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The outcome of a coactor's prediction as a determinant of choice reaction time

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Two coactors performed simultaneously in a two-choice reaction time paradigm; one individual was the subject while the other was a confederate of the experimenter. Prior to each presentation of the symbol $\sqcup$ or $\sqcap$, the subject and the confederate verbally predicted which stimulus they expected, and after each presentation, the subject and the confederate identified the stimulus by pulling their own left or right reaction trigger. Following the more probable stimulus, the subject reacted faster when the confederate's prediction was correct. Contrary to a hypothesis from expectancy theory, the subject reacted markedly faster to the less probable stimulus than the more probable alternative when the prediction outcome was correct for the subject but incorrect for the confederate.

If one stimulus occurs more often than the other in a two-choice reaction time (RT) paradigm, subjects react prominently faster to the more probable stimulus (e.g., Laming, 1969). When required to predict the sequential occurrence of the presentations in a two-choice RT task, subjects react markedly faster to correcly predicted stimuli than to incorrectly predicted stimuli (e.g., Bernstein & Reese, 1965). In addition, when subjects make stimulus predictions in a choice RT situation with a frequency imbalance, independent effects of both stimulus probability and prediction outcome have been demonstrated (e.g., Geller, Whitman, Wrenn, & Shipley, 1971). The present study was designed to determine the effects of stimulus probability and prediction outcome on RT when two coactors make stimulus predictions and choice reactions. One coactor was the subject while the other was a confederate of the experimenter; and each stimulus presentation represented one of four possible prediction outcomes: subject and confederate correct, subject correct and confederate incorrect, subject incorrect and confederate correct, subject and confederate incorrect.

Expectancy theory has been frequently used to interpret the effects of stimulus probability and prediction outcome on choice RT (e.g., Geller et al., 1971; Laming, 1969). A basic premise of these expectancy models is an inverse relationship between RT and the degree of expectancy for the stimulus presentation. The added assumption that subjects predict expected events accounts for the "prediction outcome effect." Similarly, the postulate that the subject's expectancy for a particular stimulus varies directly with the probability of that stimulus provides an explanation for the "probability effect." The present experiment studied the effects of a coactor's stimulus prediction on the subject's expectancy for a stimulus as reflected by choice RT. It was hypothesized that the subject's expectancy for the predicted stimulus would be augmented when another individual also predicts that stimulus; and, therefore, the subject should react fastest when the stimulus presentation had been correctly predicted by both subject and confederate, and the subject should react slowest when both subject and confederate had incorrectly predicted the stimulus. Also, given the probability effect, the shortest RTs should occur when subject and confederate correctly predict the more probable stimulus; and the longest RTs should occur when the more probable stimulus is predicted by both the subject and the confederate but the less probable stimulus is presented.

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METHOD

Subjects

Forty males, volunteers from large introductory psychology classes at Virginia Polytechnic Institute and State University, were randomly assigned to one of two groups, distinguished by the order of the subject's prediction on each trial (i.e., subject predicted before confederate or after confederate).

Design and Procedure

Two males (subject and confederate) sat adjacent to each other on separate chairs, a stimulus screen and a pair of reaction triggers were positioned in front of each individual. A partition was situated between the subject and the confederate so that each could not see the other's stimulus screen and reaction triggers, except by sliding one's chair backwards and leaning sideways. The sequence of events for each of 300 trials was as follows: (a) a verbal prediction by the subject and confederate (20 subjects predicted before confederate and 20 subjects predicted after confederate), (b) a .5-sec warning buzzer, (c) a random interval ranging from .5 to 2 sec, (d) a presentation of the symbol $\sqcup$ or $\sqcap$ by the illumination of a 2 x 5 cm digital readout (verbally labeled "up" and "down" respectively), (e) a choice reaction by the subject and confederate. Half of the subjects (and the corresponding confederate) pulled the left-hand trigger to identify $\sqcup$ and the right-hand trigger to identify ⊓; the reverse S--R mapping was used for the remaining subjects. The latency between each stimulus presentation and the subject's identification response was measured in milliseconds with a digital timer.

For each of the three consecutive blocks of 100 trials, the ⊔ symbol occurred 70 times. During all sessions the confederate predicted the same sequence of stimuli which was preprogrammed so that the two stimulus alternatives were predicted equally often, and so that the confederate made a correct prediction on 50% of the trials.[1] The stimulus presentation on the confederate's readout included the illumination of a small dot whenever the confederate's subsequent prediction should be "down" (i.e., the ⊓ symbol). The series of stimulus presentations and the confederate's predictions were identical for each subject and were determined by appropriate filtering of a uniform random number generator on an IBM-370 computer.

