

COMPARING THE EFFECTS OF POSITIVE AND NEGATIVE REINFORCEMENT ON HUMAN VERBAL AND AFFECTIVE BEHAVIOR

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This study experimentally analyzed the relationship between verbal behavior and self-reported affective responses under contingencies of positive reinforcement (points gain) and negative reinforcement (avoidance of points loss). Using a computerized sentence-construction task with 162 undergraduates, we investigated how these contingencies affected pronoun selection and subsequent verbal reports of affect. While pronoun selection approximated chance levels during baseline, the introduction of differential consequences produced a systematic change: Both the positive and the negative reinforcement increased the frequency of the target pronouns, although average response levels were higher under negative reinforcement. Post-session verbal reports indicated that positive reinforcement was associated with significantly more positive affective evaluations of the task than negative reinforcement. These findings provide empirical support for the differential effects of reinforcing and aversive contingencies on human operant behavior and its collateral affective responses, demonstrating that contingencies shape not only behavioral outcomes but also their accompanying emotional states.

Keywords: humans, negative reinforcement, positive reinforcement, reinforcement by-products, verbal behavior

Verbal behavior refers to operant behavior shaped and maintained through listener mediation, a conceptual framework pioneered by Skinner (1957). In a seminal study, Greenspoon (1955) instructed undergraduate students to recite as many individual words as they could think of within 50 minutes. For one group, the experimenter presented the sound “mmm-hmm” immediately after the emission of any plural noun; for another, the sound “huh-uh” was contingent upon the same response class. The results showed that “mmm-hmm” functioned as a positive reinforcer, significantly increasing the relative frequency of plural responses, while “huh-uh” decreased their occurrence frequency. Post-session interviews

revealed that the participants were unable to verbalize the relationship between their responses and the experimenter’s contingent sounds, suggesting that verbal behavior could be modified by its consequences despite the subject’s awareness.

Shortly after, Taffel (1955) used a sentence-construction task to show that the use of self-referent pronouns (“I” or “WE”) increased when reinforced with the word “good.” Hospitalized psychiatric patients were shown cards with a different verb and a list of six pronouns and were instructed to create a sentence. Taffel found that the verbal reinforcer was effective in increasing the target response, whereas a nonverbal light flash was not. Furthermore, he found that the level of reinforcement was related to the participants’ anxiety levels, with more anxious patients showing a greater increase in the reinforced response, again without being able to describe the contingency.

Hamasaki (2003) adapted Taffel’s (1955) procedure to a computerized sentence-construction task, in which participants’ use of specific pronouns earned points, demonstrating

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a systematic increase in reinforced verbal behavior. This method enabled Tomanari et al. (2007) to investigate the differential effects of positive and negative reinforcement contingencies on human verbal behavior within a didactic laboratory setting. The methodology involved 53 Psychology undergraduates exposed to the computerized sentence-construction task. Following a 12-trial no-consequence baseline, participants were assigned to a condition where the use of a target pronoun "Nós" ("We") or "Ele(a)" ("He/She") was reinforced. In the positive reinforcement contingency, participants gained 10 points for using the target pronoun. In the negative reinforcement contingency, participants started with 600 points and avoided a 10-point loss by choosing the target pronoun (that is, using any pronoun other than the target one resulted in a 10-point loss). Results showed that while both contingencies increased the frequency of the target operant, the negative reinforcement contingency produced a systematically greater increase in the use of the target's pronoun.

Following this line of research, Chippari et al. (2016) investigated how different reinforcement contingencies affected operant behavior and self-reported feelings. The methodology involved 111 undergraduate students naive to behavior analysis performing a computerized sentence-construction task. Participants were divided into two groups based on the operative contingency for using the target pronoun. The positive reinforcement group (G, $n = 59$) started with zero points and gained 10 points for each target response. Conversely, the negative reinforcement group (L, $n = 52$), endowed with 600 points, avoided a 10-point loss by emitting the same target response. Results showed positive reinforcement was more effective, yielding a higher final relative frequency of the target operant (98.7% vs. 71.6% for Group L). Affective reports correlated with the contingencies: Group G reported more positive feelings (41.3%) than Group L (27.5%), while Group L reported more negative feelings (49.3%).

