons, which allowed us to examine some of the interactions between them. This experiment was conducted to investigate (a) whether experimental pigeons' shield-peck responses toward nonrestrained targets were induced by a reinforcement schedule and (b) whether interactions occurred between experimental pigeons' shield-peck responses and those of the target pigeons.

Method

Subjects. Eight male pigeons (*Columba Livia*) served as subjects. Four (EP2, EP4, EP10, and EP20) were experimental pigeons (hereafter, EPs) and the other

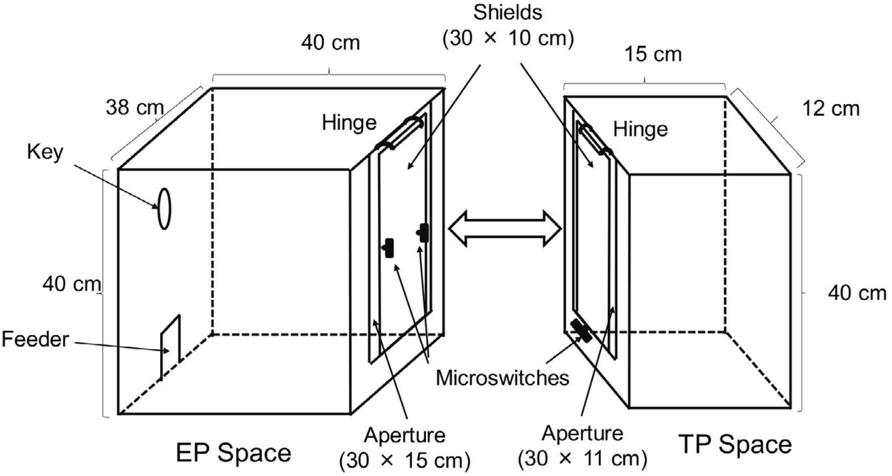


Figure 1. Modified operant chamber consisting of the space for an experimental pigeon (EP) and that for a target pigeon (TP). Respective spaces were described in isolation to make them clear. In the experiment, two spaces were set adjacently.

four (TP31, TP82, TP24, and TP12) were target pigeons (hereafter, TPs). Although EPs were experimentally naive, TPs had some experimental history. The EP2, EP4, EP10, and EP20 were paired with TP31, TP82, TP24, and TP12, respectively. The EPs were maintained at approximately 80% free-feeding weight throughout the experiment. The TPs were maintained at free-feeding weight. The TPs and EPs were housed in individual living cages with water and grit continuously available.

Apparatus. The modified operant chamber used in this experiment consisted of two spaces, one for the EP and the other for the TP (see Figure 1). The EP space was a 40 × 38 × 40 cm and was configured with a single response key (2.5 cm in diameter and 20 cm high from the floor) that could be transilluminated by a 24-VDC light bulb, a shield (described below), a food-hopper driven by a 24-VDC solenoid, and a 24-VDC houselight. The TP space was a 15 × 12 × 40 cm clear box also configured with a shield and a 24-VDC houselight. Food reinforcement was made available to the EP by the food-hopper. On the rear wall, opposite the response key of the EP's operant space, was a 30 × 15 cm rectangular aperture with a 30 × 10 cm clear plastic shield attached by two microswitches. The shield of the EP space was suspended from the rear wall ceiling of the EP's chamber by a hinge. On the front wall of the TP space, facing the EP's shield, was a 30 × 11 cm rectangular aperture with a 30 x 10 cm shield attached by a microswitch. The shield of the TP space was suspended from the ceiling of the TP space wall facing to the EP's rear wall by a hinge. The two microswitches of the EP's shield were attached to both sides of the shield and determined EP's shield-peck responses. Only one of them counted EP's shield-peck responses. The other microswitch was set for adjusting the shield. The microswitch for the TP's shield was attached to the lowest part of the shield and determined TP's shield-peck responses. The respective microswitches of the EP and the TP spaces were attached to the backside of each shield. The microswitches of the EP's and the TP's spaces were located in different places so that the shields could be closer together than if the microswitches were located in the same place. Thus, the microswitches attached to the shields could count the number of EP's and TP's pecks toward their other side. The houselight mounted on the ceiling of each space and the key light in the operant space were on throughout the experimental sessions except during each food delivery and blackout.

