Sensitivity and decisional factors in the psychological refractory period[1]

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Three trained Ss responded to a pair of events presented at fixed interstimulus intervals (ISIs) of 33, 67, and 100 msec. Each event was the independent presence of a visual stimulus (S-P) or its absence (S-A), to which Ss were to respond or not, with a set for speed over accuracy. The probabilities of S-P occurrence [P(S)] to each of the events were varied. Pretrial verbal reports or behavioral hypotheses (BHs) were also obtained. P(S), ISI, BH, and order (first vs second event) were all generally determinants of both RT to S-P and inhibition probability to S-A. However, when the RT data were corrected for inhibition probability, order was the only systematic effect that remained. The results were discussed in terms of approaches to the psychological refractory period derived from signal detection theory involving differential sensitivity as opposed to criterion.

Since its development, the theory of signal detectability (TSD) has had extensive application because of its generality and the relevance of the sensory-decisional distinction to choice situations. The present paper is concerned with the application of TSD to a traditional problem in the reaction time (RT) literature, the psychological refractory period (PRP). The PRP is defined as a degradation in RT to the second of two closely spaced stimulus events, S_1 and S_2, and has been most recently reviewed by Smith (1967).

Bernstein, Blake, and Hughes (1967) obtai[illegible] a PRP effect when an attempt was made [illegible]sure complete task certainty with event certainty and fixed time relations among S_1 and S_2. RT_2 (RT to S_2) was equal to RT_1 (RT to S_1) when S_1 and S_2 were synchronous. As the interstimulus interval (ISI) separating S_1 and S_2 increased, RT_2 increased and then decreased relative to RT_1, again reaching equality at 100 msec ISI.

The results supported a concept of the PRP based upon structural limitations in "doing two things at once." However, the lack of choice, necessary for theoretical considerations, failed to separate two possible factors that could have accounted for the effect. These will be termed *sensitivity* and *criterion* because of their conceptual similarity to these terms as used in TSD.

Suppose the RT task is to respond to the presence of a given event (S-P) but to inhibit in the absence of the event (S-A). Such variables as physical energy affect performance, as do other variables, e.g., instructions (Fitts, 1966). However, these two categories of variables affect RT by clearly different means. In the latter case, decreases in latency necessitate parallel increases in error rate and probability of inhibiting on S-A or check trials [P(I)]. The speed-error tradeoff phenomenon suggests that apparent RT differences produced by instructions would disappear following a suitable error-rate correction. On the other hand, one would not expect the former category of determinants to produce such "correctable" differences in performance.

These two categories of RT effects suggest a general parallelism of RT and TSD. Thus, correctable and uncorrectable RT differences would correspond to sensitivity and decisional effects, as the use of the ROC curve in TSD essentially seems to control statistically for error rate. However, to apply TSD logic to RT, it is not necessary to assume a complete isomorphism as to underlying mechanisms. Within TSD, various two-parameter models exist, providing a satisfactory explanation for most relevant data, yet proceeding from differing axioms (Luce, 1963).

The problems of errors in RT has been long recognized but, until recently (Fitts, 1966), not systematically explored. A consequence of this neglect has been the lack of generally accepted error-rate correction, although Yellott (1967) has recently approached the problem. Consequently, an empirical procedure, linear regression, was necessary in the present study. RT studies in general, and PRP studies in particular, traditionally have approached the problem of error by attempting to avoid it through attempts to achieve error-free performance, as was done in earlier psychophysical experiments. This strategy runs counter to the logic of TSD, which demands error rate be kept sufficiently high to allow assessment of S's response criterion. Thus, prior experimental results could not be used to see if the factors responsible for the PRP can be treated as a sensitivity deficit.