Both Tomanari et al. (2007) and Chippari et al. (2016) concluded that both positive and negative reinforcement were effective in systematically increasing the use of a target pronoun relative to baseline. However, the studies reported directly conflicting results on the relative efficacy of the contingencies. Tomanari et al. (2007) concluded that the negative reinforcement contingency resulted in a

more pronounced increase in the use of the target pronoun. In direct contrast, Chippari et al. (2016) found that the positive reinforcement contingency led to a greater increase in the frequency of the target pronoun. Additionally, Chippari et al. (2016) uniquely analyzed the affective dimension, correlating these contingencies with participants' reported feelings.

The present study aims to advance this line of investigation. The primary objective is to analyze the conflicting findings between Tomanari et al. (2007) and Chippari et al. (2016). The secondary aim is to extend the analysis of affective correlates initiated by Chippari et al. (2016). Here, we used three report-based measures of these affective by-products of contingencies: Two judgment questionnaires and an open-ended question.

METHOD

Participants

One hundred sixty-two undergraduates from Psychology and Nutrition courses at a private university participated in the study. The experiment was conducted as a didactic activity in a laboratory course for students with no prior experience in Behavior Analysis. Like previous studies, participants were divided into two groups: Positive Reinforcement (PR) and Negative Reinforcement (NR). The PR group consisted of 85 students (66 Psychology majors, 19 Nutrition majors), and the NR group consisted of 77 students (60 Psychology majors, 17 Nutrition majors).

Apparatus and Setting

The experiment used the Verbal 2.0 software (Tomanari et al., 2003) on standard personal computers. After completing the task, participants were asked to complete three questionnaires to provide additional personal information and to describe their feelings about the activity. Data collection occurred collectively in the university's computer lab.

Procedure

Before the session, the experimenter verbally described the study's general objectives and informed the students that participation was voluntary. It was explicitly stated that declining to participate would have no negative

consequences for their course evaluation. Verbal assent was obtained from all individuals before they began the task.

The procedure involved a computerized sentence construction task where 72 verbs were presented sequentially. These verbs, initially proposed by Matos et al. (1995), are listed in Matos and Tomanari (2002). For each verb, participants constructed a sentence by selecting options from three consecutive drop-down menus: (a) One of six subject pronouns “Eu”, “Tu”, “Ele(a)”, “Nós”, “Vós”, “Eles(as)” (“I”, “You”, “He/She”, “We”, “You”, “They”), (b) the corresponding conjugated verb in one of six tenses, and (c) a verbal complement or a “no complement” option.

The session started with a 12-trial baseline phase, during which sentence construction had no programmed consequence. Following the baseline, the 60-trial experimental phase began, with contingencies modified according to each group. Participants in the PR Group, which started with 0 points, earned 10 points for using the target pronoun “Nós” (“We”). Using any other pronoun resulted in no change in points. Participants in the NR Group, which started with 600 points, showed no change in points (maintenance) for using the target pronoun “Ele(a)” (“He/She”). Using any other pronoun caused a 10-point loss.

After the sentence-construction task, participants completed two judgment questionnaires. Each questionnaire was presented as a table in which participants were required, for each row, to assign a number from one to seven, where one represented an adjective describing a negative affective response and seven represented its positive antonym. The first questionnaire assessed self-reported emotional responses, including the following judgment scales: Uncomfortable-comfortable, tense-relaxed, awful-great, inattentive-attentive, nervous-calm, tired-energetic, bored-stimulated. The second questionnaire was presented in a similar format and measured participants’ opinions about the task itself through these scales: Useless-useful, unpleasant-pleasant, uninteresting-interesting, boring-enjoyable, slow-fast, tiring-relaxing, worthless-important.

After completing the judgment questionnaires, participants answered an open-ended question: “Report, if you wish, your feelings or opinion about the task performed.”

RESULTS

Due to technical issues, some performance raw data have been corrupted, which limited our sentence-construction analysis to 52 participants, fewer than the 162 participants for whom we could analyze results for the affective report tasks.

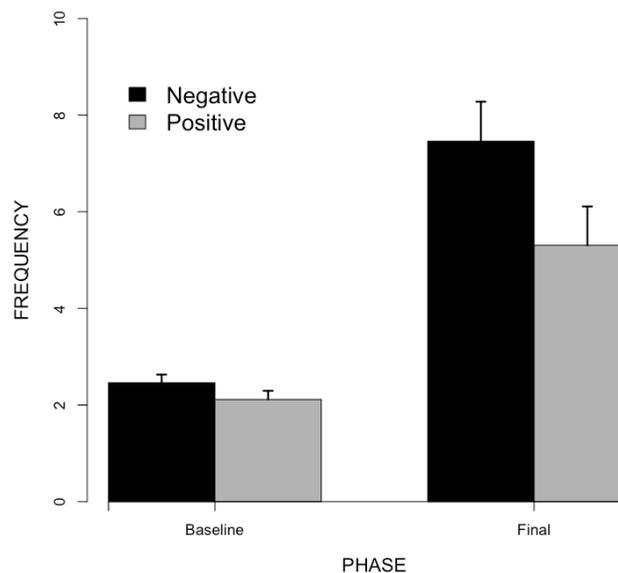
Contingencies of positive and negative reinforcement had different effects on participants’ use of pronouns. Figure 1 displays the mean frequencies of using the target pronoun “Nós” or “Ele(a)” (We or He/She) by participants exposed to these reinforcement contingencies ($n = 52$).