A laptop computer with an Arduino mega 2580 microcontroller board interface and Visual Basic 2010 programming were used to control the experiment and record key-peck responses by EPs and shield-peck responses by both EPs and TPs. The pigeons were observed via a web camera. A white-noise generator provided continuous masking noise during each experimental session.

Procedure. Prior to the experiment, each EP received some feeder training sessions and shaping of the key-pecking response for food in the operant space, with the TP space empty. After each EP key pecked consistently, its paired TP was introduced into its space and four phases (ABAB) were conducted. The A phases were no-reinforcement phases (cf., Gentry, 1968) and the B phases were continuous reinforcement-extinction phases (hereafter, CRF-EXT; cf., Azrin et al., 1966). The phases were changed when systematic trends were absent on visual inspection of each EP's shield-peck response rates (number of shield-peck responses per min) within each phase.

During the first and the third phases (Phase A), the response key for the EP was covered and the reinforcement-delivery mechanism was inoperative. These no-reinforcement phases provided the baseline levels of shield pecking by both pigeons. Each session of these phases was 60 min. The procedure of the second and the fourth reinforcement-extinction phases (Phase B) was almost the same as that of Azrin et al. (1966). Each session consisted of alternating periods of a continuous reinforcement (CRF) schedule and extinction of each EP's key-peck responses. The schedules were not in effect for any of the TPs' responses. Each reinforcement during the CRF periods was a 4-s access to a solenoid-operated food hopper. Immediately after the 10th food reinforcements arranged by the CRF schedule, the key pecks became ineffective for 5 min (the extinction periods). This cycle of alternating CRF 10 and extinction periods was repeated eight times within a session. However, unlike Azrin et al., instead of a tone, the lighting of both the houselight and the key served to signal the beginning of the continuous reinforcement period. During blackouts that were in effect after each cycle of the CRF and extinction periods, EPs' key-peck and shield-peck responses and TPs' shield-peck responses were not recorded. As the two houselights for EPs and TPs were yoked together, only TPs' presence could be an effective discriminative stimulus for EPs' shield pecking. A 1-s changeover delay (COD) was in effect during CRF periods, thus EPs' key-peck responses were not reinforced if a key-peck response has been emitted during 1 s after a shield-peck response.

Results

Figure 2 shows the log-converted shield-peck response rates for each pair of EP and TP. Because the common logarithm has a base of 10, the converted value of 1 means that the response rate was 10. As there sometimes were response rates of 0, all data were converted by adding 1 to the actual value. Thus, a response rate of 0 was converted to 0 + 1 = 1. See Appendix for complete data analyses, including key-peck response rates for each pigeon. Overall, the EPs' response rates were lower than those for the TPs, and changing trends in the rates between phases were similar between EPs and TPs of each pair except the pair of EP4 and TP82. Table 1 shows each pigeon's mean log-converted shield-peck response rates over the last five sessions of each phase and geometric mean response rates for Phases A and B. All pigeons except EP4 responded more in Phase B than in Phase A. The shield-peck rates of all EPs except EP4 increased following each change from A to B phases and decreased following the change from B to A phases. Three TPs (TP31, TP82, and TP24) also showed the same tendency but TP 12 did not. Pigeon EP4's rates were very low all over phases.

These results showed that the shield-peck responses of the EPs except EP4 were induced by the schedule consisting of CRF 10 and extinction periods. The lower rates of EPs relative to those of TPs could be due to differences in the size of each pigeon's space (the EP's space was larger) or the presence of the key to peck in the EP's space. Furthermore, food reinforcement for the EPs' key-peck respond-

