The Influence of Surface Detail on Object Identification in Alzheimer's Patients and Healthy Participants

By

Rebecca Adlington

Submitted to the University of Hertfordshire in partial fulfilment of the requirements of the degree of Doctor of Philosophy

May 2009

CONTENTS

	Page
Acknowledgements	iv
List of Publications	V
Index of Tables	vi
Index of Figures	viii
index of Figures	VIII
Abstract	1
Chapter 1: Theories of Category Specificity and the Emergence of Category Specific Deficits in	
Alzheimer's Patients and Healthy Controls.	3
1.1 What are Category Specific Disorders?	3
1.2 Theories of Category Specificity	8
1.3 What is Alzheimer's Dementia (AD)?	25
1.4 Accounts of Semantic Memory Specifically Relating to Category Specificity in AD	28
1.5 A 'Normal' Naming Profile	33
Chapter 2: The Role of Surface Information in Object Recognition and the Implications for	
Category Specific Research	41
2.1 Introduction	41
2.2 Edge based accounts of object recognition	41
2.2 A Role for Surface Details in Object Recognition?	41
2.4 Edge Plus Surface Accounts of Object Recognition	44
2.4 Edge-Flus-Surface Accounts of Object Recognition	40 51
2.5 Object Recognition in Relation to Category Specificity 2.6 Conclusion	56
	50
Chapter 3: The Hatfield Image Test (HIT): A New Picture Test and Norms for Clinical and	
Experimental use.	58
3.1 Introduction	58
3.2 Method	61
3.3 Results	68
3.4 Discussion	79
Chapter 4: Further Development of the HIT Corpus: Normative Data for Grevscale and Line-	
Drawn Versions, and a Comparison across Format	84
4.1 Introduction	84
4.2 Method	87
4.3 Results	89
4.4 Discussion	112
Chapter 5: The influence of Format, Category, and Naming Difficulty on Naming Accuracy and	
Latencies in Healthy Controls	119
5.1 Introduction	119
5.2 Method	123
	120

5.3 Results	125
5.4 Discussion	137
Chapter 6: Visual Processing in Alzheimer's disease: Surface Detail and Colour fail to aid Object	
Identification	142
6.1 Introduction	142
6.2 Method	146
6.3 Results	151
6.4 Discussion	160
Chapter 7: A longitudinal Investigation of Category Specificity in Alzheimer's Dementia	164
7.1 Introduction	164
7.2 Method	173
7.3 Results	179
7.4 Discussion	200
Chapter 8: Do Category Specific Deficits Emerge in Alzheimer's Dementia when Patients are	
Referenced to Controls?	206
8.1 Introduction	206
8.2 Method	210
8.3 Results	212
8.4 Discussion	222
Chapter 9: A Meta-analytic Study of Category Specific Naming in Alzheimer's Dementia Patients	
and Controls: A Comparison of the Snodgrass and Vanderwart (1980) Corpus and Other	
Corpora.	228
9.1 Introduction	228
9.2 Method	229
9.3 Results	231
9.4 Discussion	236
Chapter 10: Conclusion	240
10.1 Introduction	240
10.2 The Hatfield Image Test (HIT)	241
10.3 The influence of format on object recognition	243
10.4 Participant and control group factors	247
10.5 Conclusion	251
References	253
Appendices	283

ACKNOWLEDGEMENTS

To my supervisors Prof. Keith Laws and Dr Tim Gale, I would like to extend sincere thanks for their unreserved encouragement and guidance, and for the many opportunities offered to me. I feel it is safe to say that I have been fortunate to have as supervisors two individuals who could not be better suited to the role. Without their support, I feel I would not have achieved nearly as much, both in my research, and ongoing career.

I would also like to thank the many other people without whom, it would not have been possible to complete my research. I am grateful to all those who generously gave their time to participate in the investigation, and also, to those who facilitated recruitment. Indeed, I would like to thank all the staff at the QEII memory clinic for their assistance, and in particular, Sue Ferrissey, for her time and support of my research. I would also like to thank all the staff at Snipits hair and beauty, who allowed me to recruit their clients to the normative investigation.

