About face!
Reversing the Processing Shift Supports a Transfer-Inappropriate Processing Account of Overshadowing Recognition.

Thea Stefanie Vanags

A thesis submitted for the degree of Doctor of Philosophy of the Australian National University.

March, 2008
A short title

Resolving the Processing Shift Support and Transfer

Prefatory Processing Account

Overshadowing Recognition

The Staging Vantage

A thesis submitted for the degree of Doctor of

Philosophy of the Australian National University

March 2002
Declaration

I declare that this thesis represents my original work, that no part has been previously accepted and presented for the award of any degree or diploma from any university, and that, to the best of my knowledge, no material published or written by any person is included, except where due acknowledgement is given.

Thea Stefanie Vanags
Acknowledgements

Firstly, I would like to thank my husband Ed for supporting me in every way with his wonderful sense of humour, his cooking, his love, his encouragement, and his constant belief in my ability to see this project through and produce the inevitable thesis. Thank you, Ed, you have been amazing. I could not have done this without you. I would like to thank my family, Dave, Tanya, Jay and Baby Vanags (BV2) as well. Your support has been unwavering. To my little nephew Jay and to BV2, I hope this inspires you to go as far in your education as you can.

To my supervisor, Professor Marie Carroll, you are simply the best. Thank you for the encouragement, the laughs and celebrations when I finally got a significant result, and your professionalism and dedication to your students. You inspire me. I hope to be as great a supervisor as you one day.

To Dr Elinor McKone and Dr Michael Cook, my panel members, thank you for your constant support in what felt like an interminable battle to produce results. Your guidance, commitment, professionalism and refusal to give up on my topic are greatly appreciated. To the cognitive group, Kristen, Mark, Cobie, Judy, Alison and Kate - thank you for just being around to listen. A special thanks to Emina, John G, Anthony and Al for being such fabulous roommates. Thank you for your support and for sharing the long PhD journey with me. Al, thank you for being a stats genius who answers emails promptly and never makes me feel inadequate.

To my dear friends - Kerry, Mands, Phoebe, Rach, Caz, Megan, and Liana - how would I have stayed sane without you? You have been an amazing support, and I appreciate everything you have done to help me along the way. Kerry, thank you for being such a great friend and being so supportive during the PhD journey. To Di and Lorraine and Rohan and Rebecca – thank you for Fridays at Sammy’s and biking expeditions that kept me so exhausted I didn’t have the energy to think about my thesis. Your encouragement has been invaluable. Tim, thank you for your positive outlook on life. It has been great to come to work on a Monday, after a long weekend working on the thesis, and be infected with your enthusiasm and joie de vivre. I look forward to exploring verbal overshadowing from a PCT perspective.
My thanks as well to the people who rarely get mentioned – to Dr Craig McGarty for giving me the opportunity to do the PhD, to the ANU for financially supporting me, to Mary, Shane, Petrina and Girish, and Caroline, Jen and Kate Hogan. My thanks also to Nicola Weston for being a long-distance email buddy who just understood the whole processing shift thing! Thank you also to Dr Nic Cherbuin for the use of his fTMT equipment.

I also want to thank Professor Debra Rickwood and Dr Judith Anson from the Faculty of Health at the University of Canberra for affording me the time to complete writing up the thesis after starting work there. Your support has made this task so much easier, and is very much appreciated. Thank you.

Finally, but importantly, I would like to thank all my participants. In the end, there were over 1,000 of you who came along and gave me your time, your energy and your thoughts. Although not all the data ended up in this thesis, all my learning did; I learnt so much from you. Without you, this thesis would not exist. Thank you.
Abstract

Verbal overshadowing is the impairment in subsequent recognition that occurs as a result of generating a detailed description of an unfamiliar face. This study sought to test the Transfer-Inappropriate Processing Shift (TIPS) hypothesis of verbal overshadowing by reversing the direction of the processing shift in order to determine whether recognition impairment would be similar to that produced in the standard verbal overshadowing paradigm. In the first four experiments, participants learned a single face and undertook a global Navon, local Navon or control task during the period between encoding and recognition. In Experiment 1, the encoding and recognition stimuli were identical, and the local Navon group unexpectedly performed better than the global Navon group. In Experiment 2, with non-identical encoding and recognition stimuli, there was no difference between groups, and the standard processing shift was not evident. In Experiment 3, the face stimuli from Experiment 2 were combined with a set of equally salient Navon letters and the global group outperformed the local group at recognition; this experiment replicated the standard processing shift. In Experiment 4, the identical encoding and recognition stimuli from Experiment 1 were used with the equally salient Navon letters from Experiment 3. The result was impaired recognition for the global Navon group, showing that the direction of the processing shift can be reversed successfully. The results indicate that a shift from either holistic to featural or featural to holistic can impair recognition of the same stimuli. An aberrant finding of poor identification by the control group in Experiment 3 led to the hypothesis that impaired recognition can occur without a processing shift if encoding and recognition task demands result in different forms of processing. The study also investigated the proposal that the processing shift may result from competition between left and right hemispheres of the brain. Experiments 1, 3 and 4 were replicated with tympanic membrane temperature (TMT) recordings during cognitive tasks. Previous research indicates that TMT of the ipsilateral ear decreases when activation of that hemisphere increases. The TMT results for these experiments showed significant left hemisphere activation during the standard and reversed processing shift experiments for all groups, but no right hemisphere asymmetry for the global Navon group. TMT was also recorded for a standard verbal overshadowing experiment, but no hemispheric asymmetry was evident for any interpolated tasks. It was concluded that there was no evidence from these experiments for the processing shift originating in left-right hemisphere
competition. Finally, a serendipitous finding led to the conclusion that understanding the theoretical explanations of the phenomenon, and being knowledgeable about the procedures involved in verbal overshadowing experiments, can release participants from its effect without prejudicing description quality. The results of all experiments are discussed in relation to the TIPS hypothesis.
1. INTRODUCTION

1.1 Verbal Overshadowing: What We Know So Far

Dual Codes
The Recoding Interference (RI) Hypothesis
The Description-Identification Correlation
Expertise and Style of Face Processing
The Transfer-Inappropriate Processing Shift (TIPS) Hypothesis
The Effect of the Control Tasks on Processing Strategy

1.2 The Structure of the Thesis

1.3 Summary

2. REVERSING THE PROCESSING SHIFT IN THE OVERSHADOWING PARADIGM

2.1 Methodological Considerations for Reversing the Processing Shift

Inducing a Shift from Featural to Holistic Processing
Featurally-Encoded Stimuli
Choice of Control Task
Cognitive Style
Lineup Format

2.2 Experiment 1

Method
Results
Discussion

2.3 Experiment 2

Method
Results
Discussion

2.4 Summary of Experiments 1 and 2

2.5 Experiment 3
3. LOOKING FOR EVIDENCE OF THE ORIGINS OF THE PROCESSING SHIFT

3.1 Functional Tympanic Membrane Thermometry (fTMT) .........102
3.2 Re-Running Experiments 1, 3 and 4 from Chapter 2 .............104
3.3 Experiment 5 ..............................................................................106
   Method .......................................................................................106
   Results .....................................................................................110
   Discussion ..................................................................................125
3.4 Experiment 6 ..............................................................................129
   Method .......................................................................................129
   Results .....................................................................................131
   Discussion ..................................................................................143
3.5 Experiment 7 – Reversed TIPS Experiment with TMT .............146
   Method .......................................................................................147
   Results .....................................................................................149
   Discussion ..................................................................................161
3.6 General Discussion ....................................................................164
3.7 Summary ....................................................................................165
4. VERBAL OVERSHADOWING AND HEMISPHERIC ACTIVATION

4.1 Experiments

A Typical Verbal Overshadowing Experiment
Processing Shifts
Method
Results
Discussion

4.2 Summary

5. A SERENDIPITOUS FINDING

5.1 Experiment 9 – Non-Naïve Participants
Method
Results
Discussion

5.2 Summary

6. GENERAL DISCUSSION

6.1 Featural or Holistic?
6.2 Processing Shift or Task Demands?
6.3 Origin of the Processing Shift?
6.4 Conclusion

REFERENCES

APPENDIX A

A.1 Navon letter sheet
A.2 Control Task Sample Photographs
A.3 Control Task Photo Rating Sheet
A.4 Lineup Sheet for Sequential Lineup
A.5 Demographic Cover Sheet
A.7 Encoding and Test Stimuli for Verbal Overshadowing Studies
A.8 Control Reading Aloud Task
Table 1.1 Control Tasks for Published Verbal Overshadowing Studies
Table 2.1 Experiment 1: Experimental Condition and Cell Sizes
Table 2.2 Experiment 1: Correct and Incorrect Responses for Scrambled Faces by Condition
Table 2.3 Confidence/Accuracy Scores for Face Ratings
Table 2.4 Experiment 1: Discrimination Ratings for Scrambled Faces by Condition
Table 2.5 Experiment 1: Correct and Incorrect Responses for Normal Faces by Condition
Table 2.6 Experiment 1: Discrimination Ratings for Normal Faces by Condition
Table 2.7 Experiment 2: Correct and Incorrect Responses by Condition
Table 2.8 Experiment 2: Discrimination Ratings by Condition
Table 2.9 Experiment 3: Correct and Incorrect Responses by Condition
Table 2.10 Experiment 4: Correct and Incorrect Responses by Condition
Table 3.1 Experiment 5: Correct and Incorrect Responses by Condition
Table 3.2 Experiments 1 and 5: Correct and Incorrect Responses by Condition
Table 3.3 Mapping of Time Labels to Activities
Table 3.4 Experiment 5: Multivariate and Between-Subject Statistics for Baseline Period (N=19)
Table 3.5 Experiment 5: Planned Comparisons for Time 1 and Time 2 for Each TMT for Each Condition
Table 3.6 Experiment 5: Mean TMT Readings for Time 2 and Time 3 for each Condition
Table 3.7 Experiment 5: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition
### Table 3.8 Experiment 5: Summary of Hemispheric Activation for Each Condition and Phase

<table>
<thead>
<tr>
<th>Table 3.8</th>
<th>Experiment 5: Summary of Hemispheric Activation for Each Condition and Phase</th>
<th>128</th>
</tr>
</thead>
</table>

### Table 3.9 Experiment 6: Multivariate and Between-Subject Statistics for Baseline Period (N=22)

<table>
<thead>
<tr>
<th>Table 3.9</th>
<th>Experiment 6: Multivariate and Between-Subject Statistics for Baseline Period (N=22)</th>
<th>133</th>
</tr>
</thead>
</table>

### Table 3.10 Experiment 6: Multivariate and Between-Subjects Statistics for Navon and Control Tasks (N=22)

<table>
<thead>
<tr>
<th>Table 3.10</th>
<th>Experiment 6: Multivariate and Between-Subjects Statistics for Navon and Control Tasks (N=22)</th>
<th>136</th>
</tr>
</thead>
</table>

### Table 3.11 Experiment 6: Mean TMT Readings for Time 1 and Time 2 for each Condition

<table>
<thead>
<tr>
<th>Table 3.11</th>
<th>Experiment 6: Mean TMT Readings for Time 1 and Time 2 for each Condition</th>
<th>138</th>
</tr>
</thead>
</table>

### Table 3.12 Experiment 6: Mean TMT Readings for Time 2 and Time 3 for each Condition

<table>
<thead>
<tr>
<th>Table 3.12</th>
<th>Experiment 6: Mean TMT Readings for Time 2 and Time 3 for each Condition</th>
<th>141</th>
</tr>
</thead>
</table>

### Table 3.13 Experiment 6: Multivariate and Between-Subject Statistics for Lineup Tasks (N=22)

<table>
<thead>
<tr>
<th>Table 3.13</th>
<th>Experiment 6: Multivariate and Between-Subject Statistics for Lineup Tasks (N=22)</th>
<th>141</th>
</tr>
</thead>
</table>

### Table 3.14 Experiment 6: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition

<table>
<thead>
<tr>
<th>Table 3.14</th>
<th>Experiment 6: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition</th>
<th>142</th>
</tr>
</thead>
</table>

### Table 3.15 Experiments 5 and 6: Summary of Hemispheric Activation for Each Condition and Phase

<table>
<thead>
<tr>
<th>Table 3.15</th>
<th>Experiments 5 and 6: Summary of Hemispheric Activation for Each Condition and Phase</th>
<th>145</th>
</tr>
</thead>
</table>

### Table 3.16 Experiment 7: Multivariate and Between-Subjects (Experiment) Statistics for Navon and Control Tasks (N=44)

<table>
<thead>
<tr>
<th>Table 3.16</th>
<th>Experiment 7: Multivariate and Between-Subjects (Experiment) Statistics for Navon and Control Tasks (N=44)</th>
<th>153</th>
</tr>
</thead>
</table>

### Table 3.17 Experiment 7: Multivariate and Between-Subjects (Condition) Statistics for Navon and Control Tasks (N=44)

<table>
<thead>
<tr>
<th>Table 3.17</th>
<th>Experiment 7: Multivariate and Between-Subjects (Condition) Statistics for Navon and Control Tasks (N=44)</th>
<th>154</th>
</tr>
</thead>
</table>

### Table 3.18 Experiment 7: Mean TMT Readings for Time 1 and Time 2 for each Condition

<table>
<thead>
<tr>
<th>Table 3.18</th>
<th>Experiment 7: Mean TMT Readings for Time 1 and Time 2 for each Condition</th>
<th>154</th>
</tr>
</thead>
</table>

### Table 3.19 Experiment 7: Mean TMT Readings for Time 2 and Time 3 for each Condition

<table>
<thead>
<tr>
<th>Table 3.19</th>
<th>Experiment 7: Mean TMT Readings for Time 2 and Time 3 for each Condition</th>
<th>160</th>
</tr>
</thead>
</table>

### Table 3.20 Experiment 7: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition

<table>
<thead>
<tr>
<th>Table 3.20</th>
<th>Experiment 7: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition</th>
<th>161</th>
</tr>
</thead>
</table>

### Table 3.21 Experiments 5, 6 and 7: Summary of Hemispheric Activation for Each Condition and Phase

<table>
<thead>
<tr>
<th>Table 3.21</th>
<th>Experiments 5, 6 and 7: Summary of Hemispheric Activation for Each Condition and Phase</th>
<th>163</th>
</tr>
</thead>
</table>

### Table 4.1 Experiment 8: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th>Table 4.1</th>
<th>Experiment 8: Correct and Incorrect Responses by Condition</th>
<th>175</th>
</tr>
</thead>
</table>

### Table 4.2 Experiment 8: Mapping of Time Labels to Activities

<table>
<thead>
<tr>
<th>Table 4.2</th>
<th>Experiment 8: Mapping of Time Labels to Activities</th>
<th>176</th>
</tr>
</thead>
</table>
Table 4.3 Experiment 8: Multivariate and Between-Subject Statistics for Crossword Task for Verbalisation and Control Groups (N=14)......179

Table 4.4 Experiment 8: Mean TMT Readings for Time 1 and Time 2 for each Condition.................................................................181

Table 4.5 Experiment 8: Multivariate and Between-Subject Statistics for Verbalisation and Control Tasks (N=14).................................182

Table 4.6 Experiment 8: Mean TMT Readings for Time 2 and Time 3 for each Condition.................................................................183