Because TSD-oriented RT models are fairly recent (McGill, 1963; Grice, 1968), extant explanations of the PRP are not directly phrased in sensitivity and decisional terms. However, many are easily translated by considering whether or not they would predict the delays in RT_2 to remain under error-rate correction. For example, single-channel theory would treat the deficit as a sensitivity effect. Different versions of single-channel theory (Smith, 1967; Bernstein, Blake, & Hughes, 1968) all assume a storage phase for S_2 prior to processing with short ISIs. Thus, after being equated for P(I), RT_1 and RT_2 would still differ by the duration of this storage phase. Conversely, preparatory-state theories (Poulton, 1950; Smith, 1967) may be interpreted as decisional if it is assumed that higher states of preparation facilitate responding but low states facilitate inhibition, i.e., response readiness behaves like inertia in physical systems. Hence, whereas Ss could respond more easily to S_1-P than S_2-P, they would also be able to inhibit more easily S_2-A as opposed to S_1-A. Although RT order differences would exist, they would vanish upon error-rate correction.

The purpose of the present study was to see if order differences in RT would or would not remain following error-rate correction as part of a general concern with the error-rate correction problem. A sequential Donder's Type C task was used in which the occurrence probability of S_1-P, [$P(S_1)$] was statistically independent of the occurrence probability of S_2-P, [$P(S_2)$]. $P(S_1)$ and $P(S_2)$ were varied factorially across conditions at levels of .4 and .8. The ISIs chosen were 33, 67, and 100 msec, as suggested from prior findings (Bernstein, Blake, & Hughes, 1968). The instructions stressed speed over accuracy. Pretrial verbal reports or behavioral hypotheses (Bernstein, Schurman, & Forester, 1967) were obtained from Ss regarding their expected pattern of events. The RT and P(I) changes that occurred to the various combinations of P(S) and BH were then analyzed to explore ISI and order effects. Also, differences in performance to an event as a function of the presence or absence of the alternative event were examined to investigate whether it is the paying attention to a second channel or the presence of an overt response to stimuli

Table 1
Mean RT and z as a Function of $P(S_1)$, $P(S_2)$, and ISI, Separately for Each S and as a Composite

		RT						z					
		S_1 ISI			S_2 ISI			S_1 ISI			S_2 ISI		
$P(S_1)-P(S_2)$	S	33	67	100	33	67	100	33	67	100	33	67	100
.4–.4	MC	422	331	301	433	358	326	2.29	2.54	2.29	2.29	2.13	2.13
	RB	275^{b}	250^{b}	254	341	266	264	1.70	1.83	1.91	2.01	1.25^{b}	1.28^{b}
	MT	276	288	302	303	307	309	2.01^{b}	1.92	2.13	2.50	2.54	1.54^{b}
	Comp	324	289	286	359	310	300	2.00	2.10	2.11	2.27	1.97	1.65
.4–.8	MC	259	249	257	243	229	195	1.35	1.91	1.48	.52	.34	–.07
	RB	266	286	258	238	222	214	2.01	1.76	2.01	.43	.30	.53
	MT	271	279	269	236	214	207	1.16	1.42	1.19	.34	.34	.04
	Comp	265	271	261	239	221	205	1.51	1.70	1.56	.43	.33	.17
.8–.4	MC	227	214	228	312	290	318	.53	.43	.73	1.38	1.16	1.70
	RB	212	213	214	246	230	231	.73	.78	.71	1.70	1.35	1.03
	MT	275	263	264	364	318	315	.78	.97	.90	1.92	2.13	1.92
	Comp	238	230	235	307	279	288	.68	.73	.78	1.67	1.55	1.55
.8–.8	MC	225^{b}	237	234	268	260	242	1.55	.85	.91	.45	.59	$.28^{a}$
	RB	202	227	230	201	207	297	.74	.85	.79	$.23^{a}$	$.10^{c}$	$.13^{b}$
	MT	229^{c}	228	236	278	243	266	1.05	.51	.97	.85	.40	$.23^{b}$
	Comp	219	231	233	249	237	268	.78	.78	.89	.51	.36	.21

Note: a, b, and c denote the lesser RT or z, comparing performance to S_1 and S_2 for that S, ISI and condition, at the .05, .01 and .001 levels respectively.

on that channel that produces the refractory effect (Davis, 1959).