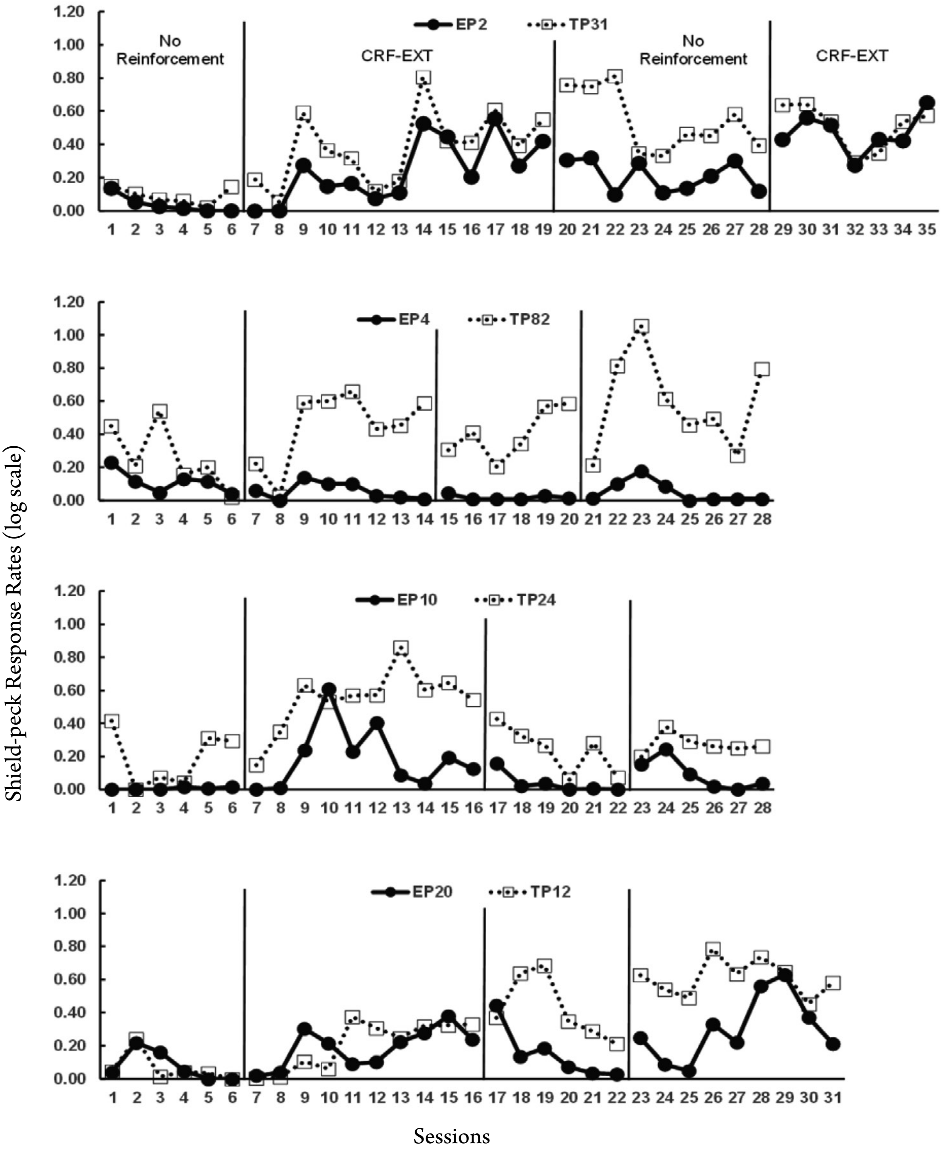
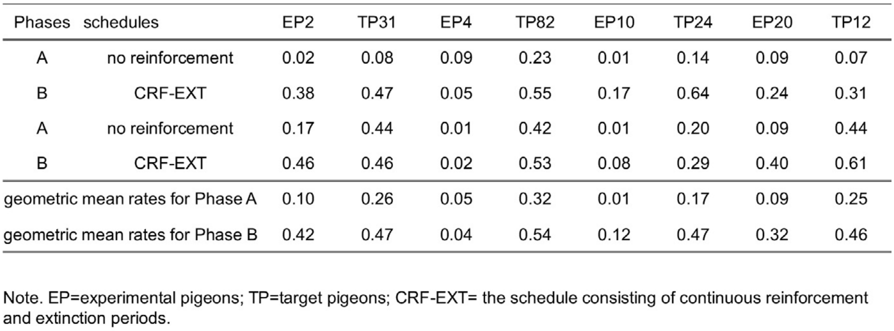


Figure 2. Log-converted shield-peck response rates (number of shield-peck responses per min) of experimental and target pigeons in each pair per session and phase. EP denotes an experimental pigeon and TP does a target pigeon.

