Temporal set associated with brief stimulus duration in a psychophysical recognition of length

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In order to test the effect of increase or decrease of brief stimulus duration on perceptual process, a psychophysical recognition experiment was conducted, in which two lengths of line were presented in random sequences under instructions to identify which stimulus was presented on each trial. The duration of presentation also varied randomly. Accuracy was lower for the briefest of the three levels of stimulus duration, but only for those sequences in which this level occurred infrequently.

Abrupt change of stimulus duration has been used as a probe in studies dealing with duration-specific phenomena in habituation (Koepke & Pribram, 1966), Pavlovian conditioning (Kimmel & Greene, 1964; Kimmel, 1966), and reaction time experiments (Karling, 1959; Drazin, 1961; Zahn & Rosenthal, 1966). Although explanatory concepts used in these studies vary, it must be noted that duration is not unique or specific to any sense modality, so that a process brought about by the effect of stimulus duration may be regarded as nonspecific and common to sense modalities. For lack of better terminology, such process is referred to as a temporal set. This study attempts to show the existence of such temporal sets by excluding the likelihood of both conditioned inhibition (inhibition of delay) and preparatory set entering into the experimental situation. In order to do this, a psychophysical recognition experiment using a fixed brief stimulus duration was conducted. The reason is twofold. First, if a temporal change within a brief stimulus duration is to have any effect on performance, then such an effect is not likely due to inhibition of delay or any conditioned process. Second, unlike reaction time experiments, overt motor response contingent on stimulus onset or offset is not a crucial variable in a recognition experiment, thereby avoiding the ambiguity as to whether set is primarily motor or sensory.

METHOD

Two straight dark lines of 24- and 26-mm length were presented randomly, one per trial for 100 trials, by means of a Harvard tachistoscope. The task for each S was to recognize the length of each stimulus by saying either "short" or "long." There were three different stimulus durations: .1, .5, and .9 sec. A total of 30 Ss, recruited from the introductory psychology courses, were assigned to three groups of 10 each, with three distributions of the stimulus durations. For the first group (G1), the probability of occurrence of the .5-sec duration was .34; probabilities for .1- and .9-sec durations were both .33. For the second group (G2), the probability of occurrence of the .5-sec duration was .60, that of the .1- and .9-sec durations, .20 each. For the third group (G3), the probability of the .5-sec duration was .80, and that of .1- and .9-sec durations, .10 each. Defining .5-sec duration as a training stimulus, .1- and .9-sec durations as probe stimuli, the ratios of training trials to probe trials would be 1:1 (G1), 1.5:1 (G2), and 4:1 (G3).

RESULTS AND DISCUSSION

The number of errors of judgment of length was obtained for each S with respect to each stimulus duration. Since statistical expectation of such errors is expressed as a proportion, the proportion of errors with respect to each stimulus duration was obtained. In order to determine the effect of change of stimulus duration, the proportion of errors for the .5-sec duration was subtracted from those associated probe trials. The results are shown in Fig. 1. There was no appreciable difference in the number of errors for .5-sec duration among groups. Two observations are made from this figure. Decrease of stimulus duration appears to be associated with increase of errors, while increase of stimulus duration is not associated with increase of errors. Secondly, this relationship becomes more pronounced as the number of the training trials is increased. In order to substantiate these two observations, analysis of variance was conducted. Its results indicate that both the main effect of change in duration ($F = 10.44$, $p < .005$) and its interaction with the ratio of the number of training trials to probe trials ($F = 8.89$, $p < .005$) are very highly significant. On the other hand, the proportion of "long" judgments for the .1-, .5-, and .9-sec durations, respectively, were as follows: .47, .44, and .44 for G1; .42, .40, and .41 for G2; .41, .39, and .40 for G3. It is clear that increase of errors brought about by decrease of stimulus duration is not due to any factor specific to the nature of response itself.

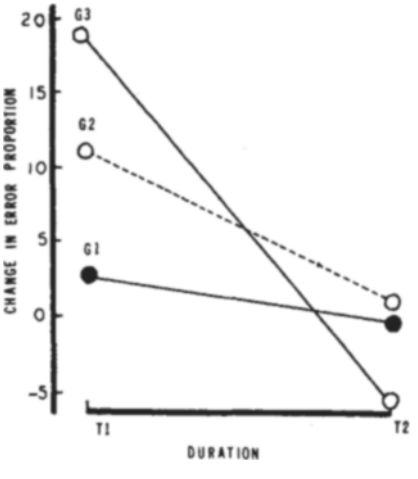

Fig. 1. Change in proportion of errors of judgment as a function of decrease (T_1) and increase (T_2) of the .5-sec duration. Positive values indicate increase of error proportion, negative values indicate decrease of error proportion.

The .5-sec duration used for training is too brief to bring in the concept of inhibition of delay to account for the observation made; it is unlikely that a process underlying the increase of errors as a function of both shortening of duration and number of training trials, is a conditioned process. On the other hand, the fact that no immediate motor responding was called for at the end of the stimulus duration rules out the likelihood that such a process is a preparatory set. This point is even more plausible in the light of the fact that no appreciable change of the proportion of "long" judgments was brought about by the change of stimulus duration. If any set is involved, such a set appears to be specific only to the .5-sec duration. Such a set, therefore, must be regarded primarily as a temporal set.

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An analysis of response patterns for conditional reasoning schemes

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One hundred and ten college Ss assessed the truth of the conclusions for 40 conditional reasoning items. These items varied according to principles of inference and validity status. The results indicated some interesting intra- and interrule variations in response patterns.