Thanks to Noel Taylor for his help with the Testbed software, to Karen Irvine and Sunil Sthanakiya for providing me with their control naming data for the Snodgrass and Vanderwart corpus, and to Dr. Simone Schlagman for supplying me with a list of potential participants for the normative part of my study. Thanks also to Dr. Javier Moreno-Martínez, Dr. Lia Kvavilashvili, and Sue Anthony for their support and expertise.

A special thanks goes to several of my fellow students at the University of Hertfordshire, Shivani Sharma, Nadine Page, and Liz Kirk, who made my time at UH enjoyable, and were always on hand to remind me that it was important to have a life away from my desk. Thanks also to the many other researchers, students, and staff at UH for their advice and support.

To my family, friends, and boyfriend, thank you for all your support and encouragement, and for generally being amazing. Also to my housemates Kristine and Liz, thank you for giving me the peace and quiet needed for me to get work done, but also for knowing when a bowl of ice cream and a film were exactly what I needed.

PUBLICATIONS

Adlington, R. L., Laws, K. R., & Gale, T. M., (2009). The Hatfield Image Test (HIT): A new picture set and norms for clinical and experimental use. *Journal of Clinical and Experimental Neuropsychology*, *31*, 731-753. (CHAPTER 3)

Adlington, R. L., Laws, K. R., & Gale, T. M., (2009). Visual processing in Alzheimer's disease: Surface detail and colour fail to aid object identification. *Neuropsychologia*, in press. (CHAPTER 6)

Laws, K. R., Adlington, R. L., Gale, T. M., Moreno-Martinez, F. J., & Sartori, G. (2007). Meta analysis of category naming in Alzheimer's disease. *Neuropsychologia*, 45, 2674-2682.

Laws K.R, Gale, T.M., Moreno-Martínez F.J., **Adlington R.L**, Irvine K & Sthanakiya S. In Cognitive Psychology Research Developments (Ed:) Stella P. Weingarten and Helena O. Penat

Laws K.R, Gale, T.M., Adlington R.L, Moreno-Martínez F.J. (In preparation). Modularity of mind , Nova Science Publishers, USA.

CONFERENCES

Adlington, R. L., Laws, K. R., & Gale, T. M. (2008). The Hatfield Image Test (HIT): A new picture set and norms for clinical and experimental use. The Federation of the European Societies of Neuroscience, Edinburgh, September 2008.

Adlington, R. L., Laws, K. R., & Gale, T. M. (2008). The role of surface information and colour on category-specific naming in Alzheimer's dementia. International Neuropsychological Society, Buenos Aires, Argentina, July 2008.

Adlington, R. L., Laws, K. R., & Gale, T. M. (2008). The role of surface information and colour on category-specific naming in Alzheimer's dementia. PsyPAG Human Neuropsychology and Neuroscience Conference, April, 2008.

Adlington, R. L., Laws, K. R., & Gale, T. M. (2007). The influence of gender on category-specific naming in non-brain injured individuals. British Psychological Society, Cognitive Section, Aberdeen, September 2007.

INDEX OF TABLES

Number	Title	Page
1.1	Variables controlled (+) in group studies of AD patients. Adapted from Laws et al., (2007).	12
3.1 3.2 3.3	Summary statistics for naming (percentages) of the colour HIT stimuli Naming responses (%) for each subcategory of the HIT colour stimuli Summary statistics for ratings obtained for the colour HIT	69 70 78
3.4	Correlation matrix for picture naming performance and item ratings obtained for the colour HIT	79
4.1 4.2 4.3	Summary statistics for greyscale naming (percentages) Naming responses (%) for each subcategory when presented in greyscale format Summary statistics for ratings of the greyscale items	90 91 97
4.4	Correlation matrix for greyscale picture naming performance and item ratings	97
4.5	Summary statistics for line-drawn naming (percentages)	99
4.6	Naming responses (%) for each subcategory presented as line drawings	100
4.7	Summary statistics for ratings of the line-drawn items	105
4.8	drawn items.	105
4.9	Analysis of ratings of nuisance variables across subcategory for all versions of the HIT	107
4.10	Regression analysis to explore the extent to which nuisance variables were found to predict naming.	110
4.11	Regression analyses to determine the extent to which sex, age, and years in education predict normative naming	111
	education predict normative naming.	111
5.1	Comparison of age and years in education across condition (colour and line-	102
5 2	drawn). Pairwise comparisons (colour line drawn) across subcategory	123
5.2	Comparison of means (SD) of intrinsic variables, across living and nonliving	120
5.4	Comparison of matching variables across category for the easy and difficult	129
5.5	Correlations between nuisance variables, naming accuracy, and naming latency.	135
5.6	Regression analyses to determine the extent to which nuisance variables may	136
	predict hanning accuracy and accuracy facincy	150
6.1	Patient and control demographics	147
6.2	Matching nuisance variables for living and nonliving items	148
6.3	Control naming performance: format by category	152
6.4	Patient naming performance: format by category	152
6.5	Comparison of AD patients and elderly controls on the Ishihara and Cortical	150
6.6	Regression analysis examining predictors for picture naming in healthy controls	150
	and AD patients	158
7.1	Summary of cross sectional and longitudinal studies of category-specific naming	169
7.2	Variables controlled (+) in longitudinal and cross-sectional studies of AD	108
· ·=	patients	171