METHOD

Subjects

One male (RB) and one female (MT) graduate student, and one male advanced undergraduate psychology student (MC), whose ages ranged from 19 to 25, served as paid volunteers. Each served for 12 experimental sessions of approximately 1 h duration. MC and RB were co-investigators in the study. All three Ss had prior RT experience and course familiarity with RT findings and the PRP.

Apparatus and Stimuli

Stimulus events were presented on a three-channel Scientific Prototype Model GB tachistoscope. Each stimulus event (S-P) consisted of the appearance of a 46-min visual angle spot of light to the left and/or right of a central fixation point of like size. The stimulus events and fixation point were produced by back illumination of an opaque black card with an appropriately sized hole, placed in the front card holders of the tachistoscope. S-A consisted of the null event. Illumination was provided by a pair of Argon-Mercury bulbs located in each channel of the tachistoscope. The maximum width of the display was 3 deg 20 min of visual angle. The luminance of the fixation point was 11 ft-L and the luminance of the stimulus events was 16 ft-L, as measured by a SEI spot photometer. The warning signal was a .1-sec offset of the center spot that began a constant 2-sec foreperiod delay. At the end of the foreperiod delay, the center spot again went off and remained off until the end of the trial, i.e., until S had made both responses or E had reset the apparatus. Onset of the light in a given stimulus event channel simultaneously started a Hunter Klockounter through a system of Scientific Prototype dc-powered electronic buffers, reed relays, and flip-flops. S's response, a homolateral telegraph key depression, reset the appropriate flip-flop and stopped the Klockounter. A white-noise generator was used to mask relay clicks and other transients.

Procedure

Each trial was defined by the occurrence of S_1-P or S_1-A and S_2-P or S_2-A. A session consisted of 300 trials at the same ISI (33, 67, or 100 msec) and condition distinguished by $P(S_1)$ and $P(S_2)$: (a) $P(S_1) = .8$, $P(S_2) = .8$; (b) $P(S_1) = .8$, $p(S_2) = .4$; (c) $P(S_1) = .4$, $P(S_2) = .8$; (d) $P(S_1) = .4$, $P(S_2) = .4$. In all cases, the occurrence of S_1-P and S_2-P were independent. Ss were instructed as to the ISI and condition for each session but knew only probabilistically if the trial would be S_1-P and S_2-P, S_1-P and S_2-A, etc. The order in which sessions were run was randomized separately for each S to minimize carry-over effects.

Warm-up trials were run to familiarize S with the parameters employed for that session. Following the warm-up trials, 300 experimental trials were run with a rest period occurring in the middle of the session. Prior to each trial, S stated his BH, e.g., "S_1 will occur but not S_2."

RESULTS

Three separate sets of analyses dealt with (a) effects of variation in P(S), (b) effects of BH, and (c) effects of presence or absence of a stimulus event upon performance to the alternative event.

Preliminary examination of the relation between RT as a function of P(I) revealed a marked positive acceleration. Transformation of P(I) to normal deviate form largely eliminated the extent of this curvilinearity. Consequently, except for certain tests, inhibition data were analyzed and reported in terms of the transformed values, to be denoted Z_1 and Z_2.

Analysis of Probability Effects

The mean values of RT and Z are presented in Table 1 as a function of condition and ISI, separately for each S and as a composite. To examine differences in performance to S_1 and S_2 (order effects), t tests were conducted upon the RT_1 and RT_2 means in the .8-.8 and .4-.4 conditions, with respective df of 476 and 238. The observations were considered to be unrelated in view of the independent occurrence of S_1-P and S_2-P. Also run were z tests comparing the corresponding values of P(I) upon which the z values were based. The tests were not conducted in the remaining two conditions because order effects are confounded with differences in P(S). Significant differences are cited in Table 1 alongside the *lesser* RT or Z.