Table 4.7 Experiment 8: Planned Comparisons for Time 2 and Time 3 for Each TMT for Each Condition...............................................186

Table 4.8 Experiment 8: Multivariate and Between-Subject Statistics for Lineup Instructions Period (N=14).............................................189

Table 4.9 Experiment 8: Mean TMT Readings for Time 3 and Time 4 for each Condition.................................................................190

Table 4.10 Experiment 8: Multivariate and Between-Subject Statistics for Lineup Tasks (N=14).........................................................191

Table 4.11 Experiment 8: Mean TMT Readings for Time 4 and Time 5 for each Condition.................................................................191

Table 5.1 Experiment 9: Correct and Incorrect Responses by Condition ....200

Table 5.2 Experiment 9: Correct and Incorrect Responses by Condition for Naive and Non-Naive Participants.................................201

Table 5.3 Experiment 9: Discrimination Ratings by Condition for Naive and Non-Naive Participants....................................................203

Table 5.4 Experiment 9: Descriptors for Naive and Non-Naive Conditions ....205

Table 5.5 Experiment 9: Correlations between Dependent Variables........206

Table 5.6 Experiment 9: Misses by Condition for Naive and Non-Naive Participants.................................................................206
## TABLE OF FIGURES

**Figure 2.1.** Impairing recognition by reversing the direction of the processing shift.................................................................................................................. 43

**Figure 2.2.** Navon letter ........................................................................................................................................................................................................... 45

**Figure 2.3.** Experiment 1: Target and lineup of normal faces. .......................................................... 53

**Figure 2.4.** Experiment 1: Target and lineup of scrambled faces. .................................................. 54

**Figure 2.5.** Pair of complex geometric figures from the CSA program. ................................. 56

**Figure 2.6.** A simple and complex geometric figure from the CSA program. ............................. 57

**Figure 2.7.** Experiment 1: Scrambled faces cognitive style distribution. ................................. 61

**Figure 2.8.** Experiment 1: Normal faces cognitive style distribution............................... 64

**Figure 2.9.** Experiment 2: Encoding and test views of target face. ...................................... 71

**Figure 2.10.** Experiment 2: Target and lineup of head-and-shoulder faces......................... 71

**Figure 2.11.** Experiment 2: Cognitive style distribution. ....................................................... 74

**Figure 2.12.** Original Navon letter format (left) and Experiment 2 Navon letter (right)....................................................................................................................................................... 76

**Figure 2.13.** Navon letter showing distorted edges. ................................................................. 78

**Figure 2.14.** Experiment 3: Target and lineup head-and-shoulder faces............................. 83

**Figure 2.15.** Experiment 3: Equally salient Navon letter. ..................................................... 84

**Figure 2.16.** Experiment 3: Target and lineup oval cut-out faces....................................... 92

**Figure 3.1.** Ear probe inserted in participant’s ear, and helmet and flexible arms holding the ear probes. (Reproduced with the permission of N. Cherbuin). ........................................................................................................ 104

**Figure 3.2.** fTMT computer program recording tympanic membrane temperatures. ............................................................... 105

**Figure 3.3.** Experiment 5: Target and lineup oval cut-out faces....................................... 108

**Figure 3.4.** Locally-salient Navon letter. .................................................................................. 108

**Figure 3.5.** Experiment 5: fTMT data for baseline period................................................. 114
Figure 3.6. Experiment 5: fTMT data for local Navon participants.........115
Figure 3.7. Experiment 5: fTMT data for global Navon participants.........115
Figure 3.8. Experiment 5: fTMT data for control participants...............115
Figure 3.9. Experiment 5: Right TMT data for control and Navon conditions.121
Figure 3.10. Experiment 5: Left TMT data for control and Navon conditions.122
Figure 3.11. Experiment 6: Target and lineup head-and-shoulder faces.......130
Figure 3.12. Experiment 6: Equally salient Navon letter..........................131
Figure 3.13. Experiment 6: fTMT data for baseline period......................133
Figure 3.14. Experiment 6: fTMT data for local Navon participants..........135
Figure 3.15. Experiment 6: fTMT data for global Navon participants.........135
Figure 3.16. Experiment 6: fTMT data for control participants...............135
Figure 3.17. Experiment 6: fTMT data for local Navon task only...............137
Figure 3.18. Experiment 6: fTMT data for global Navon task only.............137
Figure 3.19. Experiment 6: fTMT data for control task only....................137
Figure 3.20. Experiment 6: Right TMT data for control and Navon conditions.
.................................................................139
Figure 3.21. Experiment 6: Left TMT data for control and Navon conditions.140
Figure 3.22. Experiment 7: Target and lineup oval cut-out faces...............148
Figure 3.23. Experiment 7: Equally salient Navon letter..........................148
Figure 3.24. Experiment 7: fTMT data for local Navon participants..........152
Figure 3.25. Experiment 7: fTMT data for global Navon participants.........152
Figure 3.26. Experiment 7: fTMT data for control participants...............152
Figure 3.27. Experiment 7: fTMT data for local Navon task only...............156
Figure 3.28. Experiment 7: fTMT data for Global Navon task only..............156
Figure 3.29. Experiment 7: fTMT data for control task only....................156
Figure 3.30. Experiment 7: Right TMT data for control and Navon conditions.
........................................................................................................158
Figure 3.31. Experiment 7: Left TMT data for control and Navon conditions.159
Figure 4.1. The typical verbal overshadowing study format. .................................. 169

Figure 4.2. Experiment 8: Target and lineup head-and-shoulder faces. ........... 172

Figure 4.3. Experiment 6: fTMT data for control participants. ...................... 178

Figure 4.4. Experiment 6: fTMT data for verbalisation participants.............. 178

Figure 4.5. Experiment 8: fTMT data for crossword task (Control group). .... 180

Figure 4.6. Experiment 8: fTMT data for crossword task only (Verbalisation group). .............................................................................................................. 180

Figure 4.7. Experiment 8: fTMT data for control task. ............................... 184

Figure 4.8. Experiment 8: fTMT data for verbalisation task. ....................... 184

Figure 4.9. Experiment 8: Right TMT data for control and verbalisation conditions. .............................................................................................................. 187

Figure 4.10. Experiment 8: Left TMT data for control and Navon conditions. 188

Figure 5.1. Experiment 9: Head-and-shoulder faces .................................... 199

Figure 5.2. Experiment 9: Percent correct for naïve and non-naïve participants by condition.......................................................... 202

Figure 5.3. Experiment 9: Discrimination ratings for naïve and non-naïve participants ................................................................. 203

Figure 5.4. Experiment 9: Interaction for naïve and non-naïve participants in each condition rejecting the lineup. ....................... 208

Figure 6.1. Transfer-inappropriate processing shift or transfer-inappropriate processing strategy? .......................................................... 221

Figure 6.2. Experiment 4 (reversed processing shift) results in terms of processing strategy......................................................... 223

Figure 6.3. Experiment 3 (Macrae and Lewis replication) results in terms of processing strategy......................................................... 224

Figure 6.4. Experiment 6: fTMT data for a single participant who was distracted. ......................................................................................... 266
INTRODUCTION

Verbal overshadowing was identified by Schooler and Engstler-Schooler (1990) in a series of experiments which showed that describing an unfamiliar face could impair subsequent recognition of that face. The phenomenon is of major importance in a forensic context as eyewitnesses are invariably asked to give a description of the person they saw committing the crime prior to identifying that person in a lineup (Brigham, Wasserman, & Meissner, 1999). If describing the face of the perpetrator can impair a witness’s subsequent ability to recognise that person then understanding the processes underlying that phenomenon might help mitigate its effects.

After seventeen years of research, the question of what underlies verbal overshadowing is still unanswered. Two quite different theories have been proposed: the recoding interference (RI) hypothesis, proposed first, and the subsequent transfer-inappropriate processing shift (TIPS) hypothesis. According to the RI hypothesis, the inaccurate content of the verbal description is responsible for the subsequent misidentification because it “interferes” with the more accurate visual memory of the face. Research published as recently as 2002 (Meissner, 2002; Meissner, Brigham, & Kelley, 2001) suggests this explanation has some merit. However, a growing number of results defy explanation by the RI account. In particular, describing a face other than the target face impairs recognition (Brown & Lloyd-Jones, 2002a; Dodson, Johnson, & Schooler, 1997; Westerman & Larsen, 1997). This suggests that investigation of the cause of the phenomenon needs to focus on the alternative TIPS hypothesis.

In a typical verbal overshadowing experiment, a delay separates the acquisition of a target stimulus from a recognition test. During the delay, the experimental group is given an interpolated task (in the paradigmatic version of the procedure, the task is to describe the target), while a control group performs a “neutral task”). Verbal overshadowing occurs when target recognition is poorer in the experimental than the control group. The target stimulus is most commonly a face (either a video or photograph of the target person), but non-visual targets has been used in variants of the procedure. While the most frequent interpolated task is to describe the target, other verbal tasks and some non-verbal tasks have been used to investigate the cause of the verbal overshadowing effect.

According to the TIPS hypothesis, when the processing strategy adopted at retrieval does not match the strategy used at encoding, recognition is impaired. The
inappropriate recognition strategy is presumed to be induced by, and carried over from, the interpolated task. This explanation appears to account for all verbal overshadowing findings to-date. Furthermore, it can be used to explain findings of studies closely related to the phenomenon, such as those which show face recognition can be impaired by replacing the verbalisation task with a seemingly irrelevant cognitive task, for instance, a local Navon letter recognition task (Macrae & Lewis, 2002; Perfect, 2003; Weston & Perfect, 2005).

If a processing shift is responsible for the impaired recognition associated with the verbal overshadowing phenomenon, then reversing the direction of that processing shift should also result in poorer identification. *If inducing a featural processing strategy impairs recognition of holistically processed stimuli because the encoding and retrieval strategies do not match, then inducing a holistic processing strategy should also impair recognition of featurally processed stimuli.* If such a reversed processing shift leads to recognition impairment, this would provide strong support for the TIPS hypothesis. The research reported in this thesis shows that reversing the direction of the processing shift does indeed impair face recognition when the target faces are highly suited to featural processing. This result supports the processing-shift explanation of verbal overshadowing.

Another issue that requires investigation with regard to the TIPS hypothesis is the nature of the processing strategy at retrieval used by the control group. If an explanation of verbal overshadowing is based on the premise that those who engage in a verbalisation task experience a shift from one form of processing to another, then an implicit assumption is that the interpolated task given to the control group does not induce a processing shift. The processing done by the control group needs to be adequately accounted for in any examination of the TIPS hypothesis. The study reported in this thesis sought converging evidence for the assumption that control tasks do not produce a processing shift.

How do we confirm the presence of the hypothesised processing shifts in the experimental group? One approach uses behavioural evidence based on manipulations of the verbal overshadowing paradigm. Alternatively, we might seek direct psychophysiological evidence. The research to be reported in later chapters examined the TIPS explanation of verbal overshadowing by attempting to reverse the direction of the processing shift. It also sought converging evidence of processing shifts by measuring hemispheric activation during cognitive tasks routinely undertaken in verbal
overshadowing studies. Schooler (2002) proposed that the activation of one type of processing over another is the result of competition between brain regions, for example left and right hemispheres. If that is the case, simple psychophysiological measures could identify processing shifts. Language operations have been linked primarily to left hemisphere processes (e.g., Evans & Federmeier, 2007; Hellige, 2001; Hunter & Brysbaert, in press; Kelley et al., 1998; Springer & Deutsch, 1993) while memory for non-verbal, visuo-spatial and face processing have been shown to be associated with right hemisphere processes (e.g., Blanchet et al., 2001; Golby et al., 2001; Hellige, 2001; Kelley et al., 1998). Schooler drew a parallel to the TIPS hypothesis; stimuli susceptible to verbal overshadowing rely on covert, right hemisphere processes, particularly those used in face recognition tasks (e.g., Lee, Simos, Sawrie, Martin, & Knowlton, 2005; Schiltz et al., 2006; Turk, Handy, & Gazzaniga, 2005), whereas describing a face entails language and the reportable processes associated with the left hemisphere. If Schooler is correct, and the verbalisation task engages the left hemisphere while the control and face recognition tasks engage the right, this should be reflected in appropriate psychophysiological measures.

The present study used functional tympanic membrane thermometry (fTMT) (Cherbuin & Brinkman, 2004, 2007) for this purpose. This technique measures tympanic membrane temperature (TMT) via infrared thermometers. TMT has been shown to be a reliable index of hemispheric activation in cognitive activities such as letter-matching tasks which activate the left hemisphere, and mental cube-folding tasks, which activate the right hemisphere (Cherbuin & Brinkman, 2004, 2007). In particular, the technique was used to explore Schooler’s suggestion that the processing shift in verbal overshadowing experiments could be the result of competition between left and right hemisphere brain regions.

As a background to the experiments to be reported in later Chapters, the next section reviews the literature relating to a number of issues concerning both verbal overshadowing and the methodology used in the experiments.
1.1 Verbal Overshadowing: What We Know So Far

Before Schooler and Engstler-Schooler’s (1990) empirical study demonstrating verbal overshadowing, memory research had shown that verbal rehearsal and verbal elaboration generally improved long-term memory. However, the Schooler and Engstler-Schooler study indicated that this may not always be true, particularly when the memory is for non-verbal material such as faces. They repeatedly found that participants who generated a description of an unfamiliar face were poorer at recognising that face than participants who did not.

Schooler and Engstler-Schooler (1990) observed that much of the previous research into memory performance had used verbal stimuli which were well suited to verbal rehearsal and elaboration. In contrast, their stimuli (faces and colours) did not lend themselves easily to verbal description. They hypothesised that verbal rehearsal or elaboration would be effective in strengthening recognition ability only when a stimulus is easily translated into words, and not when it is difficult to generate an accurate or complete linguistic description of that stimulus, particularly when the purpose of the description is to discriminate it from distractors. Later investigations supported this contention as verbal overshadowing studies continued to show verbalisation adversely affects face recognition (Brown & Lloyd-Jones, 2002a; Dodson et al., 1997; Fallshore & Schooler, 1995; Finger, 2002; Finger & Pezdek, 1999; Memon & Bartlett, 2002; Schooler, Ryan, & Reder, 1996; Westerman & Larsen, 1997) colour memory (Schooler & Engstler-Schooler, 1990), affect judgements (Wilson & Schooler, 1991), higher-order cognitive processes such as insight-problem solving (Schooler, Ohlsson, & Brooks, 1993), visuo-spatial stimuli (DeShon, Chan, & Weissbein, 1995), visual images (Pelizzon, Brandimonte, & Luccio, 2002), configural distances (Fiore & Schooler, 2002), voices (Perfect, Hunt, & Harris, 2002), deep-structure memory (Lane & Schooler, 2004), taste (Melcher & Schooler, 1996), and perceptually learnt material (Melcher & Schooler, 2004). In contrast, the type of memory not affected by verbalisation in verbal overshadowing studies has involved material that translates easily into words, for example, verbal tasks (Schooler & Engstler-Schooler, 1990), verbal-analytic stimuli (DeShon et al., 1995), tasks that rely on readily reported knowledge and/or surface-level information (Lane & Schooler, 2004; Schooler et al., 1996), the verbal/analytic processes associated with solving logic problems (Schooler et al., 1993), route map memory (Fiore & Schooler, 2002) and conceptually learnt material (Melcher & Schooler, 2004).