Table 1.

Each pigeon's mean shield-peck response rates over the last five sessions of each phase and geometric mean response rates for Phases A and B



Phases	schedules	EP2	TP31	EP4	TP82	EP10	TP24	EP20	TP12
A	no reinforcement	0.02	0.08	0.09	0.23	0.01	0.14	0.09	0.07
B	CRF-EXT	0.38	0.47	0.05	0.55	0.17	0.64	0.24	0.31
A	no reinforcement	0.17	0.44	0.01	0.42	0.01	0.20	0.09	0.44
B	CRF-EXT	0.46	0.46	0.02	0.53	0.08	0.29	0.40	0.61
geometric mean rates for Phase A		0.10	0.26	0.05	0.32	0.01	0.17	0.09	0.25
geometric mean rates for Phase B		0.42	0.47	0.04	0.54	0.12	0.47	0.32	0.46

Note. EP=experimental pigeons; TP=target pigeons; CRF-EXT= the schedule consisting of continuous reinforcement and extinction periods.

ing during the CRF periods might have affected negatively their rate of shield-peck responses. However, the effect of key pecking seemed to be partially because there were no significant negative correlations between the rates of key-peck and shield-peck responding over the two B phases for three of the EPs. Only for EP10 was there a significant negative correlation between them (Kendall's coefficient of correlation (τ) was -.5774, $p = .0019$), suggesting that its low rates of shield-peck responding might be partly responsible for its key-peck responding.

Azrin et al. (1966) reported that some TPs counterattacked so vigorously that EPs stopped attacking altogether. Considering their report, the EP's lower shield-peck responses could be controlled by the TPs' shield-peck responses.

Another contributing variable to the EPs' shield-peck responses might be the temporal nature of the CRF-EXT schedule. After the 10th reinforcer and no presentation of food for further key-peck responses in a given cycle, the EPs turned around, approached, and then began pecking the shield. Thereafter, they returned to the key and pecked it. If the key-peck response did not produce food, they returned to the shield. This back-and-forth movement from the key to the shield was repeated until the beginning of the blackout. Considering this behavior pattern, the EPs' shield-peck responses may be controlled not only by the CRF-EXT schedule but also by the duration of the extinction period. Because this duration was fixed, EP responding also might be under the temporal control of the extinction period. This temporal control of the EP's responses by the extinction period also would reduce the EPs' shield-peck responses.

The results for EP4 were not clear, probably because its response rates were extremely low throughout all phases compared to other EPs. We may deal with this issue within the range of individual differences for schedule-induced behavior, which has been reported in most experiments in which pigeons have been the subjects (Frederiksen & Peterson, 1977; Knutson, 1970; Knutson & Kleinknecht, 1970). We attribute these low rates to some combination of an unspecified behavioral history and its health problem detected at the end of this experiment.

As described above, there were some phases in which the direction of change in shield-peck response rates was similar between EPs and TPs. The similarities may reflect some relation between EP's and TPs' shield-peck responses. To further quantify this relation, Kendall's coefficient of correlation (τ) was determined between the log-converted shield-peck response rates of EP and those of TP for each pair over all sessions of both A and B phases. All pairs except the pair of EP4 and TP82 showed significant correlations (EP2-TP31: $\tau = .577$, $p < .001$; EP10-TP24: $\tau = .495$, $p < .001$: EP20-TP12: $\tau = .433$, $p < .001$). We do not know which pigeon's (EP's or TP's) behavior mainly contributed to the creation of this relation because we did not control either pigeons' behavior as independent variables. However, as most EPs' and TPs' rates of shield-peck responding were higher during Phase B than during Phase A, the relation between EPs' and TPs' shield-peck responses during the two B phases could be that of responses to each other's behavior. First, the increase in shield-peck responses of the EPs could be schedule-induced by the B phases. This increase in shield-peck responses could trigger shield-peck responses on the TPs. After that, the exchange of responses between both pigeons could escalate into higher response rates for both pigeons. When schedule-induced behavior of the EPs decreased during the A phases, the TPs' shield-peck responses could also decrease. Similar response patterns between EP and TP of each pair could reflect such a response exchange between them. In that case, the TPs' behavior could be induced by the EPs' behavior.