As can be seen from this table, RT_2 was never significantly faster than RT_1, and Z_2 was significantly greater than Z_1 in only one comparison. In contrast, there were four cases in which RT_1 was significantly greater than RT_2 and eight cases in which Z_1 was significantly greater than Z_2. Hence, the present analysis confirms the impression gathered from Table 1 that there is a delay in processing S_2 which, in part, defines the PRP.

Two sets of regression analyses were conducted upon the data in Table 1. The

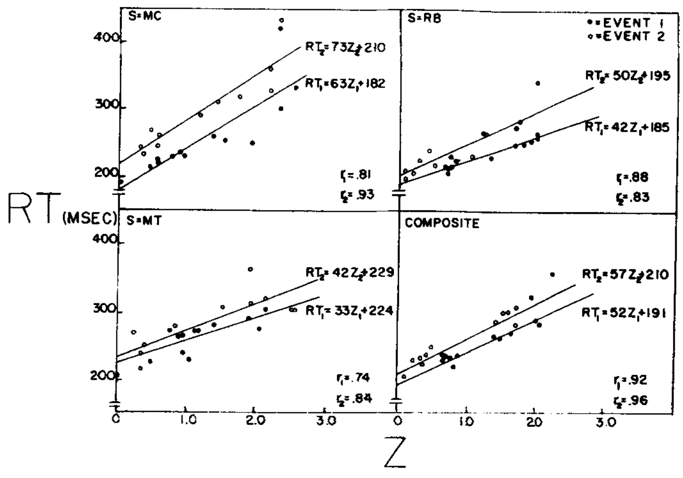

Fig. 1. Scatter plots relating RT to z, the normal deviate of P(I), for S_1 (filled circle) and S_2 (open circle), separately for each S. Also presented for each S are the separate regression lines for RT_1 as a function of Z_1 and RT_2 as a function of Z_2 and the corresponding correlations between RT and z, r_1 and r_2.

first of these, termed the *common* analysis, utilized all 24 data points per S to determine a single value of 4 (3 ISIs x 4 x 2 events). Obtained in each of these analyses was the regression line in predicting RT from z and regressed RT scores, to be denoted L measures. Figure 1 presents the results of the separate analyses and scatter plots of data points in Table 1. As can be seen, the correlations were significant in all cases beyond the .01 level. The correlations derived from the common analyses were generally lower, but similar trends obtained.

The L measures derived from the common analysis were used to confirm the results of the separate t and z tests that the RT difference is not a function of differential error rate. Direct difference t tests were run comparing corresponding ISI by Condition data points, separately for each S. The resultant values of t were 7.93 ($p < .001$), 2.75 ($p < .05$) and 2.25 ($p < .05$) for MC, RB, and MT, respectively (all comparisons two-tailed, df = 11). Thus, the deviations about the common regression line tended to be positive for S_2 and negative for S_1.

Because the order effects attenuated the correlations in the common analysis, L measures were analyzed in the present and subsequent cases from the separate analyses. Four-way ANOVA [$P(S_1)$, $P(S_2)$, ISI, and Ss] were conducted upon the RT_1, RT_2, Z_1, Z_2, L_1, and L_2 means. Summary values of F derived from these analyses are presented in Table 2.

The significant effects of $P(S_1)$ upon RT_1 and Z_1, and of $P(S_2)$ upon Z_1, RT_2, and Z_2 were in the expected direction as the performance measures were lower for P(S) = .8 than P(S) = .4. The $P(S_1)$ by $P(S_2)$ interaction arose because the effects of $P(S_2)$ were greater for $P(S_1) = .4$ than $P(S_1) = .8$. More important is the elimination of all probability effects with the regression analysis. Although P(S) manipulation was not chosen under the assumption that its only effects were upon S's criterion, the lack of posterror-rate P(S) effect suggests that such is the case. However, given the small number of Ss and df, the usual limitations regarding acceptance-support statistical logic apply.