21
Dual Codes

Schooler and Engstler-Schooler (1990) raised the issue of whether impairment resulted from a distortion of the original visual encoding or from reliance in the recognition test on a separate, possibly less accurate, verbal code. They argued that their final experiment suggested the latter, that two separate memory encodings carried through to the recognition test, the original, unaltered visual memory, and a second, verbal recoding of that visual memory. Impaired memory occurs, they contended, due to an over-reliance on the verbal representation, and under-reliance on the visual representation. They asserted that the original visual memory must still be intact because participants with limited recognition time (five seconds) did not show verbal overshadowing. They argued that, with sufficient time, the visual encoding was likely to have been accessed first, and the verbal encoding retrieved subsequently (as suggested in Paivio's dual code theory). When participants had limited time for recognition, they had time only to access their original visual representation, and not the verbal representation which would otherwise be a source of interference.

Brandimonte et al. (1997) and DeShon et al. (1995) also argued for the existence of two concurrent memory codes. They claimed that their findings supported coexisting visual representations of visuo-spatial material and propositional representations of verbal-analytic material in memory. They found that verbal overshadowing resulting from either implicit or explicit verbalisation of easy-to-name and hard-to-name shapes could be attenuated by re-presenting colour cues associated with the target material. They claimed that the original visual encoding is neither distorted nor overwritten. It is simply overshadowed by an implicit or explicit verbal memory. Brandimonte et al. also suggested that although the two memory encodings coexist in independent memory systems (visual and verbal), these systems are interconnected and the translation of information between them can be either beneficial or disruptive to recognition. When retrieval cues are of the same modality as the original memory, they assist in recognition; when they are of a different modality, they interfere with the original memory. This notion is supported by DeShon et al.'s findings that participants who verbalised their thoughts while solving verbal-analytic problems from Raven's Advanced Progressive Matrices (APM) did not show impaired performance. Yet these same participants showed poorer problem-solving ability when verbalising their thoughts on visuo-spatial problems.
The Recoding Interference (RI) Hypothesis

Interference from the verbal encoding was Schooler and Engstler-Schooler’s (1990) original explanation for verbal overshadowing. They suggested that recoding interference was due to a “tendency to rely on a verbally-biased recoding at the expense of the original visual memory” (p. 37). This hypothesis was underpinned by two assumptions: 1) that writing a detailed verbal description of the face would result in a verbal encoding of the original visual memory; and 2) that the verbal recoding would misrepresent the original memory and would cause interference at recognition.

The verbal encoding, they argued, is misrepresentative of the original visual memory because it is difficult to describe accurately stimuli that do not lend themselves easily to verbalisation; people are exceptionally good at recognising faces, but find it difficult either to describe them or to communicate the basis of discrimination of one face from another (Ellis, 1984; Schooler et al., 1993). The information required to discriminate between highly similar faces is configural in nature, representing how their features are positioned relative to one another (Searcy & Bartlett, 1996; Tanaka & Farah, 2003; Tanaka & Sengco, 1997), and it is difficult to put this into words. Instead, when describing a face, people focus on easily verbalised aspects such as the eyes, nose and mouth, and overlook the all-important configural information (Schooler & Engstler-Schooler, 1990). This results in a verbal description biased towards featural information and lacking in the critical configural information. At the time of recognition, Schooler and Engstler-Schooler argued, participants retrieve both memories, and conflicting information from the verbal memory interferes with the original visual memory. This results in poorer recognition.

The Description-Identification Correlation

An RI explanation of verbal overshadowing should be fairly straightforward to test. If verbal overshadowing is the result of interference from a distorted verbal memory, then as Schooler and Engstler-Schooler (1990) suggested, there should be a correlation between the quality of the verbal description and the participant’s recognition performance. An extremely inaccurate description, or one that does not distinguish the target from the distractors in the recognition test, would be expected to produce greater interference and poorer recognition than an accurate description.
Accurate descriptions should produce little disparity between the visual and verbal memories and therefore cause less interference at identification.

However, Schooler and Engstler-Schooler’s (1990) studies failed to show such a correlation in all but two instances. In their Experiment 5, there was a correlation between description quality and recognition accuracy when participants were asked to describe the statement spoken by the robber in the video. The more accurate the participants’ statement descriptions, the more likely they would correctly identify the statement from a lineup of similar statements. Schooler and Engstler-Schooler attributed this to the match in task and stimulus modality; both were verbal. The second description-identification correlation found was in Experiment 2 where the overall number of critical features attempted in the description (both accurate and inaccurate) predicted identification of the target face. Participants who attempted to describe a greater number of features were less likely to identify the face than those who attempted to describe fewer features.

This last relationship has been found in other studies. A correlation exists between the length of the description and recognition accuracy rather than description accuracy and identification (Finger & Pezdek, 1999, Exp 1; Schooler & Engstler-Schooler, 1990), suggesting that the actual content of the description may be immaterial. This finding appears puzzling. However, it is notable that the description-identification relationship is typically evident only when data are collapsed across different instruction conditions (Finger & Pezdek, 1999; Meissner et al., 2001). The correlation is usually not found for individual conditions. For example, in Finger and Pezdek’s (1999, Exp 1) study, the correlation was apparent only when they collapsed data across the verbal overshadowing condition (a partial cognitive interview) and non-overshadowing condition (participants were asked to describe the face). Although participants in the overshadowing condition performed more poorly on identification than those in the non-overshadowing condition, no description-identification correlation was evident for that group alone. However, combining the conditions produced a relationship between misidentification and longer descriptions with a greater number of both correct and incorrect details.

The fact that this relationship is only discernible when data are collapsed over both conditions poses a conundrum for the RI hypothesis. In Finger and Pezdek’s study, verbal overshadowing was evidenced by the poor performance of the cognitive interview group. Yet, the description-identification relationship predicted by RI was
manifest only when the data from those not experiencing verbal overshadowing were included in the analysis. The implication is that the relationship was present for both groups; however, the RI hypothesis implies that it should exist for the verbal overshadowing condition alone, something this and other studies have failed to show (Brown & Lloyd-Jones, 2002a; Fallshore & Schooler, 1995; Finger, 2002; Kitagami, Sato, & Yoshikawa, 2002; Lyle & Johnson, 2004; Wickham & Swift, 2006). Of course, the absence of significant correlations for individual conditions may indicate the correlations are weak and may only be evident with larger sample sizes. Alternatively, the correlations in the pooled data may be an artefact of differences between mean values of the two variables across subgroups.

Finger and Pezdek (1999) accounted for their findings by suggesting that impaired recognition was due to retroactive interference. The verbal encoding, they claimed, was more salient during recognition than the visual encoding because recognition was more recent. They proposed that if a similar time elapsed between describing the face and attempting recognition, the verbal encoding would be less salient and participants would rely on it to a lesser extent. Participants could then compare the lineup faces to their original visual memory rather than the verbal memory. By introducing a 24-minute or 1-hour delay between description and identification phases, Finger and Pezdek were able to show exactly that - a lack of verbal overshadowing, and consequently no description-identification relationship.

While many verbal overshadowing studies have not been able to demonstrate a direct inverse relationship between the number of incorrect features and accuracy of identification, this is not true for Meissner et al. (2001). By manipulating description instructions, they were able to show a correlation between the number of incorrect items and recognition accuracy. Participants in the warning-recall condition were told that accuracy of reporting was important for recognition and that they should only recall details of which they were confident. Participants in the forced-recall condition were encouraged to keep recalling details past the point of free recall, and participants in the free-recall condition were given no instructions. Participants in both the free-recall and forced-recall conditions generated significantly less accurate descriptions than those in the warning condition, and when data was combined across conditions, description accuracy and identification were correlated. In a second study, Meissner (2002) found that participants in the forced recall condition produced significantly less accurate descriptions than those in either the warning or free-recall conditions. In both studies,
description accuracy predicted identification performance primarily through incorrect details being associated with misidentification. Meissner argued that the verbal memory representation is a distortion of the visual memory because participants who are asked to keep generating a description of the face past the point of free recall lower their response criterion and produce consistently greater numbers of incorrect (and correct) descriptors in the description.

Clare and Lewandowsky (2004) favoured a slightly different response-criterion explanation of verbal overshadowing. They argued that participants are likely to be uncertain about their ability to generate a verbal description of a face, because the task is difficult and they have no benchmark against which to judge their ability. They suggested that a lack of belief in the ability to do the description task results in a reluctance to choose a face from the lineup, and hence, provision of a “not-present” response allows participants to opt out of making a choice; they increase the stringency of their response criterion, and they choose not to select a face from the lineup unless they are very sure it is the target face. Clare and Lewandowsky argued that in optional-choice lineups, correct identifications decrease because participants can reject the entire lineup. In contrast, participants given a forced-choice lineup must adopt a more liberal response criterion. They argue that verbal overshadowing is more likely to occur when participants use a stringent response criterion than when they adopt a liberal one. While their results support their argument, Clare and Lewandowsky do not explain why verbal overshadowing is sometimes found in forced-choice lineup studies (e.g., Fallshore & Schooler, 1995; Perfect et al., 2002; Ryan & Schooler, 1998; Schooler & Engstler-Schooler, 1990, Exp 6) and studies that manipulated response criterion levels (Lane & Schooler, 2004; Schooler & Engstler-Schooler, 1990) except to say that these studies use elaborative description instructions and that such instructions evoke a qualitatively different manifestation of verbal overshadowing.

The notion that elaborative instructions result in description errors is consistent with Ericsson’s (2002) suggestion that impaired recognition in verbal overshadowing studies is the result of requiring detailed, non-spontaneous descriptions which result in new or altered thoughts and memories which are not necessarily accurate. While this appears plausible, the problem is that only Meissner (2002) and his colleagues (Meissner et al., 2001) have been able to provide supporting evidence. They are the only researchers to consistently show a correlation between description accuracy and recognition performance. Most verbal overshadowing studies have found either no
relationship between description quality and recognition (e.g., Brown & Lloyd-Jones, 2002a; Fallshore & Schooler, 1995; Finger, 2002; Kitagami et al., 2002; Lyle & Johnson, 2004; Wickham & Swift, 2006), or a correlation between identification performance and the length, rather than the accuracy, of the description (Finger & Pezdek, 1999, Exp 1; Schooler & Engstler-Schooler, 1990). This suggests that it may be the length of the verbalisation activity, rather than its specific content, that impairs recognition performance. This is not inconsistent with the finding in Meissner and Brigham’s (2001) meta-analysis that elaborative description instructions are more likely to produce verbal overshadowing than free-recall instructions.

Other studies have challenged the role of description misinformation as the sole explanation of verbal overshadowing. For example, Fallshore and Schooler (1995) found verbal overshadowing when participants described own-race faces, but not when they described other-race faces. The verbal descriptions of own- and other-race faces were similarly inaccurate, yet only own-race face recognition was disrupted by the generation of a verbal description. How can this be reconciled with the RI hypothesis? Similarly, Dodson et al. (1997) found verbal overshadowing when participants described a face of the sex opposite to that of the target face. Why would description content not pertinent to the target face disrupt recognition of that face? In addressing these questions, Fallshore and Schooler (1995) proposed that several factors may influence the type of processing used by participants. For example, inverted faces and other-race faces require a greater degree of featural processing than holistic processing (Michel, Caldara, & Rossion, 2006; Yin, 1969), whereas upright and own-race faces require a higher ratio of holistic than featural processing (Tanaka & Farah, 2003; Tanaka, Kiefer, & Bukach, 2004). It has been suggested also that the holistic processing associated with own-race and upright faces might be the result of expertise individuals possess with faces (Diamond & Carey, 1986). Fallshore and Schooler suggested that these two factors, featural and holistic processing of faces, and the holistic processing associate with expertise, could be important in explaining verbal overshadowing.

**Expertise and Style of Face Processing**

Fallshore and Schooler (1995) suggested that application of perceptual expertise may be vulnerable to demands for verbalisation because people have difficulty articulating their implicit knowledge. To test this, they compared verbalisations about own-race, other-race and inverted faces. They argued that people have high perceptual
expertise with own-race faces involving predominately configural processing (McKone, Martini, & Nakayama, 2003; Tanaka & Sengco, 1997) (although there is evidence to suggest that own-race faces can be processed in both a configural and a featural manner (Cabeza & Kato, 2000; Sergent, 1984; Tanaka & Farah, 1993)). However, this configural information would be omitted from descriptions due to the difficulty of articulating it (Schooler & Engstler-Schooler, 1990). In contrast, people have much less experience recognising other-race or inverted faces, and therefore have low perceptual expertise with these faces. Accordingly, they would engage in less configural processing of other-race faces (e.g., Michel, Caldara et al., 2006; Michel, Rossion, Han, Chung, & Caldara, 2006; Tanaka et al., 2004), and inverted faces (Yin, 1969). That is, other-race and inverted faces would require a greater degree of featural processing.

Furthermore, Fallshore and Schooler argued that the verbalisation task would engage a featural processing strategy. So, for own-race face recognition, requiring expertise and configural processing, the processing style would shift from a configural strategy at encoding to the featural strategy required by the description task. This processing shift would result in poorer recognition because the optimal processing mode, configural processing, would no longer be engaged when participants reached the identification phase. In contrast, since other-race face recognition would require featural processing to a greater extent than configural processing, the featural processing resulting from the description task would not impair recognition.

In keeping with this analysis, Fallshore and Schooler found different effects of verbalisation on own-race, other-race and inverted faces. As with previous verbal overshadowing studies, they found impairment in recognition for own-race faces. In contrast, there was no impairment in recognition by participants who described other-race or inverted faces. If verbal overshadowing is due to recoding interference from inaccurate verbal encodings, then describing own-, other-race or inverted faces should lead to poorer recognition of both types of stimuli as individuals are likely to be equally poor at describing them. However, if verbalisation disrupts the configural processing associated with perceptual expertise, but has little or no effect on the operations associated with featural processing, then the outcomes of Fallshore and Schooler’s study are to be expected.

Nevertheless, Fallshore and Schooler did not discount the possibility that description error played some role in verbal overshadowing. They sought evidence of a description-identification correlation by asking one group of participants (yoked judges)
to identify the target on the basis of descriptions generated by others who had done the experiment previously. For own-race targets there was no relationship between the accuracy of the description and the performance of yoked judges, but a correlation did exist for (featurally processed) other-race and inverted faces. This is consistent with Schooler and Engstler-Schooler’s (1990, Exp 5) findings that when a task involves featural rather than configural processing (statement verbalisation), an accurate description can be helpful for recognition.

Based on their findings, Fallshore and Schooler proposed that the impairment of face recognition after verbalisation may depend on the degree to which individuals use configural processing, and use of configural processing may be mediated by perceptual and verbal expertise with the stimuli. They suggested that if levels of perceptual and verbal expertise were similar, as was the case for other-race faces (verbal and perceptual expertise being low), then verbalisation should not degrade recognition by interfering with the perceptual processes. However, if perceptual expertise was much greater than verbal expertise as in own-race face recognition, recognition would be poor because limited verbal expertise would disrupt the strategies used in tasks calling on greater (perceptual) expertise.