Discussion

In summary, EPs' shield-peck responses toward their nonrestrained TPs during the CRF-EXT periods were induced by both the reinforcement schedule and TPs' shield-peck responses toward EPs. Furthermore, EPs' and TPs' shield-peck responses were mutually interrelated. These results give rise to further questions:

whether the behavior toward the other pigeon was social and whether the behavior of the EPs toward the TPs can be considered aggressive behavior.

As shield-peck responses of EPs and TPs sharing almost the same environment could influence each other, their behavior meets the revised definition of social behavior based on the one cited above by Skinner (1953). Although the reinforcer maintaining the social behavior was unknown, some interlocking behavioral contingencies might be involved in the relation (cf., Glenn, 2003). To clarify the possibility, the interlocking contingencies such as those for pigeons' symbolic communication (Epstein, Lanza, & Skinner, 1980; Lubinski & Thompson, 1987), ping-pong playing pigeons' responses, and the emergence of leading and following relationships between two pigeons (cf., Kubota, 1997; Kubota & Moriyama, 2001; Skinner, 1962) invite investigation in schedule-induced aggression.

However, the contingencies for shield-peck responses for EPs could involve at least three variables: the reinforcement schedule consisting of food reinforcement and extinction for key-peck responding, the temporal feature of the extinction period of the schedule, and the TPs' behavior. Although these variables were most obviously and proximally based on ontogenic contingencies for EPs' shield-peck responses, the social stimuli derived from TPs' behavior also might be traced back to phylogenic contingencies. Thus, the interlocking contingencies for the EPs' shield-peck responses could be based on both ontogenic and phylogenic contingencies.

The second question is whether the EPs' shield-peck responses toward the TP can be considered aggressive behavior. Informal visual observations of the EPs' shield-peck responses during the CRF-EXT schedule revealed occasional wing flaps accompanied by pecking responses at the same positions on the shield as those of throat, head, and especially the eyes on the TPs (cf., Looney & Cohen, 1982). These observed responses of the EPs were similar to descriptions of pigeons' intraspecific aggression occurring in other biosocial contexts (Cohen, Pennington, & Yoburn, 1979; Cohen, Yoburn, Pennington, & Ball, 1979; Looney et al., 1976). Thus, shield-peck responses by the EPs during the CRF-EXT schedule could be schedule-induced aggressive behavior.

As the TPs received no food reinforcement for pecking, their shield-peck responses toward their EPs might be entirely controlled by their EPs' responses. Further, as their shield-peck response patterns were very similar to those of EPs, the TPs' shield-peck responses could be counter-aggressive behavior. In that case, the EPs' and TP's shield-peck responses could have been controlled by each other's responses. In terms of the exchange of high rates of aggressive shield-peck responding between both pigeons, the interrelations between EPs' and TPs' shield-peck responses might be an analog of boxing and the cycle of human violence.

Arbuckle and Lattal (1988) discussed how certain reinforcement contingencies might give rise to behavioral patterns reflecting tempo or rhythmicity in behavior. Informal visual observation in the present experiment showed that EPs' and TPs' shield-peck responses seemed to be emitted rhythmically. That is, their shield-peck responding showed some regular repeated pattern of emission. Once a shield peck occurred, it tended to be followed by a bout of other such responses. Considering this, EPs' and TPs' shield-peck responses were also controlled by their own occurrence. Future experiments might investigate the possibility of self-stimulation of shield-peck responding along with the examination of the interlocking behavioral contingencies in schedule-induced aggression as a social contingency of reinforcement.

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Appendix

Key-peck and shield-peck response rates (number of responses per min) for experimental and target pigeons of each pair in all sessions during each phase. The key-peck responses were only for the experimental pigeons. The alphabet "EP" preceding the pigeon number denotes the symbol for the experimental pigeons, the "TP" for the target pigeons. Both A1 and A2 phases were the no-reinforcement phases. Both B1 and B2 phases were the CRF-EXT phases.