At the beginning of each session, the subject and confederate were given 10 practice trials during which questions concerning the task were answered. During practice, the subject and confederate were encouraged to look at each others' stimulus screen to see that each received the same stimulus. Following the experimenter's prompt at each session, the confederate slid his chair backwards and leaned around the partition to make the comparison. The dot never occurred on the confederate's readout during practice. The instructions emphasized the importance of both speed and accuracy when identifying the stimuli. On five predetermined trials during the session, the experimenter told the confederate that he made an identification error. Likewise, the subject was reminded of his errors whenever they occurred.

After the experimental session, the experimenter signed an experiment credit sheet for the subject and confederate and asked, "Well, how was it?" After any comments were given, the confederate walked with the subject from the research room to the building's elevator; and continuing his disguise as a naive subject, the confederate attempted to provoke some further discussion of the experiment with statements like, "Did you get tired in there?, Did you get more of one stimulus than the other?" The purpose of these postexperimental inquires by the experimenter and confederate was to determine if the subject believed the confederate to be a confederate of the experimenter. No subject verbalized disbelief that the confederate was another volunteer student gaining research credit for the introductory psychology course.

RESULTS

Predictions

For consecutive blocks of 50 trials, the proportion of "up" predictions was calculated for each subject and group averages were determined. The results showed a tendency for subjects who predicted before the confederate to predict "up" more often than subjects who predicted after the confederate. For example, the average proportions of "up" predictions for each group was highest for the last two trial blocks; but only when the subject predicted before the confederate was probability matching reached. Specifically, for the last two blocks of 50 trials the average proportions were .69 and .73 when the subjects predicted first, and .61 and .62 when the subjects predicted second. However, the 2 (group) by 6 (50-trial blocks) analysis did not show a main effect of group, $F(1,38) = 2.01$, $.25 > p > .10$, nor a Group by Trial Block interaction, $F(5,190) = 1.64$, $.25 > p > .10$. A main effect of trial block was obtained, $F(5,190 = 15.35$, $p < .001$.

Reaction Time

Errors (i.e., anticipatory reactions and inappropriate identifications) were eliminated from the analysis and did not exceed 5% for any subject. The RTs for appropriate reactions were classified into one of eight mutually exclusive categories according to the stimulus (⊔ or ⊓) and the prediction outcome (PO) of the subject and the confederate. The category means were calculated for each subject, and group averages computed.

The group means are depicted in Figure 1 and indicate that choice RT was influenced by stimulus probability, subject-PO, and confederate-PO. Effects of subject-PO and stimulus probability are illustrated by consistently shorter RTs when the subject had correctly predicted the stimulus and by usually shorter RTs to the more probable stimulus. The effect of confederate-PO was apparently dependent on the probability of the stimulus. Following the more probable stimulus, subjects reacted faster when the confederate's PO was correct. This same effect of confederate-PO also occurred when the subject incorrectly predicted the occurrences of the less probable stimulus. However, when the subject correctly predicted the less probable stimulus, RT was shorter when the confederate had predicted the more probable stimulus than when the confederate had also correctly predicted the less probable stimulus. In fact, RT was not shorter to the more probable stimulus when the stimulus