Figure 1 illustrates how both positive and negative reinforcement contingencies effectively increased the use of pronouns. During the baseline, the average frequency of target pronouns in a 12-trial block was 2.12 (SE = 0.18) for the PR group and 2.46 (SE = 0.17) for the NR group. These frequencies rose to 5.31 (SE = 0.80) and 7.46 (SE = 0.82) for the PR and NR groups, respectively.

We analyzed groups (PR vs. NR) and phases (Baseline vs. Final Block) as fixed effects in a mixed model, accounting for individual

Figure 1

Average Frequencies of Pronoun Use in the Baseline and Final Trial Blocks for Contingencies of Negative and Positive Reinforcement



differences by clustering each participant. Our results show a marginally significant effect of different contingencies, indicating a slightly higher frequency under NR ($X^2 = 4.51, p = 0.03$). A much more apparent effect was found for phases, with higher frequencies observed during the last trial block ($X^2 = 49.68, p < 0.001$). Our model did not indicate any significant interaction effects.

Figure 2 shows the box plots for total scores on feelings and task opinion scales for PR and NR groups.

Since both feelings and opinions were measured using a seven-item scale with higher scores indicating more positive adjectives, Figure 2 suggests some effect of contingencies favoring more positive adjectives in the PR group, especially for the opinion scale (right panel).

We compared groups for each scale separately using a Type II ANOVA. For the feelings scale, we did not find a significant difference, with $F(1, 157) = 1.12, p = 0.29$. Conversely, the task opinion scale yielded a significant difference favoring the PR group: $F(1, 157) = 7.82, p < 0.01$. Although we should consider the possibility of the low sensitivity of our judgment questionnaires, these results suggest an effect of reinforcement contingencies on verbal reports related to the task itself, which is consistent with the frequencies of spontaneous adjectives used in verbal reports.

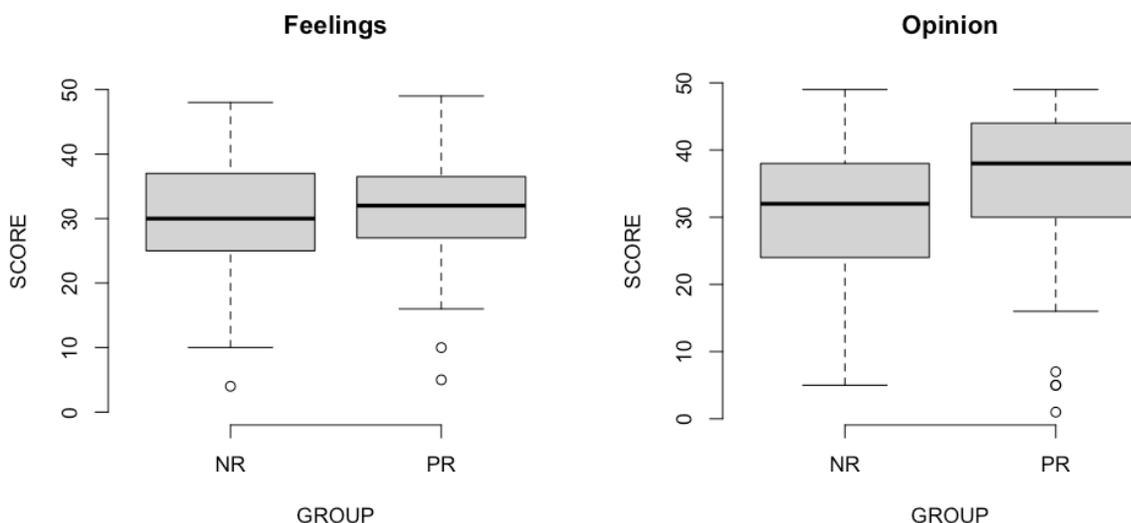
Overall, participants used 224 spontaneous adjectives organized into three categories: Positive, Negative, and Neutral feelings. For the PR group, 52.6% of the adjectives were positive, 44% were negative, and 3.4% were neutral. The NR group, on the other hand, used positive adjectives in 35.8% of cases and negative adjectives in 64.2%, with no instances of adjectives categorized as neutral.

