

recovery of potential recessive lethals occurred between 30 and 40 min. after irradiation at anoxia. The establishment of this borderline may be taken as a proof that there may exist recoverable mutations, although it does not give any information about the ratio of mutations which has this possibility.

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¹ Lüning and Hannerz, *Hereditas*, 43, 549 (1957).

² Lüning and Söderström, *Hereditas*, 43, 563 (1957).

PSYCHOLOGY

Effects of Independent Variations in Stimulus and Response Probability

THE time taken by human beings to react to one of a number of possible signals increases with the number of alternatives involved. The effects of jointly varying stimulus and response uncertainty have been long known and adequately discussed^{1,2}. In the present investigation these were varied independently, by using situations where the same response was required for a number of stimuli. The number of responses, and the ratio of response/stimuli were varied.

Card sorting was used as a convenient task for a pilot study. The subject turned and dealt cards from packs held in the non-dominant hand, on to a number of piles. Each pile represented a group of stimuli to which the same response was required. The stimuli were letters and figures (72 point) stencilled on the cards in indian ink. Packs were made up for each condition, so as to vary the number of different symbols for each pile; the number of piles was of course constant for each condition.

Four conditions of response uncertainty were used, four packs for each condition being employed. In one condition packs were to be sorted into two piles, there being one, two, four and eight symbols per pile. Cards were sorted into letters, or figures.

The other conditions used four, six and eight piles, with response/stimulus ratios of 1/1, 1/2, 1/3 and 1/4 in each case. Ten subjects were tested on condition one, and a fresh batch of twelve on condition two. Four trials were given on each pack (that is, each response/stimulus ratio). A third batch of nine subjects was used on the six- and eight-pile conditions. Six of these had eight trials with each pack; the remaining three had sixteen trials with each pack. Sorting time was taken with a stop-watch. Packs were given in random order. For the first sortings in each condition, but never afterwards, indicator cards were attached to the boxes into which the cards had to be sorted. The order of the boxes from left to right was varied randomly for each subject. Subjects were students at a teachers' training college, and female shop assistants. No significant differences appeared between these groups.

The results of these tests are shown below. In condition one there was a marked significant increase in time between pack I and pack II. Times for packs II, III and IV did not differ. In condition two the results were similar. In condition three the most striking difference remains that between packs I and II. There is a non-significant difference between packs II and III, and a significant ($P < 0.02$)

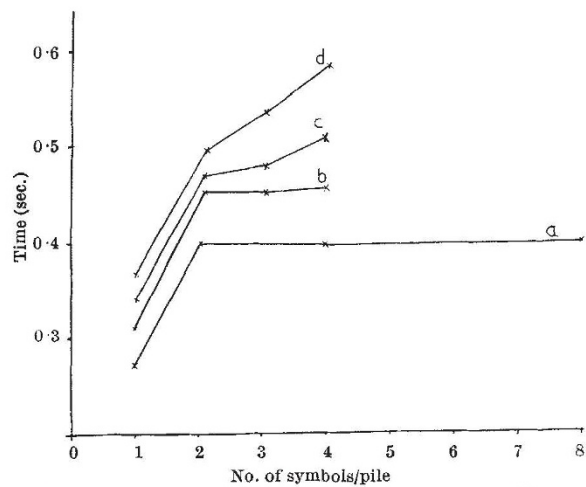


Fig. 1. a, 2-pile condition; b, 4-pile condition; c, 6-pile condition; d, 8-pile condition. Decision time/card was obtained by subtracting mean movement time, obtained individually for each subject, from the mean sorting time for each condition

increase between pack III and pack IV. In the fourth condition there are highly significant differences between all packs. The most striking is that between pack I and pack II. The results of the three practised subjects on the last conditions were of the same pattern.

In the last three conditions digits had been sorted into two of the piles. It was felt that the results might have been partly explained by the diminishing effect of the figures/letters dichotomy as the number of piles increased. Accordingly, the two- and four-pile conditions were repeated on six subjects practised in earlier trials using letters only. After eight trials on each pack in both conditions, the results showed the same pattern as the earlier tests. The increased practice necessary suggests that the figure/letter dichotomy had been used by the subject in earlier tests.

The results were still open to the interpretation that, despite the precaution of giving packs to the subjects face down, a small increase in reaction time with increase of stimuli/response was masked by subjects 'taking up the slack', and overlapping movement and decision-time to some extent. A choice reaction-time apparatus was used for investigating this, push buttons representing piles, and stimuli being projected on to a screen before the subject. Individual reaction-times were measured with a 'Dekatron' timer. Six subjects were used on the two-pile condition (letters/figures) and four on a four-pile condition (2 letters/figures, 2 letters only). The results gave the same pattern as the card sorting tests. In the four-pile condition considerable practice was necessary (500 presentations for each response/stimulus ratio) before this pattern emerged.

These results suggest that there are certain limits within which the response-time to groups of stimuli is dependent on the number of possible responses, rather than on the number of different alternative stimuli to which each response is to be made.

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¹ Quastler, H., "Information Theory in Psychology" (Illinois, 1955).

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