

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

**Gaze Direction and
Two-choice Reaction Time:
Multiple Tests of a Theory**

A dissertation presented in partial
fulfilment of the requirements
for the degree
of Doctor of Philosophy
in
Psychology
at
Massey University

Michael Andreasen

1995

Acknowledgements

I would like to express my thanks and appreciation to John Podd for the quality of his supervision. In the beginning he steered me away from unreal ambition. Later, when stark reality loomed, he hauled me back from the abyss of despair. He also showed remarkable patience when Life, which is just one damned thing after another, got in the way of more important issues. Best of all, he never ever interfered but was always there when I needed him.

* * * * *

Thanks are due to Harvey Jones who did all of the computer programming for my experiments. The successful outcome of my research owes a great deal to his creative and thorough work.

Mike Hughes and Hung That Ton of the Psychology Department workshop are also acknowledged for building my equipment to very high standards of accuracy and workmanship.

Contents

	page
Acknowledgements	iii
List of figures	viii
List of tables	viii
Summary	ix
Preface	1
Introduction	
Historical outline	8
Theoretical models of CLEMs	18
Models of cerebral laterality	30
Methodological and conceptual problems	36
Strategic problems	36
Defining CLEMs	37
Stimulus questions	40
Psychophysiological studies	43
Cognitive strategies and laterality	50
Reverse CLEMs: a different approach	54
Programme overview and hypotheses	69
Experimental Programme	
Methodological rationale	79
Basic experimental procedure	
Equipment	84
Arrangement	85
Trial sequence and control	90
Experimenter-controlled trials	90
Self-paced trials	91
Analysis	92

Experiment 1

Method	94
Results and Discussion	101

Experiment 2

Method	104
Results and Discussion	106

Experiment 3

Method	112
Results and Discussion	114

Experiment 4

Method	122
Results and Discussion	124

Experiment 5

Method	130
Results and Discussion	132

General Discussion**Experimental programme**

Divided field	140
Vertical GPs	145
CVF	146

Further analysis

Task difficulty	148
Meta analysis	152
Modality	156

Explanations

158

Wider issues

Attentional gradient	171
Functional laterality	172
Modern trends	179
Programme evaluation	185

Problems, Difficulties and Mistakes

Methodological issues	187
S-R compatibility	188
Sex	191
Hand x task interactions	191
Fast hand effects	192
Handedness	193
Slow finger syndrome	193
Intrahemispheric interference	194
Statistical problems of design and analysis	195
Statistical problems of design	196
Statistical problems of analysis	201
Difference scores	203
RT analysis	205
Summary statistics	207
Alpha and Omega	209
Other problems	
Practice effects	217
Experimental measures	220
Mistakes	222
Future research	225
References	228
Appendices	
List of abbreviations	259
Notes	260
1. Stimulus exposure	261
2. Stimulus list for Experiment 3	262
E1: Tables. RT and ANOVA	263
E2: Tables. RT and ANOVA	270
E3: Tables. RT and ANOVA	283
E4: Tables. RT and ANOVA	300
E5: Tables. RT and ANOVA	311
Diff: Tables. ANOVA	324
Meta: Tables. ANOVA	328
Errata	333

List of Figures

Figure		
1.	VDU display grid	80
2.	Schematic of the VDU layout	86
3.	Sequence of trial events	91
4.	Block diagram of VDU control	93
5.	Stimuli used in Experiment 5	131
6.	Meta analysis RT/GP profiles	154

List of Tables

Table		
1.	Expt. 1 Group mean median RTs	102
2.	Expt. 2 Sessional group mean median RTs	107
3.	Expt. 2 Condition group mean median RTs	108
4.	Expt. 2 Overall group mean median RTs	110
5.	Expt. 3 CVF group mean median RTs, by condition and stimuli	117
6.	Expt. 3 Divided field group mean median RTs by condition	118
7.	Expt. 3 Overall group mean median RTs for CVF and mean of divided fields	120
8.	Expt. 4 CVF group mean median RTs by condition	125
9.	Expt. 4 Divided field group mean medians by condition	127
10.	Expt. 4 Divided field group mean medians by condition and VF	128
11.	Expt. 5 CVF group mean median RTs by condition	134
12.	Expt. 5 Divided field group mean median RTs by condition	135
13.	Expt. 5 Divided field group mean median RTs by condition and VF	136
14.	Comparisons of alpha and w^2	212

Summary

The relationship between voluntary eye movements and cognition was examined in terms of Kinsbourne's (1972) account of conjugate lateral eye movements (CLEMs). This account is itself based upon his (1970) attentional gradient model of lateralized cerebral asymmetry. A novel methodology was devised with gaze position (GP) and visual field (VF) as the independent variables and manual reaction time (RT) as the dependant measure. A divided VF paradigm using two-choice RT tasks was used thereby avoiding the ambiguities of orthodox CLEM methods. The tasks were, letter (X,V) identification, a lexical decision using words and non-words, simple geometrical shapes, and a mental rotation task. Five visual display units (VDUs) arranged in the form of a Maltese cross subtending 50 degrees horizontally and 35 degrees vertically functioned as tachistoscopes. Trials were either randomized (R) over the VDUs or presented in blocks (B) on each VDU in turn. Under R conditions using verbal tasks, a GP x VF interaction was found for horizontal GPs. This interaction was due to RTs being fastest when the VF and GP hemisphere were congruent (e.g., LVF and LGP). Under B conditions, a GP main effect was found for verbal tasks. This effect was shown by RTs being fastest when subjects looked to the right GP, both VFs producing this effect. No reliable effects were found for visual-spatial tasks. The GP effects found under B conditions were weak and inconsistent and required a form of

meta analysis to demonstrate their reliability. No evidence was found for an interaction of GP with task difficulty. A number of possible explanations, including Kinsbourne's models, were examined. The direction of the GP x VF interaction when trials were randomized was contrary to the predictions made from Kinsbourne's models and the GP main effect found under B conditions was not predicted by them; hence "arousal" and "attention" as used by Kinsbourne were rejected. If eye movements and cognition were regarded as a dual task workload, then intrahemispheric interference could account for the interaction. However, it could not account for the GP effect under B conditions, nor could it account for the absence of any effects with visual-spatial tasks. Also, neuroanatomical considerations made global intrahemispheric arousal and interference implausible as explanations. One possible explanation was that under both presentation conditions, an habitual bias towards right hemisphere occurred. But this bias could be reversed if motor interference occurred in the left hemisphere between saccade control and subvocalization. Interference would only occur with randomized trials and verbal tasks, producing the GP x VF interaction. This explanation also accounted for the absence of any effects when visual-spatial tasks were used. The overall results were evaluated in relation to other accounts of CLEM production and also against modern developments in cerebral laterality investigations.