7.3	Mean (standard deviation) background details for controls and AD patients within each format group	174
74	Mean (standard deviation) background details for controls and AD patients	174
7.5	The headings used by participants to sort items in the picture-sorting task	177
7.6	ANOVA results for control naming performance: time v category v format	170
7.0 7 7	ANOVA results for AD patient naming performance: time x category x format	181
7.0	ANOVA result for control performance on the word nicture metabing tasks time	101
1.0	ANOVA result for control performance on the word-picture matching task. time	102
7.9	ANOVA results for AD patient performance on the word-picture matching task:	165
	time x category x format	185
7.10	ANOVA results for control performance across living and nonliving things on the similar subcategory sorting task: time x category x format	188
7.11	ANOVA results for AD patient performance across living and nonliving things	
7 12	on the similar and dissimilar subcategory sorting task: time x category x format	189
7.12	subcategory sorting tasks: time x category x format	192
7 13	$\Delta NOVA$ results for control performance: the interaction between time attribute	172
7.15	and subcategory	194
7.14	ANOVA results for patient performance on the visual and functional within	
	subcategory sorting task: time x category x format	196
7.15	ANOVA results for patient performance; the interaction between time, attribute,	
	and subcategory	197
8.1	Demographic information for patients and controls	212
8.2	Results of a three-way ANOVA to explore the influence of category, corpus, and	
	format on picture naming in AD patients	214
8.3	One-way ANOVA to explore category naming in AD patients, across each	
	format and stimulus set	215
8.4	Results of a two-way ANOVA to explore the effects of category and format on	
	controls naming items from the HIT corpus	216
8.5	Results of a two-way ANOVA to explore the effects of category and format on	
	controls naming items from the SV corpus	217
8.6	Bootstrap analyses to explore category naming in controls	219
8.7	Comparison of z-scores across living and nonliving things	220
8.8	Bootstrap analyses to explore category naming in patients when covarying	
	control performance	221
9.1	Background information for all studies included in the meta-analysis	230
92	Effect sizes for patients and controls for the SV and non-SV studies comparing	200
.	performance across living and nonliving things	232
9.3	Effect sizes for living and nonliving for the SV and non-SV studies comparing	
	performance of patients to that of controls	234