The lack of an ISI effect was surprising and disappointing. The data means for RT_2 were 262, 255, and 254 msec for RT_1 and 289, 262, and 265 for RT_2 at 33-, 67-, and 100-msec ISIs, respectively. The mean RT_2 decline of 24 msec is slightly smaller than, but not out of range of, similar studies conducted in our laboratory. Also, ISI effects were obtained in other analyses to be reported below.

Analysis of BH Data

BH data were used to define fluctuating biases to respond to S_1 relative to S_2 (Bernstein, Schurman, & Forester, 1967). Pretrial reports were classified into three categories: (a) The hypothesis that S_1-P and S_2-A would occur, denoted BH-1, which implies a bias to responding to S_1; (b) the hypothesis that S_1-A and S_2-P would occur, denoted BH-2, which implies a bias in responding to S_2; (c) the hypothesis that S_1-A and S_2-A or S_1-P and S_2-P occur, denoted BH-0, which implies the absence of a differential bias to respond to S_1 or S_2. The resulting values of RT and z are presented in Table 3 as a function of ISI, separately for each S and as a composite.

Inspection of Table 3 indicates that changes in RT and z are as expected from the assumption that the pretrial hypothesis does in fact denote a differential bias. RT_1 and Z_1 were lowest for BH-1 and highest for BH-2, whereas the reverse held for RT_2 and Z_2. RT and z values were then compared under equivalent BH levels as a function of order. That is, RT_1-BH-1 was compared with RT_2-BH-2, RT_1-BH-2 with RT_2-BH-1, RT_1-BH-0 with RT_2-BH-0, etc., for z, separately for each ISI and S. For MC, RT_1 was faster than RT_2 in seven of nine comparisons ($p < .001$ in five cases, $p < .01$ in one case, and $p < .05$ in one case). Also, Z_1 was higher in one comparison ($p < .05$). For RB, RT_1 was faster in two comparisons ($p < .001$ and $p < .05$). However, in these two cases, Z_1 was also higher than Z_2 ($p < .001$), as well as in an additional three cases ($p < .001$ in two cases, $p < .05$ in one case). For MT, RT_1 was faster in four cases ($p < .001$ in three cases, $p < .05$ in one case) and RT_2 was faster in two cases ($p < .001$ and $p < .05$). These latter two cases are the only two in any of the comparisons to be reported in which a significantly faster RT_2 was not accompanied by a lower Z_2.

As in the case of the probability analysis, ANOVAs were run for each of the six

Table 2
Summary Values of F Derived from Analysis of Probability Effects

		Measure					
Source	df	RT_1	Z_1	L_1	RT_2	Z_2	L_2
$P(S_1)$–A	1	25.64*	123.90**	<1	<1	3.12	<1
$P(S_2)$–B	1	3.95	4.56	1.8	38.45	185.94**	<1
ISI–C	2	<1	<1	<1	2.16	3.13	1.56
AB	1	1.70	8.43**	1.17	7.12*	4.14*	3.27
AC	2	<1	<1	<1	1.48	<1	1.09
BC	2	<1	<1	<1	<1	<1	1.25
ABC	2	<1	<1	<1	<1	<1	<1

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 3
RT and z as a Function of Criterion and ISI, Separately for Each S and as a Composite

			S_1 ISI			S_2 ISI		
BH	S		33	67	100	33	67	100
1	MC	RT	234	216	222	349	333	338
		z	.87	.87	1.12	2.05	1.87	2.05
	RB	RT	207	207	200	266	254	266
		z	.87	.91	.87	1.75	1.28	1.12
	MT	RT	245	247	246	338	315	324
		z	1.08	1.34	.99	1.87	2.05	2.05
	Comp	RT	229	223	223	318	301	309
		z	.94	1.04	.99	1.89	1.73	1.74
2	MC	RT	324	291	285	270	236	213
		z	1.64	2.05	1.12	.87	.67	.61
	RB	RT	264	281	259	237	222	203
		z	1.75	2.05	2.32	.91	.64	.58
	MT	RT	288	298	294	253	229	220
		z	1.87	1.64	2.05	1.03	.95	.67
	Comp	RT	292	290	279	253	229	212
		z	1.75	1.91	1.83	.74	.75	.62
0	MC	RT	256	247	248	284	270	243
		z	1.17	1.28	1.22	1.03	.99	.95
	RB	RT	226	236	240	241	223	213
		z	1.40	1.34	1.34	.99	.77	.80
	MT	RT	253	247	257	280	253	257
		z	1.12	1.03	1.12	1.34	1.08	.87
	Comp	RT	245	243	248	268	249	238
		z	1.21	1.22	1.23	1.12	.95	.87

