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Human Observing Behavior Maintained by S+ and S-: Preliminary Data

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ABSTRACT

The present study approaches the assessment of the reinforcing function of stimuli that signal the presence (S+) versus the absence (S-) of reinforcement. Two college students participated. A computer application presented a random sequence of two different types of discrete 18-s trials separated by 4-s intertrial intervals. Half of the trials ended with reinforcement (points delivery), and half with no reinforcement. All trials started with a mixed-schedule stimulus being displayed on the center of the monitor screen. Space-bar presses (observing responses) in its presence could change it for either one of two other stimuli correlated with the current type of trial. The schedule requirements for observing responses varied across phases. During baseline, the production of both S+ and S- was under similar schedules of reinforcement (continuous reinforcement or variable interval schedules). During experimental phases, in addition to the baseline schedules, a minimum interresponse time (IRT) was required in order to either S+ (in one experimental condition) or S- (in the other one) be presented. The evaluation of the reinforcing function of S+ relative to S- was assessed by a cross-condition comparison, particularly by the participants' observing responding when the IRT requirement was operative. Results showed that when the presentation of S+ and S- was under these conditions, both stimuli were produced, although often in lower frequencies than in baseline, as one would expect when considering the higher demand added by the IRT. However, for both participants, S+ was produced 20% more often than S- when comparable conditions were in effect. This higher production of S+ may be suggesting a higher effectiveness of S+ as a conditioned reinforcer, although the reinforcing function of S- seems also to exert a major role in the maintenance of human observing responses.
Key-words: observing responses, conditioned reinforcement, human participants.

RESUMEN

Conducta de observación en humanos mantenida por S+ y S-: datos preliminares. El presente estudio pretende evaluar la función reforzadora de estímulos que señalan la presencia (S+) versus la ausencia (S-) de refuerzo. Dos estudiantes universitarios participaron como sujetos experimentales. Un software de ordenador presentaba una secuencia aleatoria de dos tipos diferentes de ensayos discretos de 18 s separados por intervalos entre ensayos de 4 s. Mitad de los ensayos terminaba en refuerzo (entrega de puntos), mitad sin refuerzo. Todos los ensayos empezaban con un programa mixto de reforzamiento, en el que un estímulo era mostrado en el centro de la pantalla del monitor. Presiones en

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la barra espaciadora (respuestas de observación) podían cambiar ese estímulo por cualquiera uno de dos otros estímulos correlacionados con el tipo actual de ensayo. Las exigencias del programa para las respuestas de observación variaba entre las fases. Durante la línea base, la producción de ambos S+ y S- estaban bajo programas de reforzamiento similares (reforzamiento continuo o programa de intervalo variable). Durante las fases experimentales, adicionalmente a los programas de línea de base, se exigía un tiempo mínimo entre respuestas (IRT) de forma que tanto el S+ (en una condición experimental) o el S- (en la otra) fueran producidos. La evaluación de la función reforzadora del S+ con relación a la del S- fue obtenida por la comparación cruzada entre condiciones, específicamente por las respuestas de observación de los participantes cuando el requisito de IRT estaba en vigor. Los resultados muestran que cuando la presentación de los S+ y S- estaba bajo el requisito de IRT, ambos estímulos se produjeron, aunque a menudo en frecuencias más bajas que en la línea base, lo que podría ser esperado cuando es considerada la alta exigencia agregada por el IRT. Sin embargo, para ambos participantes, el S+ fue producido 20% más frecuentemente que el S- cuando condiciones comparables estaban vigentes. Esta producción más alta de S+ puede estar sugiriendo una eficacia mayor del S+ como reforzador condicionado, aunque la función reforzadora del S- debe ejercer también un papel importante en el mantenimiento de las respuestas de observación en humanos.
Palabras claves: respuestas de observación, reforzamiento condicionado, participantes humanos.

Observing responses are defined as those responses maintained by the production of discriminative stimuli for ongoing contingencies (Wyckoff, 1952, 1969). Observing responses do not change the probability of reinforcement (i.e., reinforcement by food, water, points); for this reason, they are considered an effective way to assess the conditioned reinforcing function of stimuli (Dinsmoor, 1983).

The literature on observing behavior has demonstrated that observing responses occur more often and/or last longer and/or have shorter latencies when they are followed by a discriminative stimulus indicating a higher probability of reinforcement (S+). When they are followed by a discriminative stimulus indicating a lower probability of reinforcement (S-), most studies has shown that S- either does not contribute to the maintenance of observing responses (Fantino & Case, 1983; Fantino, Case & Altus, 1983; Preston, 1985; Tomanari, 2001), or contributes to the maintenance of responses that prevent its presentation (Blanchard, 1975; Dinsmoor, Browne & Lawrence, 1972; Jwaideh & Mulvaney, 1976; Tomanari, Machado & Dube, 1998).

