respectively. The sequence sign main effect is the result of higher r_{est} accuracy to positive sequences than to negative sequences and can be observed in Fig. 5. This result is consistent with that obtained by other investigators (e.g., Erlick & Mills, 1967; Jenkins & Ward, 1965). The main effect of N is due to a general increase in r_{est} accuracy as N increases. However, the largest increase in r_{est} accuracy was under N2.

A significant ND interaction ($F = 38.29$, $df = 2/20$, $p < .01$) can be attributed to the simple effects of N2D2 that produce a relative decrease in mean error (see Fig. 3, r_{est} D2). There were no effects across N for D1 sequences.

A significant KR-NKR main effect was not present and accounted for only 1.6% of total variance in r_{est} error. However, the three-way interaction of KR-NKR with D and Sequence Sign was borderline significant ($F = 7.26$, $df = 1/10$, $p < .05$) as was also the interaction between D and Sequence Sign ($F = 6.19$, $df = 1/10$, $p < .05$). Both of these effects are the result of the simple effects of negative sequences under the NKR condition. The effects are in terms of increased underestimation of D1, negative sequences with a larger underestimation error occurring under NKR rather than under KR.

Although it is apparent that the influence of D on r_{est} error was quite significant, the contribution of r_t relative to D and r_{est} was not specifically assessed in the analysis of variance. Linear regression coefficients were obtained for r_t, r_{est} under all conditions including nonpartitioned by D. These coefficients were all very high, ranging from .80 (NKR-N1D2) to .95 (KR-N3D2), indicating the effect of r_t on r_{est} was also significant. There were negligible differences among coefficients under KR-NKR and N conditions. However, as expected from the analysis of variance, differences did occur with respect to D. In order to evaluate the relative effectiveness of r_t and D as predictors of r_{est}, predictive efficiency ratios for r_{est} variance accounted for by D using the η coefficient to that accounted for by r_t using linear regression were determined. These ratios indicated that, with the exception of the KR-N2D2 condition, D is a better predictor of r_{est} than is r_t (range of ratios = 1.0 to 2.3, mean ratio = 1.4, n = 12).

In interpreting the results of this study, primary emphasis must be given to the observed significance of the relative-frequency parameter D, especially with regard to the effects of N.

It is suggested that r_{est} functions, when partitioned by D, may be highly specific and predictable. Furthermore, functions of underestimation such as reported in a previous study of diagnostic performance based on perceptual quantification of relationship (Erlick & Mills, 1967) may be accounted for by a parameter similar to D. The functions in Fig. 4 support these statements in that r_{est} D1 functions reveal a tendency to underestimate r_t, while r_{est} D2 functions indicate a reciprocal tendency. Thus, specific independent D functions may result in r_{est} performance that underestimates r_t (e.g., see Fig. 2, calc D1N1) is nearly equivalent to r_t (e.g., see Fig. 3, calc D2N2) or overestimates r_t (e.g., see Fig. 2, calc D2N1).

This observation is important in understanding the N main effect and the ND interaction. Since there were no effects of D1 across N1, it may be concluded that D2 primarily under N2 is responsible for the observed reduction in r_{est} error. In examining the calculated D functions as N increases, it may be noted that D1 functions change little in shape and placement across N, while those of D2 change considerably from N1 to N2, from N2 to N3, and slightly from N1 to N3. Thus, in view of the strong relationship between D and r_{est}, it is not surprising that the variability of D2 functions across N result in corresponding changes in r_{est}. In addition, although calculated D1 values increase in magnitude with N, they generally remain proportionately constant, while those of D2 do not. The effect of N, then, is in terms of proportional changes in D across N rather than in terms of changes in magnitude. The fact that r_{est} performance is insensitive to changes in D magnitudes as long as there are no changes in proportion with increases in N is consistent with what would be expected on the basis of a relative-frequency principle. Such a principle requires that relative frequencies of events are proportionately constant (i.e., their probabilities) across increases in sample size when sampling from the same population.

Therefore, it may be concluded that, under the conditions of this study, a relative-frequency parameter such as D can provide an appropriate model of Ss' diagnostic performance. Since the solution of D is based on obtaining the differential between frequencies of confirming and nonconfirming events, Ss' r_{est} performance appears to have been based on the perceived magnitude of this differential.

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NOTES

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Reaction to time-out and favorability of response alternatives

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Children's preference for one of two tasks was studied under three different conditions. In one condition, S received equal reinforcement (3:3) for responding on either task. In the remaining two conditions, responses on one task produced reinforcement more frequently than did responses on the other at ratios of 3:2 and 3:1, respectively. Half of the Ss assigned to these three conditions received TOs on the more frequently reinforced task, with the remaining Ss serving as no-TO controls. Results revealed a significant tendency to

avoid TO when the alternative task was equally reinforcing. This tendency to avoid TO was reversed when the reinforcement ratio favored the task on which TO was administered. The results were interpreted as supporting the hypothesis that TO's "aversiveness" is largely determined by the favorability of available response alternatives.

