

ABSTRACT

The focus of this study is to investigate the transient deficit hypothesis in relation to children who experience Specific Reading Disability (SRD). Specific Reading Disability is defined as a child of normal intelligence (or above) who has no behavioural or emotional problems but their reading age is two or more years behind their age group. The transient deficit hypothesis is a major approach in vision reading research used to account for the differences found between normal readers and children with SRD. This approach proposes that two pathways are involved in visual processing: the transient pathway is suggested to be sensitive to global features, movement, peripheral information and low spatial and high temporal frequencies; and the sustained pathway is proposed to process central features, stationary images, colour and high spatial and low temporal frequencies (Lovegrove, 1993). Transient deficit hypothesis suggests that a weak transient channel can adversely affect the two systems combining properly during reading. A sluggish transient channel may cause a superimposition of letters, causing the SRD child to see letters that appear to overlap (Lovegrove, 1993).

This study investigated differences in visual processing between three groups (Chronological age-matched, SRD, and Reading age-matched) of 18 children. The transient deficit hypothesis was examined in the first experiment by using the global precedence paradigm. In Experiments 2 and 3, the sensitivity of the retina and the effect of variation of the size of stimulus were explored. Secondary to these experiments is the fourth experiment where the influence of incongruent processing on the visual processing of SRD children was explored.

The aim of Experiment 1 was to compare the performance of SRD to the performance of normal readers in processing whole and parts of a compound stimulus. Following the transient deficit hypothesis, SRD children should have shown difficulty in processing the global stimulus in comparison to the local aspect of a stimulus. The results of Experiment 1 showed that the global level was detected faster than the local level by all three experimental groups. The reaction times (RT) of SRD were significantly slower (77 milliseconds, $p < 0.05$) than the Chronological age-matched group, and the Reading age-matched group's times were significantly slower (96 milliseconds, $p < 0.05$) than those of the SRD.

Under the transient deficit hypothesis it could be expected that if SRD children have a weak transient channel this may lead to a deficit in processing peripheral information. Experiment 2 found that for all three groups, as stimuli were presented further from the fovea, the RT patterns best fitted with an increasing linear function. The Chronological age-matched group RT was faster than the SRD group (187 milliseconds, $p < 0.01$), and SRD group RT was faster than the Reading age-matched group (31 milliseconds, $p < 0.10$).

The purpose of Experiment 3 was to ascertain whether SRD children would have greater difficulty in processing larger stimuli as compared to smaller stimuli. By following the spatial frequency theory it is suggested that low spatial frequency could be associated with larger stimuli, and this may lead to a slower performance by SRD. The results of

Experiment 3, indicate that all three groups processed larger stimuli more slowly than they did smaller stimuli. Results for all three groups formed decreasing logarithmic functions. SRD were significantly behind the Chronological age-matched (70 milliseconds, $p < 0.05$), and significantly in front of the Reading age-matched group (140 milliseconds, $p < 0.01$).

From Experiment 4, it appears that conflicting information between the local and global levels, results in the global having an inhibitory influence on responding to the local level. Similar to Experiment 1, the pattern of results to global and local levels formed quadratic functions. The consistent stimuli were detected faster than the inconsistent stimuli in all three groups. In other words, SRD were not significantly different from the other two reading groups in response to inconsistent and consistent stimuli. The inconsistency of stimuli did not have a detrimental effect on their performance.

Results from the four experiments show that SRD children do not have any difficulties in processing wholes in comparison to parts, or problems in processing peripheral visual information in comparison to central, and no deficits in processing low spatial frequencies in comparison to high. Additionally in regard to incongruent information, SRD children did not show any significant differences from normal readers. However, the SRD children were significantly slower in the processing of any type of visual information in comparison to the Chronological age-matched children.

In conclusion, the results show that a low-level transient deficit did not lead to difficulties for SRD children in processing global information, stimuli at peripheral locations, and large and inconsistent stimuli. The findings do not support the transient deficit hypothesis in the sense that the transient sub-system is suggested to be associated with global level processing, low spatial frequencies, peripheral vision and incongruent information. However, the results of this study confirmed the transient deficit hypothesis in a sense that the transient sub-system is suggested to be associated with high temporal frequency. In this study, the slower pattern of RT for the SRD group could be related a deficit in visual processing of SRD individuals, or the difference in average IQ between the SRD group and the Chronological age-matched group.

**AN EXPLORATION OF
TRANSIENT DEFICIT HYPOTHESIS
IN SPECIFIC READING DISABILITY**

**A Thesis Presented to
CENTRAL QUEENSLAND UNIVERSITY
FACULTY OF ARTS, HEALTH AND SCIENCES
School of Psychology and Sociology**