Despite their predominance, data reflecting the neutral or aversive function of S- are not absolute, since a few studies have also described conditions in which S- reinforces observing responses (Lieberman, 1972; Lieberman, Cathro, Nichol & Watson, 1997; Perone & Baron, 1980; Schrier, Thompson & Spector, 1980). However, most of these studies were carried out with either monkeys (Lieberman, 1972; Schrier *et al.*, 1980) or human participants (Lieberman *et al.*, 1997; Perone & Baron, 1980), what suggests differences regarding the reinforcing function exerted by S- depending on the species that is studied.

At the light of the divergences regarding the reinforcing function of S-, the present paper briefly reports on how we have approached the assessment of the conditioned reinforcing function of discriminative stimuli in order to contribute with preliminary data to the understanding of the reinforcing function of S-. It is part of our methodological decisions to replicate Blanchard's (1975) and Shrier's *et al.* (1980) procedure, but employing human participants as subjects instead of pigeons (cf. Blanchard, 1975) or monkeys (cf. Shrier *et al.*, 1980).

Method

Participants

Two undergraduate students, AGA and CAS, participated. Although other participants had initiated the experiment, AGA and CAS were selected because they reached the minimum level of observing responses required during the pretraining phase. Personal contacts invited the subjects to participate, who were asked before the beginning of the experiment to read aloud and sign a consent form.

Equipment

An Apple Macintosh Performa 5215CD microcomputer, running an application developed by W. Dube and E. Hiris (UMMS-Shriver Center), controlled the experimental contingencies and recorded the data.

Procedure

Data collection for each participant lasted one single session. At the beginning of the session, the participant was seated in front of the monitor screen. Immediately before the computer started running the task, he or she was asked to read aloud the following instructions displayed in Portuguese on the monitor screen.

"To perform your task, only the space bar on the keyboard will be necessary. Use it as you like. During the experiment you will receive points continuously shown at the upper right corner of the monitor screen. At the end of the session, the points you get will be exchanged for money. Each 10 points equals R$ 0,15. The computer is ready. Press the space bar to start."

Basic Procedure

The computer application presented a random sequence of two different types of discrete 18-s trials separated by 4-s intertrial intervals (ITIs). During the ITIs, the monitor screen was completely blank and no experimental contingency was operative. With respect to trials, half of them ended with the delivery of 10 points accompanied by the presentation of a brief auditory stimulus ("beep"). Trials of this type will be designated TS+. The other half ended with no points and no sound. Trials of this type will be designated TS-. The sequence of trials prevented the same type of trial of occurring more than two times consecutively.

Both TS+ and TS- started with the mixed-schedule stimulus (Figure 1, uppermost stimulus) being displayed on the center of the monitor screen, and the operation of a schedule for observing responses (see schedules specifications below). In the presence of the mixed-schedule stimulus, space bar presses (observing responses) could change it for either one of two other stimuli (Figure 1, middle or lowermost stimuli), given that the reinforcement schedule requirements for observing responses were satisfied. Which stimulus was presented depended solely on the current type of trial. If TS+ was the current trial, then the middle stimulus shown in the Figure 1 was displayed (S+). If TS- was the current trial, then the lowermost stimulus was displayed (S-). After it was presented, S+ or S- was displayed until the end of the trial. If neither S+ nor S- was produced, the trial ended in the presence of the mixed-schedule stimulus. The ending of the trial required the absence of a space bar response in its last 3 s. Responses during this period extended the trial for 3 s from the last response. Since the schedule requirements for observing responses were fulfilled, stimulus change could occur during the trial extension period.

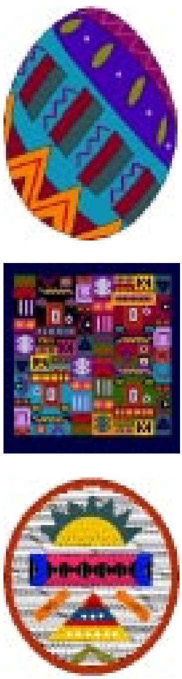

Figure 1. In colorful versions, these stimuli were displayed at the center of the monitor screen. The uppermost stimulus signaled the mixed-schedule, during which observing responses were emitted. The middle and lowermost stimuli followed observing responses. The former signaled the trials that would end with points (TS+), whereas the latter signaled the trials that would end without points (TS-).

Table 1. Sequence of phases, number of trials in each phase (numbers in parenthesis), and the schedules employed for AGA and CAS.

