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Information processed in ocular pursuit

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SUMMARY

The purpose of the research presented here was the assessment of influences which several movement parameters of a moving target, followed with the eyes, may have on the processing of visual information carried by that target. An experimental setup was used in which subjects had to follow a visual target, a circular spot of light on a screen, with their eyes while at the same time they were to react (manually) towards stimuli presented in that target.

In chapter 1 the motivation behind the research is mentioned and in chapter 2 a general outline is given of the theoretical framework within which the experiments were carried out.

The limited capacity variable allocation theory of information processing, as proposed by Kahneman, states that a certain amount of energy (capacity) is necessary to perform a task. The amount of capacity available is, however, limited and a task is said to become more difficult when it requires more capacity.

The more specific theory of information processing stages, as formulated by Sternberg, states that a task is performed in a sequence of psycho-motor stages (such as the encoding of information, the selection of an adequate response, the preparation and the execution of motor responses).

The experimental effects observed in the present research have been analysed in terms of both these theories, in order to determine whether they resulted from capacity requirements of the task and to discover some of the information processing stages involved.

The target movement parameters predictability, frequency and velocity were chosen as independent variables. Reaction time to stimuli presented in the target and in some cases also to stimuli presented in the visual background over which the target moved was chosen as the dependent variables.

In chapter 3 the experimental apparatus and methods are described, including the specific way in which predictability, frequency and velocity were manipulated independently.

In chapter 4 two preliminary experiments are reported. The first one revealed that reduced predictability, increased frequency and increased velocity lengthen RT. Predictability interacted with frequency. From experiment 2 it appeared that this interaction, which was of a peculiar shape, could not be explained as resulting from the fact that, when a moving target is followed with the eyes, oculomotor tracking performance is not always accurate and therefore stimuli are sometimes not perceived foveally.

In chapter 5 four experiments are reported in which time uncertainty was manipulated, with respect to the stimuli presented in the target. Velocity appeared to interact with time uncertainty, but the other two parameters of target movement did not.

The results from experiments 1, 3, 4, 5 and 6 were replicated in experiment 7 (chapter 6) over a larger range of frequencies (and velocities). In addition, it was shown that stimulus degradation interacted with predictability and with frequency (and probably also with velocity) as well as with the interaction between these two variables.

In chapter 7 two experiments are reported in which, in addition to RT, reactions to movements of a background pattern were also used as a dependent variable. In a third experiment one more dependent variable was added: reactions to sudden disappearances of the background. With respect to reactions to stimuli presented in the target the effects replicated those observed earlier. None of the target movement parameters, however, showed any effect on reactions to background disappearances. Reduced predictability and increased velocity did increase reaction times made to movements of the background. Increased frequency shortened such reactions. The effects of predictability and frequency (and also partly the effect of velocity) on reactions to movements of the background may, however, be an artifact.

The results and their theoretical implications for effort theory and for the theory of information processing stages, are reviewed in chapter 8.

With respect to effort theory it can be concluded that velocity seems to be the only target movement parameter which affects the difficulty of the task (as defined by effort theory). Predictability and frequency do not affect task difficulty as long as velocity is kept constant.

In terms of models of serial information processing stages it can be concluded that predictability and frequency (and probably also velocity) affect the clarity of perception, presumably because they affect oculo-motor tracking performance and thus determine to a certain extent whether stimuli in the target are seen foveally or not. Hence it can be concluded that these parameters all affect a stage of information processing responsible for the encoding of information. In addition, it has been concluded that velocity also affects a more central stage of information processing, a stage presumably responsible for (oculo-)motor adjustment.

In chapter 9 some suggestions for further research are made and some speculations regarding possible applications for this kind of research are provided.