RENEE A. HOP YEK

A thesis submitted as full requirement for the degree of Master of Arts

October 2002

AN EXPLORATION OF
TRANSIENT VISUAL HYPOTHESIS
IN SPECIFIC READING DISABILITY

RENEE A. HOP YEK

TABLE OF CONTENTS

	PAGE
ABSTRACT.....	ii
ACKNOWLEDGEMENTS AND DECLARATION.....	ix
CHAPTER 1: LITERATURE REVIEW	10
Section	
1.1 Characteristics of Specific Reading Disabled.....	11
1.1.1 <u>Sub-types</u>	11
1.1.2 <u>Auditory Domain</u>	14
1.2 Phonological Deficit Hypothesis.....	15
1.3 Visual Deficit Hypothesis.....	20
1.3.1 <u>Spatial Frequency Analysis</u>	21
1.3.2 <u>Evidence of Two Distinct Pathways</u>	22
1.3.3 <u>Transient and Sustained Sub-systems and Reading</u>	25
1.3.4 <u>Early Visual Processing</u>	27
1.3.4.1 <u>Interstimulus interval</u>	28
1.3.4.2 <u>Contrast sensitivity</u>	30
1.3.4.3 <u>Uniform field flickering</u>	31
1.3.4.4 <u>Backward masking</u>	32
1.3.4.5 <u>Blurring</u>	32
1.3.4.6 <u>Evoked potential</u>	34
1.3.4.5 <u>Anatomical evidence</u>	34
1.3.5 <u>Later Visual Processing</u>	37
1.4 An Integrated Approach	40
1.5 Interventions	44
1.6 The Present Study- Participants and Rationale.....	48
CHAPTER 2: EXPERIMENT 1	
GLOBAL AND LOCAL PROCESSING	53
2.1 Literature Review	53
2.1.1 Global Precedence Hypothesis	53
2.2 Experiment Aims	58
2.3 Method	59
2.3.1 <u>Participants</u>	59
2.3.2 <u>Apparatus and Stimuli</u>	61
2.3.3 <u>Procedure</u>	65
2.3.3.1 <u>Selection testing</u>	65
2.3.3.2 <u>Practice session</u>	65
2.3.3.3 <u>Vision experiment</u>	66
2.4 Results and Discussion	68

CONTENTS Con't

	PAGE
CHAPTER 3: EXPERIMENT 2	
ECCENTRICITY	76
3.1 Literature Review	76
3.2 Experiment Aims	77
3.3 Method	79
3.4 Results and Discussion	81
CHAPTER 4: EXPERIMENT 3	
STIMULI SIZE	87
4.1 Literature Review	87
4.2 Experiment Aims	88
4.3 Method.....	88
4.4 Results and Discussion.....	90
CHAPTER 5: EXPERIMENT 4	
GLOBAL AND LOCAL INTERFERENCE EFFECT	96
5.1 Literature Review	96
5.2 Experiment Aims	99
5.3 Method	100
5.4 Results and Discussion.....	101
CHAPTER 6:	
GENERAL DISCUSSION AND CONCLUDING REMARKS	106
6.1 Main Findings	106
6.2 Possible Shortcomings and Future Research	109
6.3 Summary and Concluding Remarks.....	113
REFERENCES	116
APPENDICES	
A: Consent form for the Department of Education and the Parents	
B: Data Sheets	
C: Answer RT- Means and SD for Experiment 1– 4	
D: Accuracy- Means and SD for Experiment 1–4	
E: Summary tables of Analysis of Variance for RT	
F: Summary tables of Analysis of Variance for Accuracy	

LIST OF FIGURES AND TABLES

	PAGE
CHAPTER 2: EXPERIMENT 1	
GLOBAL AND LOCAL PROCESSING	
Section	
2.3.1 Table 1: Participants' details	62
2.1 Figure 1: Local and global compound stimuli used by Kinchla	54
2.1 Figure 2: Local and global compound stimuli used by Navon & Norman.	56
2.3.2 Figure 3: Compound stimuli used in Experiment 1	63
2.4 Figure 4: Mean RT as a function of target level and eccentricity for the Chronological-age group	69
Figure 5: Mean RT as a function of target level and eccentricity for the SRD group.....	70
Figure 6: Mean RT as a function of target level and eccentricity for the Reading-age group	70
Figure 7: Mean RT as a function of target level and eccentricity for the global level	72
Figure 8: Mean RT as a function of target level and eccentricity for the local level	72
 CHAPTER 3: EXPERIMENT 2	
ECCENTRICITY	
3.3 Figure 9: Stimuli used in Experiment 2	79
3.4 Figure 10: Mean RT as a function of eccentricity and size for the Chronological-age group	83
Figure 11: Mean RT as a function of eccentricity and size for the SRD group	84
Figure 12: Mean RT as a function of eccentricity and size for the Reading-age group	85
Figure 13: Mean RT as a function of eccentricity and size for all groups	86
 CHAPTER 4: EXPERIMENT 3	
STIMULI SIZE	
4.3 Figure 14: Stimuli used in Experiment 3	89
4.4 Figure 15: Mean RT as a function of size and eccentricity for the Chronological-age group	91
Figure 16: Mean RT as a function of size and eccentricity for the SRD group	92
Figure 17: Mean RT as a function of size and eccentricity for the Reading-age group	93
Figure 18: Mean RT as a function of size and eccentricity for all groups	94

LIST OF FIGURES AND TABLES Con't

	PAGE
CHAPTER 5: EXPERIMENT 4	
GLOBAL AND LOCAL INTEREFENCE EFFECT	
5.3	Figure 19: Sample of Stimuli used in Experiment 4100
5.4	Figure 20: Mean RT as a function of target level and eccentricity for the Chronological-age group at the consistent and inconsistent level....102
	Figure 21: Mean RT as a function of target level and eccentricity for the SRD group at the consistent and inconsistent level103
	Figure 22: Mean RT as a function of target level and eccentricity for the Reading-age group at the consistent and inconsistent level104

ACKNOWLEDGMENTS

Much appreciation must be extended to Alan Keen, my supervisor, for instigating this study and for all his generous assistance at each stage.

I would like to thank the Glenmore and Allenstown Primary Schools, who assisted in the research. Lastly, thanks must go to Joanne Bell for her advice and to my family and workplace for their support.

DECLARATION

The work presented in this thesis is to the best of my knowledge and belief, original, except as acknowledged in the text, and the material has not been submitted, either in whole or part for a degree at this or any other university.

A handwritten signature in cursive script, reading "Renee Hop Yek", positioned above a horizontal line.

Renee A. Hop Yek.