SUBJ	PRETRAINING		PHASE 1		PHASE 2		PHASE 3		PHASE 4	
	S+	S-	S+	S-	S+	S-	S+	S-	S+	S-
AGA	CRF-DRL (20)	CRF-DRL (20)	CRF (3)	CRF (3)	CRF-DRL (20)	CRF (20)	CRF (3)	CRF (3)	CRF (20)	CRF-DRL (20)
CAS	CRF (3) DRL 1 s (2) DRL 2 s (2) DRL 3 s (4) DRL 4 s (4) VI-DRL (30)	CRF (3) DRL 1 s (2) DRL 2 s (2) DRL 3 s (4) DRL 4 s (4) VI-DRL (30)	VI (5)	VI (5)	VI-DRL (20)	VI (20)	VI (5)	VI (5)	VI (20)	VI-DRL (20)

Experimental Design

The basic experimental design consisted of running a pretraining phase followed by two baseline conditions in which the production of both S+ and S- were under similar schedules of reinforcement (i.e., continuous reinforcement or variable interval schedules). Following each baseline condition, an experimental phase was carried out, in which, in addition to the baseline schedules (i.e., a tandem schedule), a minimum interresponse time (IRT) was required in order to either S+ (in one experimental condition) or S- (in the other one) be presented (i.e., a DRL schedule). The evaluation of the reinforcing function of S+ relative to S- was assessed by a cross-condition comparison (Phases 2 vs. 4), particularly by the participants' observing responding when the IRT requirement was operative.

Pretraining: The pretraining established the occurrence of observing responses under the schedules tand CRF DRL (Participant AGA) and tand VI DRL (Participant CAS). For AGA, the pretraining consisted of 40 trials (20 TS+ e 20 TS-) under tand CRF DRL 3 s. For CAS, however, the following gradual steps were taken. The initial 6 trials were under continuous reinforcement schedule (CRF). Then, DRL 1 s, DRL 2 s, DRL 3 s, and DRL 4 s followed for 4, 4, 8, and 8 trials, respectively. Finally, the last 60 trials of pretraining were under tand VI 5 s DRL 4 s. To initiate Phase 1, the subjects should have produced the discriminative stimuli in at least 75% of the pretraining trials. The Participants AGA and CAS reached this criterion, what made it possible to proceed with the schedule manipulations planned in the subsequent phases.

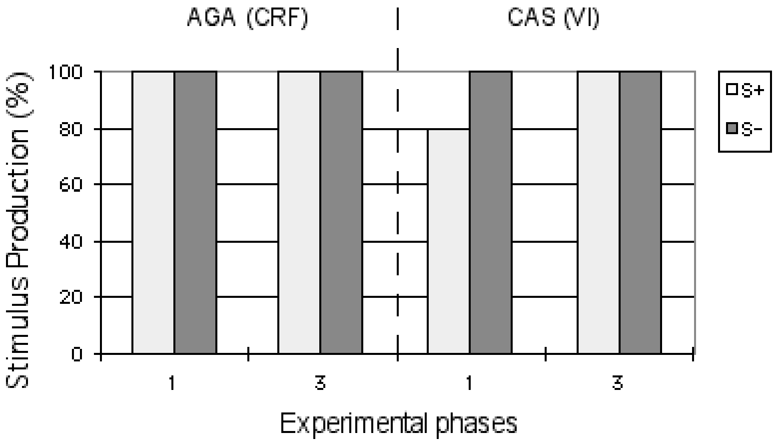

Figure 2. Percentage of S+ and S- production (relative to the total number of trials) in Phases 1 and 3 (baselines), in which the presentation of both stimuli was under the same schedule, that is, CRF for AGA, and VI 5 s for CAS.

Baselines: In Phases 1 and 3, both S+ and S- were produced under the same schedule requirements, that is, CRF for AGA, and VI 5 s (intervals 2, 4, 6, 8, and 10 s) for CAS.

Experimental Phases: In Phases 2 and 4, different schedule requirements were applied for the production of S+ and S-. For AGA during Phase 2, tand CRF DRL 3 s was on TS+ and CRF on TS-; during Phase 4, the schedules were reversed. The Participant CAS was exposed to similar conditions, except that tand VI 5 s DRL 4 s substituted for tand CRF DRL 3 s, and VI 5 s substituted for CRF. Phases 2 and 4 consisted of 40 trials each for both participants. Table 1 summarizes the sequence of phases, number of trials in each phase (numbers in parenthesis), and the schedules employed for AGA and CAS.

Results

The participants AGA and CAS produced the discriminative stimuli in 85% and 75%, respectively, during the pretraining trials; therefore, they proceeded to Phases 1 to 4.