Support for this came from Melcher and Schooler’s (1996) study of verbal overshadowing of taste memory. They used three groups in their study: non-drinkers, who drank red wine less than once a month; social drinkers, who drank red wine at least once a month but had no formal wine training; and wine experts or professionals. The results were consistent with Fallshore and Schooler’s suggestions about verbal and perceptual expertise. Neither non-drinkers with low verbal and perceptual expertise, nor wine experts who had high verbal and perceptual expertise, showed verbal overshadowing. But social drinkers, who had low verbal expertise (no structured vocabulary for describing wine) and high perceptual expertise (drank wine regularly) were affected. Melcher and Schooler argued that when verbalisation strategies are engaged, participants might abandon their reliance on perceptual expertise and focus instead on their verbal description ability; where verbal expertise was inferior to perceptual expertise, as was the case with social drinkers, relying on that verbal expertise would result in poorer identification (Melcher & Schooler, 1996; Ryan & Schooler, 1998).

The notion that disrupting the configural information associated with expertise, which is critical to face identification, can result in verbal overshadowing gained more
support from a study by Schooler et al. (1996) which involved the re-presentation of the target face after verbalisation but before identification. They anticipated that re-presenting the face would allow participants to refresh critical configural information about the face. This apparently occurred since participants who saw the face a second time between the description and identification phases did not show verbal overshadowing. More surprisingly, re-presenting the face did not merely attenuate verbal overshadowing, but reversed the effect. Participants in the verbalisation condition who saw the face twice were significantly better at recognising the face than control participants who also saw the face twice. Schooler et al. suggested that re-presenting the target face does not simply refresh configural information, but also encourages participants to elicit new information from the face. This may have been promoted some way by the prior verbalisation task. Re-presentation after verbalisation may have allowed participants to identify aspects of the face not recorded in their descriptions or had recorded inaccurately. While verbal overshadowing might depend on the extent to which participants spontaneously rely on non-reportable information from the original encoding, they argued, the effect might also depend on whether recognition requires this information. Verbalisation might result in a more general bias towards verbal processing which alters the ratio of configural and featural information used by the participant at recognition. Indeed, Fallshore and Schooler (1995) had already suggested that the effects of a shift in the ratio of configural to featural information used by participants might be analogous to findings regarding transfer-appropriate processes: that memory performance is best when the encoding and test processes are congruent. If participants use predominately configural processing at encoding, and the interpolated task produces a shift towards featural processing, recognition may be impaired because participants are using a less-optimal or even inappropriate featural processing strategy in the recognition test. This explanation of verbal overshadowing became known as the Transfer-Inappropriate Processing Shift hypothesis.

**The Transfer-Inappropriate Processing Shift (TIPS) Hypothesis**

Fallshore and Schooler suggested that a shift between two different forms of processing, configural and featural, might provide an explanation for verbal overshadowing. In line with the hypothesis, initially referred to as “transfer-inappropriate retrieval (TIR)” (Schooler, Fiore, & Brandimonte, 1997), but subsequently known as the “transfer-inappropriate processing shift (TIPS) hypothesis”
Fallshore and Schooler suggested that the interposed verbal description task encourages a featural processing strategy which carries over to the recognition phase. For own-race faces, relying primarily on configural processing, a shift to featural processing results in a less-than-optimal strategy at the time of recognition. In contrast, for other-race and inverted faces, which rely to a greater extent on featural processing (Michel, Caldara et al., 2006), encouraging a featural processing strategy does not affect recognition because a featural processing style is appropriate for those stimuli. On the other hand, for own-race faces (the most commonly used stimuli in verbal overshadowing studies) the processing strategy changes from configural at encoding to featural at retrieval and recognition is impaired.

One advantage of the TIPS account of verbal overshadowing is that a lack of a description-identification correlation is irrelevant. If a processing shift underlies the phenomenon, it is the act of generating the verbal description that induces the effect, and its quality is quite immaterial. In fact, the findings regarding the description-identification correlation are consistent with the TIPS hypothesis because it is the total number of details attempted in the description, both correct and incorrect, that most commonly predicts recognition rather than its accuracy. If a processing shift is responsible for verbal overshadowing, producing more details, whether correct or incorrect, would mean engaging in the verbalisation task for longer, it would not be surprising if this effected a stronger processing shift (Schooler, 2002).

Another important verbal overshadowing outcome that can be accommodated by the TIPS hypothesis, but not the RI explanation, is the finding that generating a description of a face other than the target can still result in verbal overshadowing of the target face. Dodson et al. (1997) gave participants either a male or a female target face to encode and then asked them to describe either someone of the opposite sex or the face of one of their parents. The verbalisation participants performed more poorly than control participants in the recognition test, describing one face resulted in verbal overshadowing of an entirely different face. These findings were unintentionally replicated when Westerman and Larsen (1997) failed to obtain verbal overshadowing in their first experiment because they asked all participants to describe a face. The experimental group was asked to describe the “robber”, and the control group to describe the “victim”. Under the RI account, Westerman and Larsen could have expected the participants who describe the “robber” to experience verbal overshadowing whereas those who described the “victim” should not. But, this did not happen. This is
consistent with the TIPS hypothesis. Furthermore, the recognition rates of 33% (for those who described the “robber”) and 44% (for those who described the “victim”) were well below the level at which a control group would normally be expected to perform, suggesting both groups’ recognition had been impeded by verbalisation.

Further support for the TIPS hypothesis comes from Westerman and Larsen’s (1997) second experiment. They found that describing a car impaired recognition of a target face. That is, describing an item other than a face, albeit one semantically related to the target (both the car and the robber being in the video), induced verbal overshadowing for the target face. And, the lack of verbal overshadowing for the car is consistent with a processing shift account, as it can be attributed to the fact that cars do not have the unusual configural properties of a face. Despite the fact that Westerman and Larsen used “different makes and models of silver-colored, mid-sized sedans” (1997, p. 423), it is likely that one of the “features” of the car was its make or model, and this information would have assisted participants in differentiating between cars in the “car lineup”. The car was a stimulus identifiable through features alone, and recognition of it would not have been affected by a shift to a featural processing strategy. These results cannot be attributed to RI. Rather, they support the argument that verbal overshadowing is due to verbalisation encouraging a featural processing shift which carries over to recognition and interferes with the optimal, configural processing strategy.

Westerman and Larsen (1997) argue that one of their findings is consistent with both the RI and the TIPS hypotheses. They found that participants who tried to identify the face immediately after describing it performed more poorly than those who experienced a 15-minute delay between description and identification. They argue that if participants do rely on the content of their verbal descriptions (RI), then those who experienced a delay between encoding and description would have experienced some deterioration in memory and would have produced less accurate descriptions consistent with poorer recognition. However, they claimed, it can also be argued that the influence of a processing shift (TIPS) might be greater for those who undertook the description task immediately before identification (confusingly called the “delay” condition because there was a delay between encoding and description). These

1 There was no analysis done in the Westerman and Larsen paper to determine if a description-identification correlation existed.
participants were likely to be experiencing the full effect of the processing shift at the
time of recognition because they had made the description immediately before the
identification test. For participants who had described the face immediately after
encoding (the “no-delay” condition), more time had elapsed attenuating the effect of the
description on processing orientation; the recognition task was 15 minutes after the
description task, and the featural processing strategy engaged during verbalisation may
have weakened during this delay.

It is not clear whether verbal overshadowing persists after longer delays between
encoding and identification. Schooler and Engstler-Schooler’s (1990) and Meissner’s
(2002) findings suggest that this is the case. Schooler and Engstler-Schooler found
verbal overshadowing after a 48-hour delay, and Meissner found it after a one-week
delay. In their meta-analysis, Meissner and Brigham (2001) found that post-encoding
delays were not predictive of verbal overshadowing, whereas post-description delays
were. A short delay (10 minutes or less) or no delay between verbalisation and
identification was more likely to produce verbal overshadowing than a longer delay (30
minutes or more). This is consistent with the TIPS hypothesis and Westerman and
Larsen’s (1997) suggestion that the shorter the time between verbalisation and
identification, the greater the expected effect of the processing shift at recognition.
While it could be argued that it is also consistent with Finger and Pezdek’s (1999) claim
that a delay between description and identification reduces the saliency of the verbal
memory, the results of the meta-analysis suggest otherwise. Meissner and Brigham
found no difference in identification for verbalisation participants given an immediate,
short or long delay between description and identification.

If the processing-shift explanation of verbal overshadowing is correct, then the
persistence of overshadowing despite a long delay between description and
identification could be explained in two ways. Either the featural strategy is still active
two days or one week later (which seems unlikely), or the featural processing
orientation is reinstated at the time of testing. In real life, witnesses to a crime can
experience long delays between seeing the event and describing the perpetrator and
eventually being asked to identify that person from a lineup. This timeframe could be
weeks or months suggesting that rather than carrying the processing style over to
recognition, the processing style may be reinstated due to the categorical association
between the description task and the memory test, perhaps as they are all related to the
crime. This brings up an important issue for the TIPS hypothesis. Many factors can
influence a participant’s processing style, and a major weakness of the TIPS hypothesis is that any intervening experience between acquisition and recall is likely to affect their processing style. Where is the evidence in the literature that control participants do not change their processing style? Filler tasks also have the propensity to affect processing style.

**The Effect of the Control Tasks on Processing Strategy**

Finger (2002) found that participants who were given a category generation task (a standard verbal overshadowing control task (e.g., Fallshore & Schooler, 1995; Kitagami et al., 2002; Meissner, 2002; Meissner et al., 2001)) after providing a verbal description of the target face performed worse on identification than those who were given a non-verbal task such as doing a maze or listening to instrumental music. She argued that this supported the processing shift explanation of verbal overshadowing: that performing the non-verbal task reinstated the processing style which had been interrupted by the verbalisation task. She suggested that the use of category/exemplar generation as a control task may be critical for demonstrating verbal overshadowing.

Just as the existence, or not, of a description-identification correlation is thought to be of no consequence to the TIPS hypothesis, so the issue of control task is immaterial for the RI explanation. Provided control participants do not generate a description of the target face and the control task occupies them long enough to require long-term memory, the nature of the task does not matter. In contrast, the effects of the control task are critical for the tests of the processing-shift hypothesis. According to this hypothesis, the necessary condition for obtaining verbal overshadowing in the verbalisation condition is a shift from holistic to featural processing, while there should be no processing shift in the control condition. Although it might be expected that the control tasks typically used in verbal overshadowing studies would not promote featural processing, their effects have not been investigated. This leaves the TIPS hypothesis open to criticism. A wide range of control tasks has been used in the verbal overshadowing literature (see Table 1.1). It seems naïve to suggest that all these tasks produce either the same effect, or no effect, on processing style.
Table 1.1

Control Tasks for Published Verbal Overshadowing Studies

<table>
<thead>
<tr>
<th>Control Task</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>category generation</td>
<td>Schooler &amp; Engstler-Schooler, 1990</td>
</tr>
<tr>
<td></td>
<td>Fallshore &amp; Schooler, 1995</td>
</tr>
<tr>
<td></td>
<td>Ryan &amp; Schooler, 1996</td>
</tr>
<tr>
<td></td>
<td>Dodson, Johnson &amp; Schooler, 1997</td>
</tr>
<tr>
<td></td>
<td>Meissner, Brigham &amp; Kelley, 2001</td>
</tr>
<tr>
<td></td>
<td>Kitagami, Sato &amp; Yoshikawa, 2002</td>
</tr>
<tr>
<td></td>
<td>Maclin, 2002</td>
</tr>
<tr>
<td></td>
<td>Meissner, 2002</td>
</tr>
<tr>
<td></td>
<td>Clare &amp; Lewandowsky, 2004</td>
</tr>
<tr>
<td>reading comprehension problems</td>
<td>Dodson, Johnson &amp; Schooler, 1997</td>
</tr>
<tr>
<td></td>
<td>Memon &amp; Bartlett, 2002</td>
</tr>
<tr>
<td></td>
<td>Lyle &amp; Johnson, 2004</td>
</tr>
<tr>
<td></td>
<td>Lloyd-Jones, Brown &amp; Clarke, 2006</td>
</tr>
<tr>
<td>doing “unrelated filler activity”</td>
<td>Schooler &amp; Engstler-Schooler, 1990</td>
</tr>
<tr>
<td></td>
<td>Schooler, Ryan &amp; Reder, 1996</td>
</tr>
<tr>
<td>reading</td>
<td>Macrae &amp; Lewis, 2002</td>
</tr>
<tr>
<td></td>
<td>Perfect, 2003</td>
</tr>
<tr>
<td>doing crossword puzzles</td>
<td>Melcher &amp; Schooler, 1996</td>
</tr>
<tr>
<td></td>
<td>Wickham &amp; Swift, 2006</td>
</tr>
<tr>
<td>writing feelings about the crime</td>
<td>Westerman &amp; Larsen, 1997</td>
</tr>
<tr>
<td>answering questions regarding school experiences</td>
<td>Finger, 2002</td>
</tr>
<tr>
<td>waiting through an unfilled delay</td>
<td>Perfect, Hunt &amp; Harris, 2002</td>
</tr>
<tr>
<td>doing a maze puzzle</td>
<td>Weston &amp; Perfect, 2005</td>
</tr>
<tr>
<td>doing visual puzzles, e.g., “spot the difference”</td>
<td>Brown &amp; Lloyd-Jones, 2005 (Exp 1)</td>
</tr>
<tr>
<td>describing a memory lapse</td>
<td>Fiore &amp; Schooler, 2002</td>
</tr>
<tr>
<td>completing a survey on euthanasia</td>
<td>Meissner, 2002</td>
</tr>
<tr>
<td>doing a word puzzle</td>
<td>Vanags, Carroll &amp; Perfect, 2005</td>
</tr>
</tbody>
</table>
Despite this criticism, it is arguable that the research literature provides more support for the TIPS hypothesis than the RI hypothesis. In a review article, Schooler (2002) evaluated the verbal overshadowing literature and identified four findings which cannot be accommodated by the RI explanation. The first of these is the lack of a description-identification correlation in the majority of verbal overshadowing studies. Schooler argues that a description-identification relationship is central to the RI hypothesis, and, in its absence, it is difficult to attribute verbal overshadowing to poor quality descriptions.

The second finding identified by Schooler is that several studies have shown verbal overshadowing occurs for stimuli which have not been described in the interpolated task. Dodson et al. (1997), Westerman and Larsen (1997), and Brown and Lloyd-Jones (2002a) have all found verbal overshadowing caused by describing non-target faces. If interference results from the inaccuracies contained in the description of the target, then description of a non-target face should have no such effect.

The third finding which cannot be accommodated by the RI hypothesis is Finger's (2002) demonstration that engaging in a non-verbal, perceptual task between verbalisation and identification can prevent verbal overshadowing. If interference from the description content underlies verbal overshadowing, why should engaging in an irrelevant perceptual task block this interference?