dependent variables. L measures were defined as in the probability analysis, using separate regression lines for the nine cells (3 ISIs by 3 criteria). The correlations between RT and z for S_1 and S_2 were .74 ($p < .05$) and .96 ($p < .01$) for MC, .92 ($p < .01$) and .87 ($p < .01$) for RB, and .91 ($p < .01$) and .95 ($p < .01$) for MT (all $p < .05$). The results of these ANOVA were that the three criteria varied beyond the .01 level significantly for RT_1 ($F = 69.76$), Z_1 ($F = 24.32$), RT_2 ($F = 64.04$), and Z_2 ($F = 69.66$), df = 2,16. RT_2 declined across ISIs [$F(2,16) = 7.68$, $p < .01$] as did Z_2 [$F(2,16) = 3.63$, $p < .05$]. However, when the error-rate correction was made, none of the effects were significant. Thus, although no specific assumption was made regarding the mechanism by which BH influences RT, the hypothesis of a criterion effect is also suggested.

Several additional analyses of the BH data were conducted. These included RT and z as a function of correct and incorrect BH, a further analysis of the criterion data contrasting performance to the two types of BH-0 and separately for the various probability levels. These results neither contributed much of additional relevance to the PRP nor conflicted with the above results.

Analysis as a Function of Presence vs Absence of an Alternative Stimulus Event

Because of the implication of Davis's (1959) "attention" hypothesis above, RT and z were obtained separately for trials on which the alternative event occurred vs when it did not occur. The data means are presented in Table 4. Comparisons of comparable order effects were similar to those already described in that 4, 1, and 1 comparisons were faster for RT_1; and 0, 2, and 0 were the reverse, 2, 3, and 1 values of Z_1 were greater than Z_2, and none the reverse, for MC, RB, and MT, respectively, with a minimum p of .05.

ANOVAs (S-P vs S-A, ISI and Ss) were conducted for the six dependent variables as above. None of the effects were significant for RT_1 or Z_1 although the trends were towards higher values of RT_1 and Z_1 for S_2-A as opposed to S_2-P. RT_2 declined with ISI as in the criterion analysis [$F(2,10) = 5.61$, $p < .05$]. Z_2 was also higher for S_1-A as opposed to S_1-P [$F(1,10) = 31.02$, $p < .01$] and also showed a slight, but nonsignificant, decline with ISI. The correlations between RT and z were −.31 and .34 for MC, .73 and .34 for RT, and .77 and .05 for MT ($p < .05$ in all cases, df = 4). Consequently, the L measures have not been presented. The major finding of this analysis is, therefore, that making a response to S_1 did not seem to interfere with performance to S_2.

DISCUSSION

The results clearly describe a sensitivity decrement in S_2 processing ability. Although the ISI effect is somewhat equivocal, evidence of a decline in RT_2 was noted in two of three analyses. However, the attenuation of the effects of various stimulus manipulations with error-rate correction does imply that criterion effects play a substantial role in complex RT tasks. Also of note is the lack of decrement in processing S_2 for S_1-P as opposed to S_1-A.