The withdrawal or inaccessibility of positive reinforcement is usually accompanied by a decrease in responding. An external stimulus, when selectively associated with such reinforcement withdrawal, is termed a time-out (TO) stimulus and its duration a TO period. Recent studies of TO have been concerned with its effectiveness as an "aversive" stimulus. The results from two such investigations (Willoughby, 1969; Willoughby, in press) have shown that TO will suppress responding in children when it is accompanied by an unpunished but equally reinforced response alternative. However, findings from these studies also revealed that TO functioned as a relatively ineffective punishment when a response alternative was unavailable or when that alternative was not reinforced. The findings from the first of these studies (Willoughby, 1969) suggest that the capacity for TO to produce suppression is largely determined by the accessibility of an alternative response. In addition, the results of the second investigation (Willoughby, in press) indicate that even when the alternative to TO is provided, S's preference for that alternative is determined by its reward value relative to that of the punished response. The present experiment attempted to explore this hypothesis further by varying the reinforcement frequency of the response alternative to TO systematically while keeping the reinforcement frequency of the TO response constant and then obtaining S's preference for one of these two responses.

METHOD

The experimental apparatus consisted of two marble boards similar to those used in previous studies with young children (Gewirtz & Baer, 1958). Each board contained several holes, through which marbles could be inserted, and a tray containing marbles. At one end of the apparatus was an upright panel containing a 2-in. circular aperture covered with translucent glass. A 50-W colored bulb, mounted in the center of the aperture, functioned as an S^d for reinforcement when illuminated. The light's offset served to indicate a period of TO.

Sixty kindergarten children from Amherst, Massachusetts, served as Ss. These Ss were assigned randomly to each of three reinforcement ratio conditions. In each of these conditions, the basic procedure was identical: In response to a "ready" signal, S was required to choose one of the two marble "games" to play for reinforcement. S was allowed to play on the chosen game until a "stop" signal was given (a period of 30 sec). After a brief interval, the "ready" signal was again presented and S's game preference recorded. This basic procedure varied for Ss assigned to the three reinforcement-ratio conditions. In the equal reinforcement (3:3) condition, responses made on either game were rewarded three times during each 30-sec interval; in a second condition (3:2), three reinforcements were dispensed for responses on one game vs two reinforcements on the other; a third condition extended this ratio from 3:2 to 3:1 for responses made on the two games.

CONTROLS

The 20 Ss in each of the three reinforcement conditions were further subdivided and assigned to either a time-out (TO) or a control (no-TO) subgroup. Each of the six subgroups contained 10 Ss. The Ss in Group TO received three 5-sec TOs during each 30-sec period, with TOs administered only after responses on the more frequently reinforced marble board. During TO, the red signal light was off, and S had to refrain from responding until the light reappeared. As an added control, the no-TO Ss also had the signal light turned off three times per trial; however, they were not instructed to stop responding during the light's offset.

An experimental session consisted of two practice trials on each board, followed by 20 response preference trials. Poker chips were used as conditioned reinforcers, with the quantity of chips required to win a prize (a small trinket) clearly designated by a standard placed between the two games and immediately before S.

RESULTS AND DISCUSSION

The mean number of trials, out of 20, on which the TO board was chosen is shown in Table 1. As this table indicates, the preference behavior of the Ss in the TO condition was influenced by the favorability of the response alternative to TO. This was not the case for the control Ss. When responses made on the two boards produced the same frequency of reinforcement (3:3), the board on which TOs were programmed was rarely chosen. However, when the frequency of reinforcement was reduced on the non-TO board in Conditions 3:2 and 3:1, this avoidance of TO did not occur.

Table 1
Mean Number of Trials on Time-Out Task (Maximum = 20 Trials)

Reinforcement Ratio	3:3	3:2	3:1
TO	1.3	11.7	16.8
Control	10.2	14.0	14.3

Statistical analyses performed on their preference data showed that the Ss in the 3:1 and 3:2 group of the TO condition did not differ significantly from their no-TO counterparts in their preference for the TO board [$t(18) = 1.54$ and $t(18) = 1.28$, respectively]. In contrast, the Ss in the 3:3 condition of the TO condition were significantly below the comparable no-TO Ss in the number of times that they chose the TO board [$t(18) = 11.74$, $p < .001$]. This fact accounts for a significant Reinforcement Ratio by Treatments interaction ($F = 19.21$, $df = 2/54$, $p < .001$). Similar comparisons among groups within the TO condition revealed that the 3:3 chose the TO board significantly less often than either the 3:2 [$t(18) = 7.23$, $p < .001$] or the 3:1 Ss [$t(18) = 9.36$, $p < .001$], indicating that TO was only avoided when the alternative to TO was equal in reinforcement value.

Examinations of the variances for the three groups comprising the TO conditions also produced some interesting information. The variance of Group 3:2 in the TO condition was found to be greater ($\sigma^2 = 19.12$) than that of either the 3:1 group ($\sigma^2 = 4.84$) or the 3:3 group ($\sigma^2 = 1.25$). If the variance is assumed to reflect different degrees of conflict in the two-choice preference situation, then it may be assumed that for some of the 3:2 Ss, the slight increase in reinforcement gained from responding to the TO board (i.e., three vs two chips) did not warrant the experience of TO, whereas for others the board with the higher payoff was chosen regardless of TO.

In conclusion, the results of the present study confirm those from earlier investigations of children's reactions to TO. Moreover, the findings that only the 3:3 group showed avoidance of TO to any significant degree provides further support for the hypothesis that the "aversiveness" of TO is relative to the favorability of the responses serving as alternatives to TO.

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