The fourth and final finding identified by Schooler is that an effect very similar to overshadowing can be obtained by interposing a non-verbal task between acquisition and recall. In a study by Macrae and Lewis (2002), participants did either a local or a global Navon letter task in place of the standard verbalisation task. Navon letters, large letters made up of a smaller, mismatching letter (e.g., an X made up of Y’s), are hypothesised to encourage participants to focus at a featural level when identifying the local or small Navon letter, and at a holistic level when identifying the global or large Navon letter. Macrae and Lewis found that participants who did the local Navon task for 10 minutes were significantly worse at recognising the target face than control participants who read aloud a passage from a novel for the same period of time. In contrast, participants who were asked to identify the large letter, focusing on the global level, actually outperformed controls at identification. It was suggested that in the local condition there was a shift towards featural processing which impaired the ability to identify the face. In contrast, in the global condition the holistic processing strategy was
reinforced and face recognition improved. These results are consistent with the notion of a transfer-inappropriate processing shift impairing recognition.

The processing shift observed in the Macrae and Lewis (2002) experiment is likely to be similar to the one hypothesised to underlie verbal overshadowing (Schooler, 2002). The Macrae and Lewis study was able to replicated the impairment in face recognition in Schooler and Engstler-Schooler's (1990) study, using their stimuli and control task, whilst strengthening the case for an explanation of verbal overshadowing that has gained credibility through other studies (e.g., Dodson et al., 1997; Fallshore & Schooler, 1995; Finger, 2002). Macrae and Lewis argued that verbalisation itself is not necessary for impaired recognition. Rather, it is the local processing orientation associated with verbalisation that interferes with recognition. Remembering is not simply passively retrieving a stored encoding. It entails a complex combination of verbal and perceptual representations and the processing operations that take place as participants try to reconstruct the past episode or image (Macrae & Lewis). Macrae and Lewis argued, as did Fallshore and Schooler (1995), that whether participants use holistic or featural information to identify a face depends on the task demands and their expertise at the task. Changing the relative importance of configural and featural in the retrieval process can change the recognition outcome, and it would appear that activities other than verbalisation can achieve this.

These four findings challenge the RI account of verbal overshadowing, but are easily accommodated by the TIPS hypothesis (indeed, the first two findings contributed to the development of this hypothesis). Hence, more recent investigations into verbal overshadowing have focused on the TIPS account and have sought ways to test the hypothesis further. For example, Perfect (2003) investigated the possibility that the different recognition rates in the various conditions of Macrae and Lewis' (2002) study were simply due to task difficulty. Perfect argued that while that study produced results consistent with the processing shift account of verbal overshadowing, a possible confound existed because the global precedence effect² could make the global Navon task less demanding than a local Navon task. It was possible that the poorer recognition performance by the local Navon group was not due to a featural processing strategy, but rather, because the local Navon task required greater effort than the global Navon task.

² The global precedence effect reflects the fact that the global aspects of a stimulus are perceived before the local aspects (Navon, 1981).
To address this, he asked participants in his study to do both the local and global Navon tasks. One group was given the global task followed by the local task, a second group was given the same tasks in the reverse order, and a third group, the control group, were given an article to read. Perfect concluded that participants who did the local Navon task second used a more featural, or local, processing mode activated during recognition because they performed more poorly at identification than the control group. However, in contrast to Macrae and Lewis’ results, there was no difference in recognition between participants who did the global task last (and who presumably had brought a holistic processing mode to the recognition test) and the control group. Perfect suggested two possible reasons for this. Either five minutes of the global Navon task was insufficient to induce the holistic processing mode required to improve recognition, or participants in the control group in his study simply outperformed those in Macrae and Lewis’ study.

Another weakness of the Macrae and Lewis study was lack of direct evidence that the improved recognition performance by the global Navon participants was due to increased holistic processing. As Weston and Perfect (2005) argued, unless there is direct evidence identifying the processing strategy participants used during the recognition test, the argument is circular and there are many factors which can contribute to the strategies used by witnesses at identification. In the absence of such evidence, the case for the TIPS hypothesis is purely circumstantial. Weston and Perfect did attempt to identify the processing style used at recall. They used the composite face task as a manipulation check to ensure that participants engaged in featural processing during the lineup. Participants were shown aligned composite faces and asked to identify the half of the face that was from one of the originally encoded faces. Weston and Perfect found that the local Navon task did indeed appear to have engaged local processing which carried over to recognition, because participants in the local Navon condition required less time to identify the composite half than participants in the control condition. Unlike previous studies, which simply assumed that the processing strategy induced by the interpolated task carried over to recognition, Weston and Perfect’s study measured the processing style at test and confirmed both that a processing bias existed and that this had an effect on recognition.

As with Perfect’s (2003) study, Weston and Perfect (2005) found no difference between the performances of the global and control groups in recognising composite faces. They explained this by suggesting that control participants may have encoded
only holistic aspects of the faces due to the short time given for encoding. In this case, when asked to recognise the face halves, control participants may have used a holistic strategy similar to that of global Navon participants, resulting in no apparent difference between the two groups. However, there is another possibility for the similarity of global and control groups responses. The interpolated task given to the control group may have affected their processing strategy. Control participants were given a maze task, and Finger (2002) has shown that such a task reinstates holistic processing. If the processing shift hypothesis is correct, and the maze task did engage a holistic processing mode, control and global participants were using similar processing strategies at the time of identification. In this case, no differences between the groups would have been expected.

While the findings of Macrae and Lewis (2002), Perfect (2003), and Weston and Perfect (2005) have all provided support for a TIPS explanation of verbal overshadowing, there is one important study that has not been done. An experiment which reverses the direction of the processing shift would provide very strong support for this account of verbal overshadowing. If the impairment in face recognition is caused by a shift from an appropriate form of processing (holistic) to an inappropriate form of processing (featural), then reversing the direction of this processing shift should impair recognition also, provided the stimuli are featurally processed. The primary assumption of TIPS is that moving from an optimal processing strategy to a less-than-optimal strategy diminishes recognition. A definitive test of this assumption would be to reverse the direction of the processing shift by inducing a holistic (and inappropriate) processing strategy after participants have encoded a stimulus featurally. This should produce the same outcome as the “standard-direction” processing shift. This was the first question addressed in this study.

Even if such a reversed processing-shift experiment were successful, the question concerning the origin of this shift would still remain unanswered, and answering this question may lead to more effective manipulation checks for processing style. Schooler (2002) has hypothesised that change between holistic and featural processing entails differential hemispheric activation. He argued that language

3 Participants were given four faces to encode, and Weston and Perfect assumed they had encoded them in an holistic manner as the participants had only eight seconds in which to simultaneously learn all four faces.
operations such as those used for the verbal description task in verbal overshadowing studies have been linked to left hemisphere processes (e.g., Evans & Federmeier, 2007; Hunter & Brysbaert, in press; Kelley et al., 1998) while memory for non-verbal, perceptual and face stimuli is linked to right hemisphere processes (e.g., Blanchet et al., 2001; Golby et al., 2001; Kelley et al., 1998). Furthermore, he argues, evidence from the cognitive neuroscience literature suggests that when there is competition between brain regions, for example left and right hemispheres, dampening of the non-activated processes can occur. Thus, competition between brain regions will result in the activation of one hemisphere at the expense of the other.

Assessment of hemispheric activation associated with processing shifts might be done using fMRI, EEG or PET methods; however, these are expensive and require multi-trial experiments. Verbal overshadowing cannot be investigated using multiple trials because the effect attenuates with repetition (Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004). A new technology that is inexpensive and suitable for standard verbal overshadowing experiments is functional tympanic membrane thermometry (fTMT). This technology measures the tympanic membrane temperature of each ear (Cherbuin & Brinkman, 2004, 2007). Changes in blood flow to the middle ear and tympanum are associated with cerebral activity, and the temperature of the ipsilateral tympanic membrane drops as cerebral activity increases (Cherbuin & Brinkman, 2004; Gur et al., 1994). The fTMT technology can be used in a laboratory environment. Infrared temperature probes in participants’ ears detect tympanic membrane temperature while participants are engaged in the cognitive tasks. This technique was used in this study in an attempt to directly test Schooler’s hypothesis that the processing shift in verbal overshadowing experiments may be associated with changes in left and right hemisphere activity.

1.2 The Structure of the Thesis

Chapter 2 describes four experiments which investigated the reversed-direction processing shift. The interference task used was the Navon letter task (global and local). After making appropriate adjustments to the methodology, it was possible to show in Experiment 4 that when holistic processing was the best strategy for encoding the target face, an interpolated local Navon task impaired recognition. In contrast, when featural processing was the optimal strategy, an interpolated global Navon task impaired performance. In other words, a reversed-direction processing shift caused
overshadowing. These results show that faces can be processed either holistically or featurally, and we can no longer assume that participants in overshadowing experiments necessarily encode them holistically.

Chapter 3 reports three experiments which used fTMT to investigate firstly, the hemispheric activation associated with the Navon letter tasks and secondly, the processing shifts in the experiments of Chapter 2. fTMT analyses indicated that both control tasks (rating animal pictures and reading aloud) activated the left and right hemispheres significantly and to a similar degree. Overall, neither version of the Navon task produced right hemisphere activation. Rather, both produced significant left hemisphere activation which differed across conditions. The results suggest that identifying different hemispheric activity with global and local Navon tasks may be inappropriate due to the intrinsically left hemisphere (i.e., verbal) nature of the task. It appears that Navon letters, whether spoken or written by participants, generate a strong left hemisphere bias. In the identification phase there was no activation of either hemisphere suggesting that the task does not engage either hemisphere preferentially and there was no deviation from the residual activation of the Navon and control tasks.

Chapter 4 reports a “typical” verbal overshadowing study (encoding, filler, interpolated verbal task/control task, identification) accompanied by fTMT results. The results revealed a complex pattern of hemispheric responses to the various activities undertaken by participants, but there was no clear pattern which could be used to diagnose processing mode. The results suggest the processing shift if not simply the result of right/left hemisphere competition.

Chapter 5 describes a serendipitous finding. The verbal overshadowing experiment reported in Chapter 4 was repeated with non-naïve participants. This was done for the benefit of the first year psychology co-ordinator who was looking for a task to fill one of the weekly laboratory sessions. Students who participated in this experiment were given a prior reading on verbal overshadowing (the Melcher and Schooler (1996) paper), and were expecting a quiz on the topic at the beginning of the laboratory session in which the experiment was undertaken. These participants, therefore, had a good, basic understanding of the phenomenon, its theoretical explanations and the verbal overshadowing experimental paradigm. Results from this experiment show that while understanding the phenomenon does not change the nature of participants’ descriptions, it does remove their susceptibility to verbal overshadowing. There was no difference in performance by those in the control or
verbalisation groups, and there was no difference in the description quality when
descriptions by those who were not naïve (Chapter 5) were compared to descriptions of
those who were naïve (Chapter 4). The results of this study add to the literature that
challenges the recoding interference explanation, and suggest that in a forensic setting,
educating eyewitnesses about the phenomenon may be helpful in overcoming it.

Finally, Chapter 6 is a general discussion of the findings of the thesis concluding
while the reversed processing shift experiment provides strong support for the TIPS
account of verbal overshadowing, the fTMT data does not support the contention that
such a shift may be due to competition between right and left hemispheres of the brain.
This Chapter also proposes that the results of the control group in the Macrae and Lewis
replication (Experiment 3) suggest that a processing shift may not be necessary for
impaired recognition in overshadowing studies. An inappropriate processing style can
result if the nature of processing required changes between encoding and recognition.
The task demands can be different at encoding and recognition. Hence, it may be a
transfer-inappropriate processing strategy rather than shift that results in overshadowing
of recognition.

1.3  Summary

From a review of the verbal overshadowing literature, it is evident that the R1
hypothesis is inadequate as an explanation of the phenomenon despite recent findings
by Meissner (2002) and colleagues (Meissner et al., 2001), and the TIPS account, while
providing a more encompassing explanation, requires further investigation. If verbal
overshadowing is the result of a processing shift, then with appropriate methodology
and stimuli it should be possible to produce a similar result by reversing the direction of
that processing shift. This experiment has been attempted (unsuccessfully) only once
before to the author’s knowledge (DeShon, personal communication, 12 April 2004),
yet such an experiment would provide strong evidence for the TIPS hypothesis. This
thesis will address that issue, and investigate the origin of such a processing shift. fTMT
technology will be used to investigate whether the processing shift can be attributed to
competition between left and right hemispheres as suggested by Schooler (2002).
REVERSING THE PROCESSING SHIFT IN THE OVERSHADOWING PARADIGM

The assumption of the TIPS hypothesis is that if the mode of processing used at retrieval is different from the one used at encoding, poorer recognition will result (Melcher & Schooler, 2004; Schooler, 2002; Schooler et al., 1997). Previous research inspired by this hypothesis has assumed that participants encode the stimulus holistically, but switch to featural processing when required to describe it. They are assumed to carry this featural-processing strategy through to the recognition test. Recognition is impaired because featural processing yields poorer recognition than the holistic processing which would have been used otherwise.

If the TIPS hypothesis is correct, then inducing a holistic strategy after a stimulus has been encoded featurally should also produce recognition impairment. If the available processing strategies are holistic and featural, then changing from one to the other should result in poorer recognition regardless of the order in which they are engaged (see Figure 2.1).

![Figure 2.1. Impairing recognition by reversing the direction of the processing shift.](image-url)
Impairing recognition by reversing the direction of the processing shift would provide strong support for the TIPS account of verbal overshadowing. There are two requirements for conducting such an experiment. Firstly, the stimuli should (in the absence of intervention) induce, and benefit from, featural rather than holistic processing in the encoding and recognition phases. Secondly, the interpolated task should produce a shift from featural processing to holistic processing.

2.1 Methodological Considerations for Reversing the Processing Shift

Inducing a Shift from Featural to Holistic Processing

Tasks that are likely to be the most useful for engaging holistic processing focus on visuo-spatial or perceptual activities. Examples are mental-imagery tasks such as the cube-folding task (Shepard & Feng, 1972), three-dimensional object rotations (Shepard & Metzler, 1971), mentally tracing the outline of an imagined letter (Brooks, 1968), or tasks that involve visuo-spatial processing such as the paper-folding test (Eliot & Smith, 1983), and visuo-spatial items on Raven’s Advanced Progressive Matrices (DeShon et al., 1995). Finger (2002) found that even listening to instrumental music or tracing a paper-and-pencil maze can instigate, or reinstate, holistic processing. In Finger’s experiment, participants who did either of these activities after generating a verbal description of the face showed no verbal overshadowing during a subsequent recognition test.

Although each of these activities could be used to induce holistic processing, there is another task that is particularly suitable because it has been used in previous overshadowing studies. This is the hierarchical or Navon letter task. A Navon letter is a large letter made up of a smaller, usually mismatching, letter (Navon, 1977), for example a large “Y” made up of multiple instances of the letter “J” (see Figure 2.2). Identifying the large letter (the “Y”) is believed to engage global or holistic processing since this letter represents the Gestalt of many smaller pieces (the instances of “J”). In contrast, identifying the small, constituent letter (the “J”) is thought to engage local or featural processing since the perceiver must focus on the details of the image to recognise the local letter. Navon letters have been used to investigate global and local processing (see Kimchi, 1992, for a review), as well as hemispheric activation (Evert &
Kmen, 2003; Fink et al., 1997; Heinze, Hinrichs, Scholz, Burchert, & Mangun, 1998; Yovel, Yovel, & Levy, 2001), and, very recently, the TIPS hypothesis in overshadowing experiments (Macrae & Lewis, 2002; Perfect, 2003; Weston & Perfect, 2005).