The percentage of S+ and S- production (relative to the total number of trials) in Phases 1 and 3 (baselines), in which the presentation of both stimuli was under the same schedule, that is, CRF for AGA, and VI 5 s for CAS, is shown in Figure 2. In these phases, S+ and S- were produced in all trials the participants were exposed to, except for CAS in Phase 1, when S+ was presented in 80% of the trials.

The relative reinforcing function of S+ and S- can be evaluated by comparing the production of each of these stimuli under the trials in which the tandem schedule

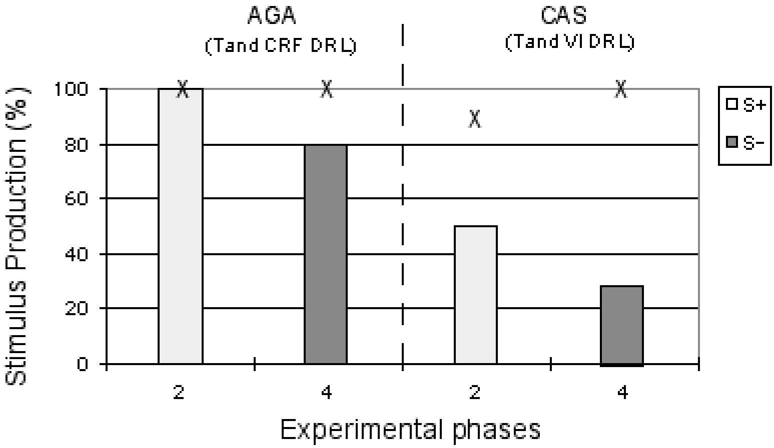

Figure 3. Percentage of S+ and S- production (relative to the total number of trials), for both AGA and CAS, in Phases 2 and 4, under the tandem schedule. The ´X´ superimposed on each bar indicates the baseline percentage obtained in each immediately previous phase.

was operative. Figure 3 displays the percentage of S+ and S- production (relative to the total number of trials), for both AGA and CAS, in Phases 2 and 4, under the tandem schedule. The ´X´ superimposed on each bar indicates the baseline percentage obtained in each immediately previous phase.

As shown in AGA's data (leftmost portion of Figure 3), the tand CRF DRL schedule had different effects on the production of S+ (Phase 2) and S- (Phase 4). When associated to S+, this participant's observing responses led to presentations of S+ in all trials (100%). When associated to S-, this stimulus was presented in 80% of the trials. For CAS (rightmost portion of Figure 3), data pointed to similar direction, that is, under the tandem schedule, S+ was presented in 50% of the trials (Phase 2), whereas S- was presented in 30% of the trials (Phase 4). In summary, the introduction of the tandem schedule had different effects over the S+ and the S- presentations; for both participants, under comparable IRT requirements, S+ was presented 20% more often than S-.

Discussion

The experimental design employed in the present study compares the reinforcing function of S+ relative to S- when each of these stimuli was under the similar condition of being produced by observing responses under a tandem schedule. When the tandem schedule was not operative, both stimuli were presented in an equivalent less demanding reinforcement schedule, that is, either CRF (for AGA) or VI 5 s (for CAS). Given the IRT imposed by the tandem schedule to produce S+ in one condition, and then the same requisite to produce S- in another one, we asked how each of these contingencies would affect the participants' observing responses.

The data reported in the present paper is still preliminary, given the considerations that will follow. They definitely do not constitute an absolute assessment of the reinforcing function of S+ and S- in human participants, nor do they respond to the possibility that primates would be more susceptible to the reinforcement by S- than non-primates (Lieberman, 1972; Perone & Baron, 1980). However, it does show data for two college students that instigate further research by proposing methodological ways that may address those questions in a possible fruitful manner.

When the presentation of S+ and S- was under the IRT requirements imposed by the tandem schedule, both stimuli were produced, although often in lower frequencies than they were in baseline, as one would expect when considering the higher demand added by the IRT. For both participants, in a systematic way, S+ was produced 20% more often than S- when comparable conditions were in effect. This higher production of S+ may be suggesting a higher effectiveness of S+ as a conditioned reinforcer, relative to S-.

The fact that this finding has been obtained with human subjects is particularly relevant, because it is the case that former studies with primates have raised the controversy that S- would be as effective as S+ in the maintenance observing behavior (c.f. Lieberman, 1972; Lieberman *et al.*, 1997; Perone & Baron, 1980; Schrier *et al.*, 1980). In this context, the present data may also contribute to the debate on current models of conditioned reinforcement, for instance, the Delay-Reduction (Fantino & Logan 1979) and the Uncertainty-Reduction Hypothesis (Berlyne, 1957; Hendry, 1969, 1983).

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