Bernstein, Blake, and Hughes (1968) found no difference between RT_1 and RT_2 at 100-msec ISI in an event-certain, fixed ISI task. The discrepancy with the present finding may have emerged from differences in the refractory limits imposed by differential task demands. On the other hand, it was not possible to isolate criterion effects in the earlier study as the absence of choice virtually precluded the possibility of error. As the present results were that $P(I_2)$ tended to decline with ISI, an alternate

Table 4
RT and z as a Function of Presence vs Absence of Alternative Stimulus Event

		S_2–P						S_1 S_2–A					
		RT_1			Z_1			RT_1			Z_1		
S	ISI	33	67	100	33	67	100	33	67	100	33	67	100
MC		260	241	247	1.13	1.42	1.25	271	256	250	1.34	1.37	1.67
RB		227	238	235	1.42	1.35	1.45	230	232	228	1.31	1.49	1.41
MT		254	253	258	.45	1.16	1.26	270	266	268	1.63	1.48	1.38
Comp		247	244	247	1.00	1.31	1.32	257	251	249	1.43	1.45	1.49
		S_1–P						S_2 S_1–A					
		RT_2			Z_2			RT_2			Z_2		
S	ISI	33	67	100	33	67	100	33	67	100	33	67	100
MC		297	271	250	1.06	.96	1.07	291	274	258	1.45	1.37	1.12
RB		229	222	234	1.08	.77	.76	269	239	229	1.34	1.17	1.09
MT		297	259	265	1.31	1.27	.92	264	260	260	1.52	1.31	1.28
Comp		274	251	250	1.15	1.00	.92	275	257	249	1.44	1.28	1.16

interpretation of the discrepancy is that Ss tended to adopt a more lenient criterion in responding to S_2 with ISI.

More recently, Bernstein and Clark (1968) used a sequential Type C task to evaluate modality effects in the PRP. Depending upon condition, S_1-P was always a visual event. Similar delays were found in processing S_2 for visual-visual sequences, supporting the sensitivity-decrement position and RT_2 and Z_2 was lower with S_1-P than S_1-A. Perhaps the reason that the presence of a first event did not interfere with performance in our studies as it did in other studies (Davis, 1959) is that the presence-absence variable was manipulated randomly within a sequence of trials, whereas in earlier studies it was manipulated across separate blocks of trials. The results of the Bernstein and Clark (1968) experiment are of relevance for an additional reason. The Ss were not generally familiar with the PRP literature and pretrial verbal reports were not obtained. Hence, neither factor is responsible for the principal effects in the present study.

An incidental finding of potential interest is the steeper slope for the RT-z regression line for S_2 as opposed to S_1 (Fig. 1). The slope difference by definition implies a greater increment in RT_2 per unit increment in $P(I_2)$. In other words, Ss profited less by adopting a stricter criterion for S_2 than they did for S_1. This finding suggests a differential efficiency in separating S-P from S-A. Such a source of decrement is clearly different from that implied by single-channel theory, which would have S_1 and S_2 processed at the same rate except for the en route delay peculiar to the latter.

Pending further examination, the slope difference merely raises the possibility of an additional interpretation of the PRP. The remaining aspects of the data are essentially in accord with contemporary versions of single-channel theory that assume only one stage in processing to be responsible for the PRP (Smith, 1967; Bernstein, Blake, & Hughes, 1968). Whether or not a preparatory-state theory predicts a diminution in sensitivity is not entirely clear from the current statements of the theory. Clearly, readiness to respond cannot be interpreted simply as a drop in inertia favoring overt execution of a response over inhibition.

Another version of preparatory-state theory based upon the role of temporal expectancies cannot be ruled out. Such a theory would have to be modified to consider subjective rather than objective time uncertainty. One experimental advantage to the use of fixed ISIs, providing appropriate safeguards are present to rule out anticipatory responding, etc., is that the effects induced by randomization of ISIs (Nickerson, 1965) are eliminated. On the other hand, physical time certainty cannot be equated with a S's perfect timekeeping ability event over a set of constant, short ISIs. What would seem to be most needed regarding preparatory state theories is a more careful application of the terms "readiness" and "subjective time uncertainty."

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NOTES

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