Figure 2.2. Navon letter.

Macrae and Lewis (2002) introduced the Navon letter task to the verbal overshadowing literature in a study that used Schooler and Engstler-Schooler’s (1990) original stimuli, but replaced the interpolated verbalisation task with a local Navon task. They argued that if verbalisation produces a shift to featural processing, then any cognitive task that triggered featural processing would produce the same recognition impairment. In keeping with this, participants who spent 10 minutes doing a local Navon letter task performed more poorly on the face recognition task than control participants who read a passage aloud (one of Schooler and Engstler-Schooler’s control tasks). In addition, participants who did the global Navon task outperformed those in the control group. The experimenters attributed this to an interaction between the mode of encoding of the original memory and the processing operations in place at the time of remembering, and suggested that strengthening the global or holistic processing strategy enabled participants to perform better in the face identification task.
Using Schooler and Engstler-Schooler's stimuli and Navon letters, Perfect (2003) also found impaired face recognition for participants in the local Navon condition, when compared to those in the control or global conditions. However, unlike Macrae and Lewis, participants in the global condition of Perfect's study did not outperform those in the control group. Perfect suggested this may have been due to the shorter timeframe for his global (and local) Navon tasks (Perfect’s participants spent five minutes on the Navon tasks), or the higher recognition rates of his control group. Macrae and Lewis' control group were correct 60% of the time, and Perfect's control group had a 70% accuracy rate.

Finally, in a third overshadowing study using Navon letters, Weston and Perfect (2005) were able to show, using a composite face task, that the local processing bias induced by the local Navon task carried over to the recognition phase. Participants in their local Navon condition were faster at recognising face halves within composite faces than those in the control and global groups suggesting that a local orientation was still in effect during the recognition phase. From these studies, it would seem that using Navon letter tasks to reverse the direction of the processing shift would be preferable to other tasks that engage holistic processing, not only because the original processing shift been replicated using Navon letters, but also due to the symmetry of cognitive effort required by the global and local Navon tasks (Perfect, 2003).

**Featurally-Encoded Stimuli**

Implementing the reversed-direction processing shift requires not only a method of engaging holistic processing, but also a target stimulus that demands featural rather than holistic processing. The overshadowing literature provides some indication of the types of stimuli that might be suitable, namely those that have not been impaired by verbalisation. To-date these have included verbal statements (Schooler & Engstler-Schooler, 1990, Exp 4), route maps (Fiore & Schooler, 2002), conceptually learnt material (Melcher & Schooler, 2004), other-race and inverted faces (Fallshore & Schooler, 1995), and face sets with low test-set similarity (Kitagami et al., 2002). As the majority of verbal overshadowing studies and the studies of Macrae and Lewis and Perfect in particular have used face stimuli, they were the preferred option for replicating the original processing shift and reversing the direction of that shift. Own-race faces are holistically encoded and these can be used to produce the standard processing shift. On the other hand, there are several classes of face stimuli that
necessitate featural processing and which might be used to generate the hypothesised processing-shift reversal.

Other-race, inverted and scrambled faces would all be expected to encourage featural processing. Other-race faces were used successfully for this purpose by Fallshore and Schooler (1995). They compared the verbal overshadowing obtained with own-race faces with the absence of the phenomenon for other-race faces. However, it was considered that inverted or scrambled faces would be a better option. The use of other-race faces would necessitate two different sets of stimuli, an own-race set for the standard processing shift condition and an other-race set for the reversed processing shift condition. This would entail matching the difficulty of the two sets. If inverted or scrambled faces are employed in inducing the reversed-direction processing shift, the same face set can be used in both processing shift conditions; upright (normal) faces for the standard shift condition, and inverted or scrambled versions of these same faces for the reversed-shift condition.

Although Fallshore and Schooler (1995) used both inverted faces and other-race faces to induce featural processing, it was considered that scrambled faces would offer a stronger manipulation of processing strategy because they would promote featural processing to a greater extent (Lobmaier & Mast, 2008; Murray, 2004). In fact, Murray has argued that scrambled faces are devoid of configural information whereas inverted-face processing still allows encoding of some holistic information. For this reason, upright, own-race faces were used in Experiment 1 to generate the standard processing shift and to provide a replication of the Macrae and Lewis study, while scrambled versions of the same faces were used to reverse the direction of the processing shift.

**Choice of Control Task**

Another issue that arises for a verbal overshadowing experiment is the type of interpolated task to be given in the control condition. It was pointed out in Chapter 2 that control tasks in verbal overshadowing studies are often assumed to have little or no effect on processing strategy; however, this has not been demonstrated directly. The effect of the control task on processing strategy is important in a hypothesis based on processing mode, and it is questionable whether any task (including doing “nothing”) could occupy a participant for 10 minutes without having any effect on processing orientation. For example, Hunt and Carroll (2008) found that asking participants to
engage in proximal thinking by considering their plans and goals for the following day enhanced the verbal overshadowing effect when their recognition performance was compared to participants who were asked to engage in distal thinking. In the distal-thinking condition, participants were asked to think about what they would be doing at the same time next year. Participants who are left to ruminate without direction could engage in either type of thinking.

Hunt and Carroll’s (2008) findings suggest that the interpolated activity given to the control group should be structured. The task used by Macrae and Lewis could not be used here as it involved reading aloud, and participants in this study were to be tested in groups. The paper-and-pencil maze task used by Weston and Perfect (2005) could not be used because it has been shown to affect processing (Finger, 2002). The control task used by Perfect (2003), reading a magazine article, was considered unsuitable because the study would take place in large tutorial groups and adherence to the task could not be monitored effectively. In these experiments control participants rated a series of animal pictures for likeability. This was expected to produce neither a strong featural nor a strong holistic processing orientation. The pictures were not considered likely to engage the specific holistic processes associated with faces, and there was no written material on the images to engage a verbal or featural form of processing. It was anticipated that this task would have little effect on processing strategy, yet would keep participants occupied for the entire period between encoding and recognition.

**Cognitive Style**

Processing strategies are not affected solely by the tasks participants are asked to do. They have a preferred cognitive style which reflects how they habitually retrieve, perceive and process information (Littlemore, 2001; Riding & Cheema, 1991). According to Littlemore, and Riding and Cheema, some have a holistic style which leads them to synthesise information and see the Gestalt. These people can find breaking the information down into parts more difficult than seeing the complete picture. In contrast, others have an analytic cognitive style and are good at seeing the details, but find it harder to synthesise all the information into a “big picture”. According to Zhang (2002), an analytic cognitive style is helpful in processing verbal or featural information, whereas an holistic style is useful for processing spatial or configural information. Vanags et al. (2005) showed that cognitive style (as measured by Riding’s (2000) Cognitive Styles Analysis (CSA) program) could be predictive of
target identification in the verbal overshadowing paradigm. When stimuli were well suited to featural processing, participants with an analytic cognitive style performed better. When the stimuli were holistic in nature, individuals with a holistic cognitive style showed better recognition.

This finding suggested that cognitive style information might be useful in assessing processing shift outcomes. Riding’s CSA program was administered after completion of the study to identify participants’ preferred cognitive styles. Although Riding (2001) concedes that there is still a need for longer-term test-retest reliability studies, indications are that this measure can be a valid predictor of individuals’ performance on tasks hypothesised to involve either holistic or analytic processing (Peterson, Deary, & Austin, 2003; Riding, 2001, 2003), although. Peterson et al. found the holistic/analytic scale to be stable in a short-term test-retest (8.5 days) and parallel forms and split-half analysis (Mean $r = 0.69$), but the verbaliser/imager scale was not (Mean $r = 0.36$). For this reason, the verbaliser/imager data, although collected, were not included in this experiment.

**Lineup Format**

One final consideration in experimental design was the form of item presentation to be used in the recognition test. Two commonly used methods are the simultaneous and the sequential lineup. The simultaneous lineup procedure presents the items in the stimulus set (i.e., the target and distractors) together. This format has generally been used in overshadowing research; however, a sequential lineup may be a better option for two reasons. Firstly, simultaneous lineups encourage a relative judgement in which participants pick the person who looks *most like* the target (Weber & Brewer, 2004; Wells & Olsen, 2003). Sequential lineups, in contrast, encourage an absolute judgement as participants make their decision by comparing each face individually with their memory of the target (Wells & Olsen, 2003). Sequential lineups are thought to reduce mistaken identifications (particularly in target-absent lineups), and they are reported to improve the rate of correctly rejecting distractors even in verbal overshadowing studies (Steblay, Dysart, Fulero, & Lindsay, 2001). It is worth noting that lineup format has *not* been found to affect verbal overshadowing outcomes (Meissner, 2002), but to encourage participants to engage in absolute- rather than relative-judgement strategies. A sequential lineup strategy was used in Experiment 1.
2.2 Experiment 1

The aim of Experiment 1 was to reverse the direction of the processing shift by inducing a holistic processing strategy at the time of retrieval after the target had been initially encoded featurally. This manipulation was contrasted with standard overshadowing procedures where participants were induced to process the recognition set featurally after encoding the target stimulus holistically. The standard procedures were expected to induce overshadowing. The question was whether the reversed processing shift would result in similar recognition impairment.

In order to manipulate the mode of processing at the time of encoding, two types of target stimulus were used and two interpolated tasks were used. The stimuli were: normal and scrambled faces. The interpolated tasks were local and global Navon-letter recognition. For each type of face stimulus, the effects of the two interpolated tasks were assessed against the effect of a control task which was the same for each stimulus type. Thus there were six experimental conditions as shown in Table 2.1. A different participant group was used in each condition.

Table 2.1
Experiment 1: Experimental Condition and Cell Sizes

<table>
<thead>
<tr>
<th>Interpolated task</th>
<th>Global Navon</th>
<th>Local Navon</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal face</td>
<td>Normal/global</td>
<td>Normal/local</td>
<td>Normal/control</td>
</tr>
<tr>
<td>Target</td>
<td>$(n=24)$</td>
<td>$(n=25)$</td>
<td>$(n=25)$</td>
</tr>
<tr>
<td>Scrambled face</td>
<td>Scrambled/global</td>
<td>Scrambled/local</td>
<td>Scrambled/control</td>
</tr>
<tr>
<td></td>
<td>$(n=36)$</td>
<td>$(n=34)$</td>
<td>$(n=36)$</td>
</tr>
</tbody>
</table>
For Experiment 1, it was hypothesised that:

**For the Scrambled face conditions**

- Using Navon letters to induce a global (holistic) processing strategy would result in poorer recognition of a featurally processed stimulus by the global group than those in the control or local Navon groups (the reversed-direction processing shift); and
- If encouraging local processing is beneficial to recognising stimuli best processed featurally, the local Navon group will outperform those in the global Navon and control groups in the recognition task.

**And for the Normal face conditions**

- Using Navon letters to induce either local or global processing would result in poorer recognition by the local Navon group than those in the control or global Navon groups because the local Navon group would experience a processing shift (the standard processing shift); and
- If encouraging a global processing strategy assists face recognition, then strengthening participants’ global processing strategy with a global Navon task will result in the global Navon group outperforming local Navon and control groups at recognition.

**Method**

**Design**

Experiment 1 was a 2 (scrambled face, normal face) x 3 (local Navon, global Navon, control) between-subjects factorial design.
Participants

Participants were 224 ANU first-year undergraduate psychology students who did the experiment as part of a scheduled cognitive psychology laboratory session. Data from eight participants were excluded due to missing or ambiguous data on their lineup sheets. In addition, one participant’s data were excluded because s/he was given the incorrect booklet for the assigned condition, and another participant’s data were excluded at the participant’s request. Finally, the data of 11 participants in the normal face condition and 23 in the scrambled face condition were excluded from analysis as they were non-Caucasians who had not lived in Australia for 10 years or more. This criterion was used to reduce the possibility of a race-of-face effect on processing orientation as individuals lacking expertise with Caucasian faces are likely to process those faces in a more featural than holistic manner (Fallshore & Schooler, 1995). Of the remaining 180 participants, 133 were female, and 47 were male with ages ranging from 17 to 46 years ($M = 20.4, SD = 4.38$). The final sample sizes for each condition are shown in Table 2.1.

Apparatus

The experiment protocol was run on a Dell GX260 personal computer with 512mb of RAM. The operating system was Microsoft XP. The monitor was a Dell E772P with a 16-inch viewable image size and a refresh rate of 70 kHz.

Materials

Face stimuli.

The one target and five distractor stimuli were black-and-white photographs of male faces provided by the Computer Vision Laboratory, Faculty of Computer and Information Science, University of Ljubljana, Slovenia (www.lrv.fri.uni-lj.si/facedb.html). They were used with the permission of Peter Peer (Solina, Peer, Batagelj, Juvan, & Kovac, 2003). The images were grayscale, 9.1cm x 11.1cm (315 x 259 pixels) in size, and subtended a visual angle of 10.3°.

The stimulus subjects were Caucasian males of approximately 18 to 25 years of age. None had distinctive features such as beards or glasses, and any distinctive facial markings such as moles, scars or earrings were edited out using Adobe Photoshop.
version 7.0. The background for each stimulus was set to a standard gray, and the images were reduced to oval cut-outs to ensure clothing, hair and ears were not visible. This eliminated extraneous featural information, and is the format in which face stimuli are often presented in face recognition experiments (e.g., Rhodes, Tan, Brake, & Taylor, 1989) (see Figure 2.3).

![Target Face at Study](image)

Lineup faces (presented **sequentially**). Target is in position 5.

*Figure 2.3. Experiment 1: Target and lineup of normal faces.*

**Scrambled face stimuli.**

The "normal" face stimuli were modified using Adobe Photoshop version 7.0 so that the eyes, nose and mouth of each face were positioned in a non-standard position for that feature. Specifically, the nose was placed where the left eye would normally be, the mouth was placed in the nose position, the left eye was placed in the right eye position and the right eye placed where the mouth would normally be (see Figure 2.4).
Lineup faces (presented **sequentially**). Target is in position 5

*Figure 2.4. Experiment 1: Target and lineup of scrambled faces.*

**Navon letters.**

The Navon letters were similar to the one previously shown in Figure 2.2. There were 180 numbered Navon letters.

**Global and local Navon letter tasks.**

The Navon letters were shown at a rate of one every three seconds. Participants in the global condition were asked to write down each large letter as it was shown. They were given a Navon letter recording sheet (see Appendix A.1), and instructed to write the Navon letter next to the corresponding number. Participants in the local condition were asked to record each small letter against the corresponding number. This task took exactly 9 minutes.
Control task.

Participants in the control condition were shown six slides each displaying five animal images (for an example, see Appendix A.2). Participants were asked to rate each image for likeability, and then to order the images from the one they liked the most through to the one they liked least on the Control Task Photo Rating Sheet (see Appendix A.3). This task took exactly 9 minutes.

Recognition test.

The recognition test involved a six-person, target-present sequential lineup of the targets and distractors shown in Figure 2.3 and Figure 2.4. Each face was displayed for 15 seconds, and the position of the target was counterbalanced across all positions.

Lineup response sheet.