A number of investigators (e.g., Ennis, 1970; Ennis & Paulus, 1965; Gardiner, 1965; Hill, 1961; Howell, 1965; Martens, 1967; Matalon, 1962; Miller, 1968; O'Brien & Shapiro, 1968; Paulus, 1967; Roberge, 1970; Roberge & Paulus, 1971; Shapiro & O'Brien, 1970a, b; Suppes, 1965) have examined children's comprehension of conditional reasoning schemes. However, there has been a dearth of similar research with adults. More precisely, most of the research on the propositional reasoning abilities of adults (e.g., Johnson-Laird & Tagart, 1969; Johnson-Laird & Wason, 1970; Wason, 1964, 1966, 1968, 1969a, b; Wason & Johnson-Laird, 1970) has focused on tasks in which Ss had to select (or classify) stimuli which would make conditional sentences (or rules) true or false and on therapeutic procedures designed to reduce Ss' tendencies to make fallacious inferences, rather than on tasks in which Ss had to assess the truth of the conclusions for conditional reasoning schemes. Furthermore, those studies which have employed tasks of the latter type have been limited to valid rules of inference (e.g., Stewart, 1961).

Thus, the aim of the present investigation was to measure adults' abilities to assess the truth of the conclusions for logical arguments embodying one of five basic principles of conditional reasoning. These were: (1) $P \supset Q$, P, $\therefore Q$ (modus ponens); (2) $P \supset Q$, Q, $\therefore P$ (affirmation of the consequent or conversion); (3) $P \supset Q$, $\overline{P}$, $\therefore \overline{Q}$ (denial of the antecedent or inversion); (4) $P \supset Q$, $\overline{Q}$, $\therefore \overline{P}$ (modus tollens or contraposition); (5) $P \supset Q$, $Q \supset R$, $\therefore P \supset R$ (transitivity). Detailed information about adults' abilities to reason with these conditional reasoning schemes is essential for the formulation of a comprehensive theory of cognitive development.

SUBJECTS

The Ss were 110 graduate students in educational psychology at Temple University.

MATERIALS

A 40-item conditional reasoning test was constructed by the E. These 40 items represent the eight possible arrangements (according to the presence or absence of negation) of the terms in the major premise and the conclusion for the five basic principles of conditional reasoning. A complete listing of the premises, conclusions, and validity statuses of the items is presented in Table 1. Each item contained two premises and a conclusion, e.g., suppose you know that

> If there is a Q, then there is an R.
>
> There is a Q.

then would this be true?

> There is an R.

The possible responses which the Ss could make were "YES," "NO," and "MAYBE." The meanings of the possible answers were explained to the Ss as follows: "YES—it must be true; NO—it can't be true; MAYBE—it may be true or it may not be true. You weren't told enough to be *certain* whether it is 'YES' or 'NO.'"

To avoid extraneous influences on responses, premises and conclusions involving capital letters (P, Q, R, and S) were used. Moreover, the order of presentation of the 40 items was randomized both within and across the principles of inference, with the additional restriction that no two items for the same principle appear consecutively.

RESULTS AND DISCUSSION

The structural characteristics of each item and its validity status are shown in Table 1. In addition, the percentages of Ss choosing each alternative, the keyed alternative, and the discrimination index (Johnson, 1951) are presented.

The mean difficulties for the five principles were .95, .48, .69, .45, and .86, respectively. In general, the relative difficulties of the various principles confirmed expectations based on extrapolation from the findings of previous studies with adolescents (e.g., Ennis & Paulus, 1965; Gardiner, 1965; Howell, 1965; Miller, 1968; Roberge, 1970). Moreover, the relative difficulties of Principles 2 and 3 supported Wason's (1964) finding that, for adults, "the affirmation of the consequent is a much more deceptive fallacy than the denial of the antecedent [p. 32]."

The mean discrimination indices for the five principles were .07, .61, .49, .08, and .24, respectively. Thus, the items for the fallacies, particularly Principle 2 (conversion), best discriminated between the groups of high- (upper 27%) and low- (lower 27%) scoring Ss formed on the basis of total test score. On the other hand, the easiness of the items for Principles 1 (modus ponens) and 5 (transitivity) had a debilitating effect on the corresponding discrimination indices for these items. Furthermore, although the items for Principle 4 (contraposition) had an average difficulty of .45, the discrimination indices for these items were surprisingly low. An analysis of the response patterns for the latter items revealed that the erroneous response MAYBE was selected by many Ss, and that it was equally attractive to both high- and low-scoring Ss.

Further examination of the response patterns revealed that for Principle 2 items the preferred error was YES when the conclusion and the antecedent of the major premise were congruent and NO when they were *not* congruent. However, for Principle 3 items the preferred error was YES when the conclusion and the consequent of the major premise were *not* congruent and NO when they were congruent. These patterns of error preference for the fallacies were concordant with those reported in earlier studies with adolescents (e.g., Gardiner, 1965; Howell, 1965; Martens, 1967; Miller, 1968).

Finally, the response patterns for Principle 4 items can be partially explained by Wason's (1966) hypothesis, and the empirical findings of Johnson-Laird & Tagart (1969), with respect to Ss' tendencies to classify a conditional sentence of the form "If P, then Q" as irrelevant in any situation that falsifies its antecedent. Specifically, approximately 20% more Ss selected