Phases		EP2		TP31
		Key	shiled	shiled
A1	1		0.37	0.42
	2		0.13	0.27
	3		0.07	0.17
	4		0.03	0.15
	5		0.00	0.05
	6		0.00	0.40
B1	7	18.21	0.00	0.54
	8	8.83	0.00	0.13
	9	20.29	0.89	2.90
	10	17.80	0.41	1.31
	11	4.68	0.47	1.07
	12	8.20	0.19	0.32
	13	3.93	0.29	0.51
	14	5.11	2.35	5.36
	15	5.39	1.80	1.62
	16	2.98	0.60	1.57
	17	5.32	2.57	3.04
	18	2.79	0.86	1.46
	19	4.22	1.62	2.54
A2	20		1.02	4.72
	21		1.08	4.58
	22		0.25	5.47
	23		0.93	1.22
	24		0.28	1.13
	25		0.37	1.90
	26		0.62	1.83
	27		1.00	2.82
	28		0.32	1.47
B2	29	7.49	1.68	3.32
	30	7.05	2.64	3.40
	31	2.92	2.29	2.45
	32	4.57	0.89	0.97
	33	5.64	1.69	1.21
	34	4.69	1.64	2.45
	35	3.64	3.49	2.72

Phases		EP4		TP82
		Key	shiled	shiled
A1	1		0.70	1.82
	2		0.30	0.62
	3		0.12	2.48
	4		0.35	0.43
	5		0.30	0.58
	6		0.10	0.05
B1	7	11.90	0.14	0.66
	8	14.27	0.00	0.06
	9	12.31	0.37	2.92
	10	3.07	0.26	2.98
	11	1.39	0.26	3.58
	12	1.89	0.07	1.70
	13	8.86	0.04	1.84
	14	10.59	0.02	2.89
A2	15		0.10	1.02
	16		0.02	1.58
	17		0.02	0.60
	18		0.02	1.20
	19		0.07	2.70
	20		0.03	2.85
B2	21	24.17	0.02	0.63
	22	12.78	0.26	5.50
	23	11.87	0.50	10.43
	24	4.38	0.21	3.12
	25	5.61	0.00	1.86
	26	8.75	0.02	2.13
	27	5.40	0.02	0.87
	28	5.89	0.02	5.26

Phases		EP10		TP24
		Key	shiled	shiled
A1	1		0.00	1.60
	2		0.00	0.00
	3		0.00	0.18
	4		0.03	0.10
	5		0.02	1.05
	6		0.03	0.97
B1	7	7.07	0.00	0.41
	8	10.47	0.02	1.24
	9	3.12	0.72	3.27
	10	1.32	3.06	2.40
	11	3.75	0.69	2.71
	12	0.83	1.53	2.72
	13	3.07	0.22	6.23
	14	1.67	0.09	2.99
	15	1.16	0.56	3.43
	16	3.22	0.33	2.49
A2	17		0.43	1.67
	18		0.05	1.10
	19		0.08	0.85
	20		0.00	0.15
	21		0.02	0.92
	22		0.00	0.18
B2	23	1.27	0.41	0.58
	24	2.14	0.76	1.39
	25	7.96	0.23	0.96
	26	6.58	0.04	0.83
	27	10.29	0.00	0.78
	28	6.20	0.08	0.82

Phases		EP20		TP12
		Key	shiled	shiled
A1	1		0.10	0.12
	2		0.65	0.75
	3		0.45	0.03
	4		0.12	0.10
	5		0.00	0.08
	6		0.00	0.00
B1	7	12.71	0.04	0.00
	8	2.58	0.10	0.03
	9	4.35	1.01	0.28
	10	11.02	0.64	0.15
	11	8.51	0.23	1.38
	12	5.36	0.27	1.02
	13	4.50	0.67	0.77
	14	3.31	0.89	1.09
	15	2.98	1.41	1.11
	16	1.50	0.73	1.15
A2	17		1.77	1.33
	18		0.37	3.35
	19		0.53	3.85
	20		0.18	1.23
	21		0.08	0.95
	22		0.07	0.63
B2	23	3.57	0.77	3.23
	24	2.47	0.23	2.47
	25	2.10	0.12	2.09
	26	3.38	1.15	5.12
	27	2.13	0.67	3.31
	28	1.78	2.64	4.44
	29	2.21	3.27	3.43
	30	2.62	1.35	1.84
	31	2.35	0.63	2.82