The lineup response sheet (see Appendix A.4) allowed participants to indicate for each face whether they thought it was the original face, and to rate their confidence in that judgement. It also allowed participants to indicate the original face was not in the lineup, and to give their confidence that the target was not present.

Experimental booklet.

The Navon letter response sheets, the control task sheet and the lineup response sheet were presented in an experimental booklet. Demographic information was collected on the cover page of this booklet (Appendix A.5).

PowerPoint presentation.

The target face, all Navon letters, the animal images and the sequential lineup were presented on computers using a PowerPoint presentation that ran automatically.
Cognitive style Analysis (CSA).

The CSA program (Riding, 2000) ran on personal computers, and generated a cognitive style for each participant based on their responses. The cognitive style included two orthogonal axes: holistic/analytic and verbaliser/imager. Each of these two axes has a third value that falls between the two extremes: intermediate for the holistic/analytic axis, and bimodal for the verbaliser/imager axis. The result was a cognitive style of holistic/intermediate/analytic and verbaliser/bimodal/imager. The program determined each individual’s position on these dimensions by computing a ratio of reaction times to true/false questions. It also generated speed and accuracy indicators to allow the identification of outlier data (Riding, 2001).

The holistic/analytic dimension of cognitive style is assessed through two subtests containing 40 items in total (Riding, 2001). The first subtest presents items containing pairs of complex geometric figures. The individual is required to determine if the two figures are identical (see Figure 2.5). Riding assumes a faster response time for such items is indicative of a holistic processing style.

![Figure 2.5. Pair of complex geometric figures from the CSA program.](image)

The second subtest displays a simple geometric shape, for example a square, and a complex geometric shape. The individual must determine if the simple figure is contained within the complex figure (see Figure 2.6). For this task, Riding assumes that individuals with an analytic processing style will respond more quickly than individuals with a holistic cognitive style.
Procedure

**Experimental (Navon) groups.**

Participants were tested in groups of between 1 and 25 people in front of personal computers, and were randomly allocated to either the global or local Navon condition. At the beginning of the experiment, participants saw the target face for five seconds. They spent the next 9 minutes doing either the local or global Navon task. Navon letters were displayed on the monitor at a rate of one every three seconds. Participants in the global condition wrote down the large letter, and those in the local condition wrote down the small letter. At the end of the 9-minute period, participants were instructed to turn to the lineup response sheet and were given the following instructions:

You are about to see a lineup of six male faces. The original face you saw may be in the lineup, or it may not. We want you to look at each face and decide if you think it is the original face. If you think it is, circle how confident you are on the left-hand side of the page under "was the original face". If you think it is not, circle how confident you are, "somewhat sure, reasonably sure or very sure", on the right-hand side of the page under "was not the original face". You should do this for each face as it appears.
If you reach the end of the lineup and you believe the face was not in the lineup, you should circle the "not in the lineup" option and indicate how sure you are that the original face was not in the lineup.

Each face will be shown for 15 seconds, so you will have plenty of time to make each decision.

When the lineup was complete, the PowerPoint presentation ended and participants' booklets were collected. As the experimenter collected the booklets, she started the CSA program for each participant. Once participants had completed the CSA program, they were given the cognitive styles information sheet, and when the entire group was finished, participants were debriefed.

**Control group.**

The procedure for the control group was the same as that for the experimental groups with one exception. In place of the local or global Navon letter task, control group participants were given the task of rating the animal photographs.

**Results**

**Scrambled Faces: Processing Orientation**

The number of correct and incorrect identifications of the target face and the number of misses (lineup rejected) by each group are shown in Table 2.2.
Table 2.2

Experiment 1: Correct and Incorrect Responses for Scrambled Faces by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Global</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>9 (25%)</td>
<td>16 (44%)</td>
<td>11 (32%)</td>
<td>36 (35%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>27 (75%)</td>
<td>20 (56%)</td>
<td>23 (68%)</td>
<td>70 (65%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(5)</td>
<td>(2)</td>
<td>(5)</td>
<td>(12)</td>
</tr>
<tr>
<td>Total</td>
<td>36 (100%)</td>
<td>36 (100%)</td>
<td>34 (100%)</td>
<td>106 (100%)</td>
</tr>
</tbody>
</table>

Control participants in the scrambled face condition performed very poorly on face recognition with only 25% correctly identifying the target. Participants in the global and local conditions performed slightly better, however there was no effect of processing orientation on face recognition for scrambled faces, $\chi^2(2) = 3.09, p = .213, \phi = 0.17^4$.

**Discrimination ratings.**

Confidence/accuracy and discrimination scores were calculated in the anticipation that such a measure of recognition would be more sensitive than the nominal correct/incorrect data. The scores were based on participants’ target choice and confidence in their choice of target. The scores also took into account participants’ accuracy and confidence on rejecting the distractor faces.

Any face selected as the target face$^5$ was given a score of $+1$, $+2$ or $+3$ depending on the confidence selected by the participant. For faces categorised as not being the target face, each face was given a negative score of $-1$, $-2$ or $-3$ based on the participants’ confidence rating for that face (see Table 2.3). This resulted in a confidence/accuracy rating for the target face and each of the distractor faces ranging from -3 to +3.

---

$^4$ Effect sizes are reported for non-significant as well as significant results as recommended by Cohen (cited in Nakagawa & Foster, 2004).

$^5$ Participants could select more than one face as the target face.
From these confidence/accuracy ratings, a discrimination rating was calculated by subtracting the mean confidence/accuracy rating for all distractor faces from the confidence/accuracy rating of the target face. The resultant discrimination rating lay between −6 (systematic rating of the target as more novel than the distractors) and +6 (completely accurate in discrimination between the target and distractor faces).

Confidence/accuracy and discrimination scores were calculated, although one case was excluded from analysis as the participant gave no confidence/accuracy rating for the target face. Analysis of variance showed that although participants in the global Navon condition had higher discrimination ratings than those in the local Navon condition, the differences between groups were not significant, $F_{(2,102)} = 2.87, p = .06$, partial $\eta^2 = .05$. However, it should be noted that this result, while not significant, was the reverse of that expected. The ratings for each group are shown in Table 2.4.
Before analysing the cognitive style data, the data set was examined for outliers through evaluation of speed and accuracy parameters. Riding (2000) suggests that if the speed index is high (greater than 10) or the percentage correct is low (less than 70%), the individual could not do the CSA task either because he or she was a poor reader or unable to understand the instructions, or because the individual was not engaged in the task and simply pressed one of the response buttons at a fast rate. No such outliers were found in the scrambled face data. The cognitive style data were not available for three participants, but data for the remaining 103 participants were analysed. Holistic/analytic ratios for this group of participants ranged from 0.7 to 2.8 ($M = 1.3, SD = 0.41$) and fell within the typical range of 0.4 to 4.0 (Riding, 2000). The distribution of cognitive styles was unimodal, positively skewed (1.3), and leptokurtic (1.9), possibly due to the ratios being derived from response times (Riding, 2000). According to Riding’s guidelines, 26% of the participants were holistic, 38% were intermediate and 36% were analytic (see Figure 2.7).

Figure 2.7. Experiment 1: Scrambled faces cognitive style distribution.
To determine the effect of cognitive style on face identification, a logistic regression was performed with cognitive style as the predictor variable. Cognitive style was not predictive of face identification, change in deviance of $\chi^2(1) = 0.76, p = 0.385, \varphi = 0.385, \text{Exp}(\beta) = 0.62$, despite the full model being an acceptable fit for the data, $-2 \log \text{Likelihood} = 128.40, \text{Hosmer and Lemeshow } \chi^2(8) = 8.52, p = 0.384$.

**Normal Faces: Processing Orientation**

The correct and incorrect identifications of the target and misses (lineup rejected) for each group are shown in Table 2.5.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Global</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correct</strong></td>
<td>16 (64%)</td>
<td>12 (50%)</td>
<td>20 (80%)</td>
<td>48 (65%)</td>
</tr>
<tr>
<td><strong>Incorrect</strong></td>
<td>9 (36%)</td>
<td>12 (50%)</td>
<td>5 (20%)</td>
<td>26 (35%)</td>
</tr>
<tr>
<td><strong>(Misses)</strong></td>
<td>(3)</td>
<td>(4)</td>
<td>(3)</td>
<td>(10)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25 (100%)</td>
<td>24 (100%)</td>
<td>25 (100%)</td>
<td>74 (100%)</td>
</tr>
</tbody>
</table>

Participants in the control group performed as expected with 64% correctly identifying the target face. However, participants in the local condition, who were expected to perform more poorly than control participants, showed a numerically greater identification rate of 80%. Conversely, participants in the global condition whose performance was expected to be similar to control participants, showed the lowest identification rate with only 50% correctly identifying the target.

The effect of processing orientation on face recognition only approached significance, $\chi^2(2) = 4.85, p = 0.089, \varphi = 0.26$, but additional analyses showed that participants in the local condition were significantly more likely to correctly identify the face than those in the global condition, $\chi^2(1) = 4.86, p = 0.027, \varphi = 0.26$. 
Discrimination ratings.

Confidence/accuracy and discrimination scores were calculated as for scrambled faces. Although discrimination ratings by the local Navon group were higher than those of the global Navon and control groups, analysis showed this difference was not significant, \( F(2,71) = 0.57, p = .569, \) partial \( \eta^2 = .02 \) (see Table 2.6).

Table 2.6

Experiment 1: Discrimination Ratings for Normal Faces by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Min</th>
<th>Max</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-0.4</td>
<td>+6.0</td>
<td>+3.4 (1.85)</td>
</tr>
<tr>
<td>Global</td>
<td>-1.8</td>
<td>+6.0</td>
<td>+3.1 (2.43)</td>
</tr>
<tr>
<td>Local</td>
<td>-0.8</td>
<td>+6.0</td>
<td>+3.8 (2.14)</td>
</tr>
</tbody>
</table>

Normal faces: Cognitive style.

The cognitive styles data for one participant in the normal face condition was unavailable, but data for the remaining 73 participants were analysed. No outliers were found. Holistic/analytic ratios for this group of participants ranged from 0.6 to 2.9 (\( M = 1.4, SD = 0.44 \)) and again fell within the typical range of 0.4 to 4.0 (Riding, 2000). The distribution of cognitive styles was again unimodal, leptokurtic (3.3), and positively skewed (1.5). According to Riding’s guidelines, 21% of the participants had a holistic cognitive style, 27% were considered intermediate and 52% were analytic (see Figure 2.8).
To determine the effect of cognitive style on face identification, a logistic regression was performed with cognitive style as the predictor variable. As with scrambled faces, cognitive style was not predictive of face identification, change in deviance of $\chi^2(1) = 0.36, p = .550$, Exp ($\beta$) = 1.41, despite the full model being an acceptable fit for the data, -2 Log Likelihood = 94.72, Hosmer and Lemeshow $\chi^2(8) = 10.46, p = .234$.

**Discussion**

The aim of Experiment 1 was to impair recognition by reversing the direction of the processing shift. This would manifest when participants in the global Navon scrambled face condition performed more poorly at recognition than those in the control and local Navon scrambled face conditions. However, there was no effect of processing orientation on recognition. A standard processing shift condition with normal faces was also included in Experiment 1 as a manipulation check for the stimuli and procedures.
This condition should have replicated the results of Macrae and Lewis (2002) and Perfect (2003). Participants in the local Navon condition should have performed more poorly at recognition than those in the control and global Navon conditions, but participants in the local Navon group *outperformed* those in the global Navon group. This was contrary to expectations.

Neither the normal-face groups nor the scrambled-face groups behaved as expected. In the first place, the scrambled-face groups did not show the reversed processing shift predicted by the TIPS hypothesis. However, the control group recognition rate for the reversed processing shift was very low. Only 25% of the participants correctly identified the target. This suggests that the task was simply too difficult. In fact, participants in all scrambled face conditions misidentified the target face more frequently than they identified it with only 44% of global participants correctly identifying the target face and only 32% of local participants giving correct responses. As might be expected with such low identification rates, there was no effect of processing orientation on face identification. Cognitive style was not predictive of recognition performance and hence not helpful for interpreting the results.

The lack of an effect of processing orientation on the recognition of scrambled faces in the reversed processing shift condition may have occurred because a shift from featural to holistic processing does not produce the same results as a shift from holistic to featural processing. However, the poor performance of the control group would make detection of any impairment in recognition by either the global or local Navon groups impossible. With a control group identification rate so low, the only possible significant difference would be if one group were to outperform the control group, and this did not occur.

The absence of an overshadowing effect for the scrambled faces could be seen as evidence against the TIPS hypothesis. However, the normal-face groups also showed no overshadowing effect, although such an effect has been reported in the published literature. This failure may provide some insight into problems with the experiment. Control group performance in the normal-face condition was good, indicating the task was not as difficult as the scrambled face recognition task. The identification rate of 64% was comparable to the optimal control rate for verbal overshadowing studies which Schooler (personal communication, January 2005) suggests should be 65% to 75%, and it was within the range of Macrae and Lewis’s (2002) and Perfect’s (2003) studies which were 60% and 70% respectively.
Participants in the Normal/Local condition did not perform worse on the recognition task than those in the Normal/Control conditions. In fact, this group’s recognition performance was numerically better than that of the Normal/Global condition (recognition rates of 80% and 50% respectively). The statistical status of this difference is open to question since the overall variation in performance across the groups did not reach the conventional 5% significance level. Nonetheless, the overall effect approached significance \((p = .089)\), and the pairwise comparison between the global and local groups was significant. A conclusion that there was such an effect must be regarded as provisional, but it is still worth discussing its implications.

A finding that the local Navon task enhanced recognition of normal faces would be contrary to the results of Macrae and Lewis, and Perfect. The question is why should the normal face results here contradict previous findings? Why would participants who were thought to be experiencing a processing shift from holistic to featural processing be better at identifying the target face if the TIPS hypothesis suggests that using a different processing strategy at recognition to the one used at encoding impairs recognition?

One possible explanation is the nature of the encoding and test stimuli. The same photograph was used at encoding and test. Both Macrae and Lewis, and Perfect used video recordings for encoding and a static photograph for the lineup. Despite the fact that face processing studies often use an identical stimulus at encoding and test (e.g., Lahaie et al., 2006; Leder & Carbon, 2006), Schooler and Engstler-Schooler (1990) have suggested that when the two stimuli are highly similar, the easily-verbalised, featural details of the image can be helpful, and are possibly used, for recognition. This suggestion, they claim, is consistent with Read, Hammersley, Cross-Calvert and McFadzen’s (1989) findings that when the target was identical at encoding and test, rehearsal (either mentally rehearsing and/or rehearsing through answering questions) improved recognition performance. In contrast, even a slight change in the stimulus between encoding and test reduced recognition performance. Indeed, Vanags et al. (2005) suggested that their findings indicate high encoding-test similarity of stimuli encourages featural processing and low encoding-test similarity promotes holistic processing. They found that individuals with an analytic cognitive style more readily identified stimuli with high encoding-test similarity (Experiment 1), and participants with a holistic cognitive style more easily identified stimuli with low encoding-test similarity (Experiment 2).
An examination of the verbal overshadowing literature supports this contention as no published verbal overshadowing studies have used the exact same stimulus at encoding and test (see Appendix A.7). Of the published studies, 78% have used different versions of the stimulus at encoding and test (e.g., a video recording at study and a static photograph at test; a casual photograph at study and a posed photograph at test; an angled photograph at study and frontal photograph at test). 8% did not involve recognition and therefore did not use a encoding/test scenario (e.g., verbalisation during insight problem-solving and problems from Raven’s Progressive Matrices), 6% used drawn picture forms of which there were two sets (Brandimonte et al., 1997), 6% used copies of the stimuli at test (a second recording of a voice (Perfect et al., 2002) and a second colour chip (Schooler & Engstler-Schooler, 1990, Experiment 3)), and the remaining 2%, Kitagami et al.’s (2002) study, do not clearly state whether the same blended photograph was used at encoding and test or whether two different, blended photographs were used⁶.