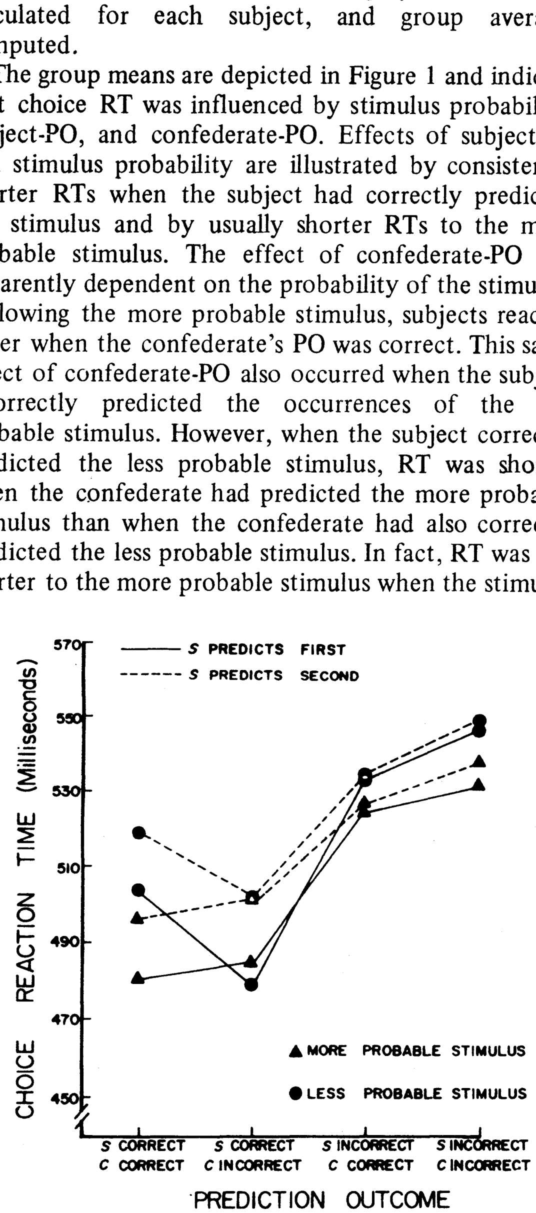

Figure 1. Choice reaction time as a function of stimulus probability, and the outcomes of the subject's and the confederate's stimulus predictions.

was correctly predicted by the subject and incorrectly predicted by the confederate.

The results of the analysis of variance showed the above observations to be reliable. The overall analysis, a 2 (group) by 2 (stimulus) by 2 (subject-PO) by 2 (confederate-PO) factorial, indicated significant main effects of only stimulus, $F(1,38) = 6.24$, $p < .025$, and subject-PO, $F(1,38) = 53.03$, $p < .001$. The significant interactions were: Stimulus by Confederate-PO, $F(1,38) = 5.58$, $p < .025$, Subject-PO by Confederate-PO, $F(1,38) = 28.20$, $p < .001$, and Stimulus by Subject-PO by Confederate-PO, $F(1,38) = 11.70$, $p < .005$. The 2 (group) by 2 (subject-PO) by 2 (confederate-PO) analysis for the more probable stimulus demonstrated significant main effects of subject-PO, $F(1,38) = 57.82$, $p < .001$, and confederate-PO, $F(1,38) = 4.78$, $p < .05$. None of the interactions reached a .05 level of significance. For the less probable stimulus the analysis indicated only a main effect of subject-PO, $F(1,38) = 34.39$, and a Subject-PO by Confederate-PO interaction, $F(1,38) = 28.95$, $ps < .001$.

DISCUSSION

As shown in previous RT research, choice reactions were markedly faster to correctly predicted stimuli than to incorrectly predicted stimuli (Bernstein & Reese, 1965; Geller et al., 1971), and were usually faster to the more probable stimulus (Geller et al, 1971; Laming, 1969). Moreover, the outcome of the coactor's prediction significantly affected the subject's RT, and this effect was not influenced by the order in which the predictions were verbalized on each trial. As hypothesized, the subject responded slower to an incorrect prediction of either stimulus when the confederate had also made the incorrect prediction than when the confederate had correctly predicted the stimulus. According to an expectancy model, the subject's degree of anticipation for a predicted stimulus was apparently augmented when the confederate predicted the same stimulus, and consequently in such cases the subject's preparation for the nonpredicted stimulus was minimized. Similarly, an expectancy interpretation accounts for the shorter latencies when both the subject and the confederate correctly predicted the more probable stimulus than when only the subject correctly predicted this alternative. Thus, increased preparation to identify the more probable stimulus resulted from the confederate's concurring prediction of that stimulus.

The prominently faster reactions to the subject's correct predictions of the less probable stimulus when the confederate's prediction was incorrect rather than correct may not be explained by the proposed expectancy model. Seemingly, when the subject correctly predicted the less probable stimulus, reactions were facilitated when the confederate incorrectly predicted the more probable stimulus. It is difficult to believe that the subject's expectancy for the less probable stimulus increased when the confederate predicted the more probable alternative, especially when the other findings of this study imply a contrary notion that the subject's expectancy increased whenever the confederate's prediction *agreed* with his prediction. Perhaps in some cases, a correct stimulus prediction involves more than the confirmation of an expectation, and the prediction outcome effect is mediated by mechanisms other than expectancy. For example, it might be speculated that some reactions to correctly predicted events are particularly fast because of a reinforcement or elation phenomenon. Other authors have suggested that subjects are reinforced to a greater extent when correctly predicting the *less* rather than the *more* probable stimulus (cf. Lee, 1971, Pp. 168). In the present paradigm, the reinforcement potential following the subject's prediction of the less probable stimulus may have been even greater when the confederate disagreed with the subject's "risky" decision.

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NOTE

1. Usually subjects predict correctly on about 50% of the trials when two stimuli are presented according to a 70/30 probability schedule. Even if the subject's predictions eventually match the stimulus probabilities, the proportion of correct predictions will only reach .58, i.e., the joint probability of the 70% stimulus occurring and of the subject predicting that stimulus is $.70 \times .70 = .49$; the joint probability of the occurrence and the prediction of the 30% stimulus is .09.

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