USE OF THESES

This copy is supplied for purposes of private study and research only. Passages from the thesis may not be copied or closely paraphrased without the written consent of the author.
SELECTION IN VISION

A study of visual search

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

by

Robert T. Solman

Australian National University

January 1977
This thesis describes original research carried out by the author in the Department of Psychology at the Australian National University; from March 1973 to January 1976.

Robert T. Solman
PREFACE

I am indebted to Dr. Michael Cook of the Australian National University. Dr. Cook was always willing to discuss my work, his criticisms were invaluable, and his encouragement during the latter stages was greatly appreciated. I would like to thank Barbara Grosser who typed this thesis, and Neville Whitworth who built and maintained much of the equipment. I would also like to acknowledge the Australian Government for awarding me a post-graduate research scholarship.

Nine empirical investigations have been reported in this thesis. The results of five of these nine have been published, and the results of the remaining four are being considered for publication. I have listed below the five published papers and two manuscripts which incorporate the remaining four studies.


Evidence that focal processing involves a build-up of a visual object. British Journal of Psychology, in press.
Processing nominal information during first-stage analysis.
Being considered for publication by the Canadian Journal of Psychology.
Relationship between accuracy of search and extended exposure-time. Being considered for publication by Perception.

R.T.S.
TABLE OF CONTENTS

PREFACE
ABSTRACT

1. INTRODUCTION
   1.1 STIMULUS CONTROL DURING SELECTION 1
   1.2 SOME PROPERTIES OF VISUAL SELECTION 3
       VISUAL SEARCH 3
       ATTRIBUTES GOVERNING SELECTION 6
       SERIAL AND PARALLEL PROCESSING 8
   1.3 THE EMPIRICAL INVESTIGATION 10

2. EXPERIMENT 1
   2.1 INTRODUCTION 12
   2.2 METHOD 13
       DESIGN 14
       MATERIALS AND APPARATUS 14
       PROCEDURE 15
   2.3 RESULTS 16
   2.4 DISCUSSION 23
       PARALLEL-SERIAL PROCESSING 24
       A TWO-STAGE MODEL 27
   2.5 FURTHER INVESTIGATION 28
<table>
<thead>
<tr>
<th>Section</th>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. EXPERIMENT 2</td>
<td>3.1 INTRODUCTION</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>3.2 METHOD</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>DESIGN</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>MATERIALS AND APPARATUS</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>PROCEDURE</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>3.3 RESULTS</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>3.4 DISCUSSION</td>
<td>37</td>
</tr>
<tr>
<td>4. EXPERIMENT 3</td>
<td>4.1 INTRODUCTION</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>4.2 METHOD</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>DESIGN</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>MATERIALS AND APPARATUS</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>PROCEDURE</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>4.3 RESULTS</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>4.4 DISCUSSION</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>A TWO-STAGE MODEL</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>PARALLEL-SERIAL PROCESSING</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>RESPONSE SPEEDING</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>MASKING</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>MEMORY SPAN LIMITATIONS</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>4.5 FURTHER INVESTIGATION</td>
<td>52</td>
</tr>
<tr>
<td>5. EXPERIMENT 4</td>
<td>5.1 INTRODUCTION</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>5.2 METHOD</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>DESIGN</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>MATERIALS AND APPARATUS</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>PROCEDURE</td>
<td>55</td>
</tr>
</tbody>
</table>
5.3 RESULTS

5.4 DISCUSSION

ACCURACY/TIME CURVES

6. EXPERIMENT 5

6.1 INTRODUCTION

6.2 METHOD

DESIGN

MATERIALS AND APPARATUS

PROCEDURE

6.3 RESULTS

6.4 DISCUSSION

IN SUMMARY

7. EXPERIMENT 6

7.1 INTRODUCTION

7.2 METHOD

DESIGN

MATERIALS AND APPARATUS

PROCEDURE

7.3 RESULTS

7.4 DISCUSSION

7.5 FURTHER INVESTIGATION

8. EXPERIMENT 7

8.1 INTRODUCTION

8.2 METHOD

THE PEST PROCEDURE

DESIGN

MATERIALS AND APPARATUS

PROCEDURE
11.3 GENERAL DISCUSSION

NEISSER'S DESCRIPTION OF THE TWO-STAGE MODEL

REFERENCES

APPENDICES

1. DATA RELEVANT TO EXPERIMENT 1
2. DATA RELEVANT TO EXPERIMENT 2
3. DATA RELEVANT TO EXPERIMENT 3
4. DATA RELEVANT TO EXPERIMENT 4
5. DATA RELEVANT TO EXPERIMENT 5
6. DATA RELEVANT TO EXPERIMENT 6
7. DATA RELEVANT TO EXPERIMENT 7
8. DATA RELEVANT TO EXPERIMENT 8
9. DATA RELEVANT TO EXPERIMENT 9
ABSTRACT

This thesis is concerned with the selective processing of information which arrives via the visual system. The introduction discusses the problem of stimulus control during selection and specifies the aim of the thesis. Nine experiments are reported. The first six examine the relationship between selection accuracy and stimulus exposure-time. It is suggested that a plausible explanation of the obtained results can be found in a two-stage model of information processing (e.g., Neisser, 1967). The remaining three experiments address the question of whether a letter-name can direct the selection process, and the results, while somewhat indecisive, do not indicate that it can. Specifically,

a) in Experiment 1 accuracy of search for a single target declined as the number of irrelevant items, and their physical (shape) similarity to the target, increased. These results could be explained either by sophisticated parallel-serial models of information processing, or by a two-stage model; Experiment 2 suggested that selection was not based on a limited retinal region, thereby negating the possibility of the distance separating items influencing the results of Experiment 1; Experiment 3 varied stimulus exposure-time along with similarity and number of items. The results replicated the effects obtained in Experiment 1, and the negatively accelerated accuracy/time curves demonstrated a plateau effect. The level of the plateau differed for each curve and these differences were attributed to errors during initial
selection; Experiment 4 found the long term course of the accuracy/time curves (i.e., exposure-time varied from 100 to 500 msec). This gave subjects the opportunity to begin a second processing run, but, possibly due to image-decay or to the absence of eye movements, no evidence of a second run was detected; Experiment 5 supplemented the time course data obtained in Experiments 3 and 4 by sampling behaviour over an exposure-time range of 15 to 400 msec. The results showed that both image-decay and the opportunity for eye movements had no effect; the results of Experiment 6 replicated those obtained in Experiment 3, and indicated that while the relationship between target and irrelevant items affected accuracy of selection, it did not influence the time required for this selection.

b) Using the PEST procedure Experiment 7 firstly, demonstrated that the process of building up a structural representation of an alphabetic character requires time, and secondly, indicated that the prior development of object structure may be necessary for naming; Experiment 8 showed that the name of a target letter need not interfere with its selection; In Experiment 9 a confounding of shape and name information made a straight-forward interpretation of the results difficult. The data, however, did not suggest that nominal information was used to direct the selection of the target.

Finally, the discussion speculates further on the nature of the information processing system underlying the findings.