For the PR group, the most common positive adjectives were interesting (11.7%), curious (8.3%), and pleasant (7.4%), while the most common negative ones were tiring (15%), doubtful (8.3%), and repetitive (2.5%). The most common positive adjectives in the NR group were also interesting (7.8%), curious (7.8%), and pleasant (6.9%), while the most common negative ones were tiring (13.7%), doubtful (13.7%), and anxious (5.9%). It is worth noting that some of the most common adjectives describe the task itself, which aligns with the differences observed between feelings and task opinion scales.

Together, the results regarding verbal reports showed that reinforcement contingencies influenced participants' opinions about the task. Specifically, participants exposed to positive reinforcement more frequently used positive adjectives, while those exposed to negative reinforcement used negative ones.

Figure 2

Box Plot Showing Overall Scores for Feelings and Task Opinion Scales for Negative and Positive Reinforcement Groups



DISCUSSION

This experiment investigated the effects of positive and negative reinforcement contingencies on both verbal behavior and subsequent affective reports. The main findings were twofold: (1) The negative reinforcement contingency was significantly more effective than positive reinforcement in establishing a high frequency of the target pronoun, and (2) participants in the positive reinforcement condition reported a significantly higher proportion of positive feelings about the task compared to those in the negative reinforcement condition, who reported a prevalence of negative feelings.

This study functions as a modified replication and extension of Chippari et al. (2016). The behavioral result — that negative reinforcement had a greater effect — aligns with Tomanari et al. (2007), contradicting Chippari et al.'s results, which favored positive reinforcement in establishing target pronoun use. However, on the affective dimension, our results reinforce and extend the conclusions of Chippari et al. (2016), demonstrating a more substantial negative affective experience under the negative reinforcement contingency.

A key challenge in this research area is ensuring the direct comparability of consequences between positive and negative reinforcement contingencies. Critchfield and Magoon (2001) addressed this issue, noting the scarcity of studies that compare these processes using truly equivalent consequences. They proposed the “differential impact hypothesis,” which posits that losses often exert a greater behavioral impact than gains of a comparable magnitude. For instance, the subjective experience of losing \$10 is typically more potent than the experience of gaining \$10. Following this hypothesis, one would predict that our negative reinforcement condition (i.e., avoiding the loss of 10 points) would reinforce the use of the target pronoun more effectively than the positive reinforcement condition (i.e., gaining 10 points).

Our findings, along with those of Tomanari et al. (2007), which found that the negative reinforcement contingency led to a more pronounced increase in the target behavior, are consistent with the differential impact hypothesis. The direct opposition between these results and those of Chippari et al. (2016) suggests that the differential impact of gains and losses is not absolute and may be highly context-

and procedure-specific. In the low-stakes, game-like setting of this task, the negative effects of losing points were more effective in promoting avoidance behavior than the benefit of earning points.

Therefore, our findings contribute to the literature by providing further support for the differential impact hypothesis. Losses, which appear to be more potent in high-stakes or more explicitly aversive scenarios, were also particularly effective in our computerized task involving generalized reinforcers, such as points. This highlights the need for future research to systematically investigate the variables that modulate the relative impact of gains and losses. Future studies could manipulate the magnitude of the consequences (e.g., comparing a 10-point increase versus a 1-point gain) or alter the salience and frequency of the feedback provided in each contingency, as suggested by Tomanari et al. (2007). Additionally, future studies could incorporate a broader range of affective measures, such as structured rating scales or physiological indicators, to provide a more comprehensive picture of the emotional responses elicited by these distinct behavioral contingencies.

Finally, it should be noted that the data were collected in a didactic context. While this provides an ecologically valid setting for student learning, it is possible that course requirements influenced participants' motivation. However, the systematic and statistically significant effects observed suggest that the programmed contingencies were effective in shaping behavior, even within this setting.

In conclusion, by employing a points-based computerized task, this research provides statistically significant evidence that positive and negative reinforcement contingencies shape not only choice behavior but also individuals' affective experiences. This work contributes empirical data to the analysis of human behavior, addressing a recognized gap in the experimental study of private events, a topic considered central to a comprehensive science of behavior (Skinner, 1974).

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