INDEX OF FIGURES

Number	Title	Page
1.1	Model of object recognition adapted from Ellis & Young (1996)	4
1.2	Two examples of within category maximal shape overlap outputs	16
1.3	Examples showing the overlap of pairs of items from the subcategories of tools, body parts, animals, and musical instruments	17
1.4	Mean EO ratings for the items and for the subcategories. Taken from Laws and Gale (2002)	18
1.5	Example of a false positive (type 1 error) when referencing patients to controls performing at ceiling	36
1.6	Example of a paradoxical category specific deficit when referencing patients to controls performing at ceiling	36
3.1	Examples of high quality photographic images from the HIT	62
3.2	A sample screen shot (Chinchilla) from the familiarity-rating task.	64
3.3	Distribution of naming for the colour HIT stimuli	69
3.4	Mean age of acquisition ratings across subcategory for the colour HIT	71
3.5	Mean colour diagnosticity ratings across subcategories for the colour HIT	72
3.6	Mean familiarity ratings (to image and name) across subcategory for the HIT	73
3.7	Mean Name agreement (<i>H</i> statistic) across subcategory for the colour HIT	74
3.8	Mean name agreement across subcategory for the colour HIT	75
3.9	Mean visual complexity ratings across subcategory for the colour HIT	76
3.10	Mean word frequencies obtained from the number of hits per item on AltaVista UK across subcategory for the HIT	77
4.1	Examples of the greyscale and line-drawn images derived from the HIT items	
	(from top left: armadillo, mosque, mincer, artichoke).	88
4.2	Distribution of naming for the greyscale HIT stimuli	90
4.3	Mean ratings of age of acquisition across subcategory for the greyscale items	92
4.4	Mean ratings of colour diagnosticity across subcategory for the greyscale items	93
4.5	Mean ratings of familiarity to image across subcategory for the greyscale items	94
4.6	Mean H-statistic across subcategory for the greyscale items	95
4./	Percentage name agreement across subcategory for the greyscale items	95
4.8	Nean ratings of visual complexity across subcategory for the greyscale items	96
4.9	Mean ratings of age of acquisition across subsets corry for the line drawn items	98
4.10 4.11 4.12	Mean ratings of colour diagnosticity across subcategory for the line-drawn items Mean ratings of familiarity (to image) across subcategory for the line drawn items	101
T. I 4	mean radings of ranning (to image) across subcategory for the inte-drawil items	102
4.13	Percentage name agreement across subcategory for the line-drawn items	102
4.14	H-statistic across subcategory for the line-drawn items	103
4.15	Mean ratings of visual complexity across subcategory for the line-drawn items	102
4.16	Comparison of normative naming performance across format and subcategories from the living domain	108
4.17	Comparison of normative naming performance across format and subcategories	100
,	from the nonliving domain	108
5.1	Naming accuracy across format and category	125
5.2	Naming accuracy across format and subcategory	127
5.3	Reaction times across format and category (number of items $= 99$)	130
5.4 5.5	Mean reaction times across subcategory and format	131
5.5	Comparison of naming accuracy across the easy (left) and difficult (right) image	

5.6	sets. Comparison of naming latencies across the easy (left) and difficult (right) image	133
	sets.	134
6.1	Colour, Greyscale and Line versions of items from the <i>HIT</i> (left –right) Daffodil, pomegranate, praying mantis, artichoke, poncho, sitar, tuk	
6.2	tuk. Elderly control naming across category on easy (left) and difficult (right) subsets	148
6.3	AD patient naming across category on easy (left) and difficult (right) subsets of the HIT	154
7.1	Screenshots of the word-picture matching stimuli presented in colour, greyscale,	170
7 2	Longitudinal control naming profile across category	1/0
7.2	Longitudinal patient naming profile across category	180
7.4	Control performance on the word-picture matching task across time and across category	181
7.5	AD patient performance over time and category on the word-picture matching task	186
7.6	Comparison of control performance across time and category on the similar picture sorting by subcategory tasks	188
7.7	Comparison of patient performance across time and category on the similar (left) and dissimilar (right) picture sorting by subcategory tasks	190
7.8	Comparison of control performance across time and category on the functional (left) and visual (right) picture sorting within subcategory tasks.	192
7.9	Influence of format on control performance across subcategory on the functional (left) and visual (right) picture sorting within subcategory tasks	193
7.10	(collapsed across time and format)	195
7.11	Comparison of patient performance across time and category on the functional (left) and visual (right) picture sorting within subcategory tasks	196
7.12	Patient performance across subcategory on the visual and functional tasks (collapsed across time and format)	197
8.1	AD patient performance on the HIT (left) and SV (right) across category and	214
8.2	Control performance on the HIT (left) and SV (right) stimuli sets, across category and format	214
0.1		217
9.1	Effect sizes showing the difference between living and nonliving things for patients across the SV (left) and non-SV (right) studies included in the meta- analysis	222
9.2	Effect sizes showing the difference between living and nonliving things for controls across the SV (left) and non-SV (right) studies included in the meta-	233
9.3	analysis Effect sizes for living things for the SV (left) and non-SV (right) studies included	233
	in the meta-analysis	235
9.4	Effect sizes for nonliving things for the SV (left) and non-SV (right) studies included in the meta-analysis	235
10.1	Example of the potential effects of comparing AD patients to controls using line- drawn (left) and colour (right) stimuli	247