It may be that the high encoding-test similarity resulting from identical stimuli benefited participants who adopted a featural processing strategy. If featural processing is useful under such circumstances, this would provide an explanation for the anomalous results in the normal face condition. Better identification by participants in the local Navon condition than in the global Navon condition would be expected as local Navon participants engaged in a featural processing strategy for 10 minutes before recognition. Carrying this featural processing strategy over to recognition would not have impaired recognition, because the high encoding-test similarity was well suited to featural processing. In contrast, participants who undertook the global Navon task and engaged in holistic processing for 10 minutes before identification may have found it more difficult to recognise the target as their processing mode was not suited to the featural nature of the identification task. While this hypothesis seems feasible, it is moderated by the scrambled face results which are more difficult to explain.

The findings of this experiment suggest that using identical stimuli at encoding and test may have promoted featural processing. Identical images would allow participants to focus on isolated features of the face because the visual representation of that feature remains unchanged between learning the face and recognising the face.

⁶ The author has attempted to contact Kitagami to clarify this point, however no reply has been received.
Hence, the task becomes one of image recognition rather than face recognition (Brown & Lloyd-Jones, 2002a).

Although the featural bias suggested by these results were considered interesting, the most important finding was the failure to replicate Macrae and Lewis’ (2002) results. If the methodology could not reproduce the standard processing shift with the normal faces, it could not be expected to reverse the processing shift with the scrambled faces. For this reason, the methodology was modified in Experiment 2. The aim was to show overshadowing in memory for a normal face resulting from an interposed local Navon task.
2.3  Experiment 2

To replicate the standard processing shift and Macrae and Lewis' (2002) results, it was considered necessary to remove the possible featural advantage Normal/Local participants appeared to experience in Experiment 1. If using identical stimuli at encoding and test promotes featural processing because participants focus on particular unchanging features of the face, introducing subtle changes in the target face between encoding and the recognition test should force participants to rely on holistic processing to a greater extent.

Unfortunately, the target stimulus used in Experiment 1 (an oval cut-out of the face) did not lend itself easily to changes between encoding and test. To overcome this problem, full head-and-shoulders photographs of the target and distractors were used in Experiment 2 with some cosmetic modifications to the photographs for the encoding phase. The hair was covered by a cap, and the clothes were changed. This ensured that the two photographs of the target were physically different. In all other respects (except for the exclusion of the scrambled face conditions), Experiment 2 was identical to Experiment 1.

The aim was to modify Experiment 1 to eliminate the featural advantage resulting from high encoding-test similarity, and hence to replicate the results of Macrae and Lewis. It was hypothesised that:

- **Using visually different photographs of the target at encoding and test would require participants to rely on holistic processing at test to a greater extent; and**

- **Because they will have experienced a shift in processing, the local Navon group would perform more poorly at recognition than the global Navon or control groups.**
Method

Design

Experiment 2 was a simple local Navon, global Navon or control condition between-subjects design.

Participants

Participants were 66 University of Canberra (UC) first-year undergraduate psychology students, and 26 ANU first-year undergraduate psychology students. Participants received 30 minutes research credit towards their first year psychology studies for participating in this experiment.

The data of one participant were excluded due to missing or ambiguous data on the lineup sheet, and a further two participants’ data were excluded from analysis as they had not lived in Australia for 10 years or more. Of the remaining 89 participants, 69 were female, and 20 were male. Their ages ranged from 17 to 43 years ($M = 21.7$, $SD = 5.52$).

Apparatus

The experiment was run on personal computers and monitors with the same configuration as Experiment 1.

Materials

Stimuli.

This experiment used the same faces as Experiment 1; however, full head-and-shoulder photographs were used in place of the oval cut-outs. The appearance of the target face was changed to create a different image for encoding and test. In the encoding image, a cap was added to cover the target’s hair, and the target was given different clothing (see Figure 2.9). These modifications were done using Adobe Photoshop version 7.0. The head-and-shoulder photographs of the target and distractors were presented in a sequential lineup (see Figure 2.10).
Figure 2.9. Experiment 2: Encoding and test views of target face.

Target face at encoding

Lineup faces (presented **sequentially**). Target is in position 5.

Figure 2.10. Experiment 2: Target and lineup of head-and-shoulder faces.
Procedure

The procedure for Experiment 2 was identical to that of Experiment 1. The global and local Navon tasks, the control task, and stimuli were identical, as were the PowerPoint presentation, response sheets and recognition test. The only difference was the use of head-and-shoulder photographs, and that the photographs of the target face were not identical at encoding and test.

Results

Processing Orientation

The number of correct and incorrect identifications and the number of misses (lineup rejected) for each group are shown in Table 2.7.

Table 2.7
Experiment 2: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Global</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>15 (60%)</td>
<td>14 (47%)</td>
<td>19 (56%)</td>
<td>48 (54%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>10 (40%)</td>
<td>16 (53%)</td>
<td>15 (44%)</td>
<td>41 (46%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(4)</td>
<td>(11)</td>
<td>(8)</td>
<td>(23)</td>
</tr>
<tr>
<td>Total</td>
<td>25 (100%)</td>
<td>30 (100%)</td>
<td>34 (100%)</td>
<td>89 (100%)</td>
</tr>
</tbody>
</table>

Participants in the control group performed at a similar level to those in Experiment 1 with 60% correctly identifying the face. Global and local condition participants, however, showed very similar recognition rates and there was no significant effect of processing orientation on face recognition, $\chi^2(2) = 1.06$, $p = .59$, $\varphi = 0.11$. 
Discrimination ratings.

Confidence/accuracy and discrimination scores were calculated as for Experiment 1. Analysis of variance showed no difference in discrimination ratings across conditions, $F_{(2,86)}= 0.66, p = .5186$, partial $\eta^2 = .02$. The mean ratings for each group are shown in Table 2.8.

Table 2.8

<table>
<thead>
<tr>
<th>Condition</th>
<th>Min</th>
<th>Max</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-1.4</td>
<td>+6.0</td>
<td>+3.1 (2.43)</td>
</tr>
<tr>
<td>Global</td>
<td>-1.6</td>
<td>+6.0</td>
<td>+2.4 (2.70)</td>
</tr>
<tr>
<td>Local</td>
<td>-1.4</td>
<td>+6.0</td>
<td>+3.0 (2.48)</td>
</tr>
</tbody>
</table>

Cognitive Style

The cognitive style data for one participant were removed as it was considered outlier data (the speed index was greater than 10). Holistic/analytic ratios for the remaining 88 participants ranged from 0.6 to 3.7 ($M = 1.3, SD = 0.49$), and were within the typical range of 0.4 to 4.0. The distribution of cognitive styles was bimodal, positively skewed (1.6), and leptokurtic (4.7) (see Figure 2.11). According to Riding’s guidelines, 33% of the participants were holistic, 24% were intermediate and 43% were analytic.
To determine the effect of cognitive style on face identification, a logistic regression was performed with cognitive style as the predictor variable. As in Experiment 1, cognitive style was not predictive of face identification, change in deviance of $\chi^2(1) = 0.30, p = .586$, $\text{Exp} (\beta) = 0.79$ despite the full model being an acceptable fit for the data, $-2 \log \text{Likelihood} = 120.97$, Hosmer and Lemeshow, $\chi^2(8) = 10.74, p = .217$.

**Discussion**

The aim of Experiment 2 was to use the normal face stimuli from the Experiment 1 to achieve the same outcome as Macrae and Lewis (2002). It was hypothesised that using a different photograph of the target at encoding and test would require participants to use holistic processing to identify the target from the lineup. It was hypothesised that any featural advantage the participants in the local Navon condition had for image-matching as opposed to face recognition would be eliminated. Participants in the local Navon condition were expected to perform more poorly than those in the control and global Navon conditions during the recognition task.
Although participants in the control condition performing at a satisfactory rate (60% identified the target), there was still no effect of processing orientation on face recognition. As cognitive style was once again not predictive of identification, information on participants' cognitive styles was not helpful in explaining this outcome. Although the use of different photographs at encoding and test appeared to have eliminated the advantage shown by the local Navon group in Experiment I, this group still did not show the impaired performance expected on the basis of the Macrae and Lewis (2002) and Perfect (2003) results. That is, there was no evidence of overshadowing resulting from the expected processing shift. It was considered that this puzzling result could be attributed to any of three factors: the nature of the face stimuli in the recognition set; the mode of presentation of the stimuli; or the nature of the Navon letters.

**The Face Stimuli**

Although the encoding and test materials were not identical, it is possible that they were similar enough to encourage some participants to focus on features rather than the face as a whole. Both encoding and test photographs were developed from a single original photograph, and participants may have relied on some unchanged aspect of the photographs for identification.

Another possible explanation involving the face stimuli is that the faces were too dissimilar. Kitagami et al. (2002) have shown that lineups incorporating a target and distractors which are low in test-set similarity do not produce verbal overshadowing. It seems reasonable to extend this observation from verbal overshadowing to the non-verbal overshadowing examined here (the Navon effect).

**The Mode of Presentation**

A second possibility is the mode of presentation of the target and distractors. Verbal overshadowing studies generally use a simultaneous lineup, and Macrae and Lewis (2002), and Perfect (2003) also presented the target and distractors simultaneously. In addition, Weston and Perfect (2005) found that the processing orientation invoked by Navon letter tasks lasts only for a couple of judgements. The sequential lineup involved six judgements. It is possible that any processing shift dissipated before the lineup was completed, and that only the judgements of the first one
or two faces were affected. This would predict a position effect on recognition; the induced recognition impairment should only occur when the target was in position 1 or 2 of the lineup. However, there was no such effect. In addition, other studies have obtained verbal overshadowing using a sequential lineup format (e.g., Brown & Lloyd-Jones, 2002a; Finger & Pezdek, 1999) suggesting, in accordance with Meissner’s (2002) findings, that the lineup format does not affect verbal overshadowing outcomes.

The Navon Letters

Finally, the lack of a Navon effect in both Experiments 1 and 2 could have been due to the particular Navon stimuli used. There are several reasons they may have been problematic. Firstly, the Navon letters used in Experiments 1 and 2 were composed of small, high density local elements and were quite different from the low-density versions originally used by Navon (1977) (see Figure 2.12). It is possible that this difference in format is critical in engaging global and local processing. Irrespective of instructions, the Navon letters used in Experiments 1 and 2 may have created either a global or local bias, or they may have induced no on-going bias at all.

Figure 2.12. Original Navon letter format (left) and Experiment 2 Navon letter (right).

7 There was no main effect for position, \(W(1) = 0.29, p = .593\), and no position by condition interaction, \(W(1) = 2.53, p = .282\).

8 These Navon letters had been used by Perfect (personal communication, 2004) in some previous experiments. The results of those experiments are unknown to this author.
In her review of the global/local paradigm, Kimchi (1992) argued from Navon and Norman’s (cited in Kimchi, 1992) results that the presentation of typical Navon letters can result in critical parts of the outline of the global letter being placed further from the fovea than some of the local letters, and that, in these circumstances, the Navon letters could generate a local bias. This would occur because the local letter is more easily seen. This occurred in both Experiments 1 and 2 as the global letters were almost screen-height. Furthermore, the letters subtended a visual angle of 20.8 degrees. Kimchi cites studies by Kinchla and Wolfe which suggest that Navon letters or patterns subtending a large visual angle result in a local advantage. Conversely, Navon letters subtending less than 7 degrees produce a global advantage. It seems likely, therefore, that the large visual angle of the Navon letters used in Experiments 1 and 2 produced a local processing bias.

Another aspect of these Navon letters may have added to the apparent local bias in these experiments; local letter elements lying along the figure border were incomplete (see Figure 2.13). These may have attracted attention, irrespective of whether participants received local or global instructions, and hence initiated local processing. Again, this feature of the Navon figures used here could explain the failure to observe both the expected reversal of the processing shift in Experiment 1 and the absence of overshadowing in both experiments.

---

9 Kinchla and Wolfe tested visual angles up to 22.1 degrees.
Figure 2.13. Navon letter showing distorted edges.

If the Navon letters used in Experiments 1 and 2 produced a local bias, the results from Experiment 1 for the normal face condition become clearer. The high encoding-test similarity of the faces in Experiment 1 made the target identifiable through featural processing. The interposed locally biased Navon task then enhanced featural processing, particularly for participants in the local Navon condition. As a result, those in the local Navon group did not show the predicted processing shift. They engaged in a featural processing task between encoding and test, and then did an image-matching task that was suited to that processing mode. Since the recognition task matched their processing orientation, recognition was not impaired. From this perspective, the finding that local Navon condition participants outperformed those in the global condition is not as perplexing.

But, what of the global Navon participants’ results? There are three possibilities: the local salience of the Navon letters may have been strong enough to impose featural processing instead of holistic processing; the local salience may have been strong enough to block holistic processing but insufficient to induce featural processing; or the local salience may have been relatively minor but sufficient to impede, but not block, holistic processing.
Cognitive Style

The results of Experiments 1 and 2 also showed that the CSA program (Riding, 2000) does not provide a reliable method of predicting recognition outcomes from participants’ cognitive style. Although Vanags et al. (2005) found that participants with a holistic cognitive style were more likely to identify voices when holistic processing was required and participants with an analytic cognitive style were more likely to identify voices with high encoding-test similarity, the results from Experiments 1 and 2 do not add to, or confirm, these findings. Disappointingly, cognitive style as measured by the CSA program was not predictive of identification in either of these experiments. Research published since these experiments were run indicates that the holistic-analytic ratio component of Riding’s CSA program may not be as reliable as previously thought. In particular, two studies have found the test-retest reliability of the program to be well below the generally accepted value of 0.8. Parkinson, Mullally and Redmond (2004) obtained an average $r = .34$ for the holistic-analytic dimension in 14-day and 23-month test-retest studies, and Rezaei and Katz (2004) found a similarly low test-retest reliability $0.42$ in three experiments, one of which retested the program after one week, and two of which retested the program after one month. While Rezaei et al. acknowledge that the CSA program appears to have a strong theoretical basis, and Parkinson et al. confirm that the holistic-analytic dimension is stable (unlike the verbaliser-imager dimension), both conclude its reliability is too low to be considered a reliable indicator of cognitive style.

Discrimination Ratings

Not only did the CSA data prove ineffectual for interpreting the results, but the discrimination ratings, combining both accuracy and confidence data, were also not helpful. Although discrimination ratings have been used successfully in other verbal overshadowing studies (e.g., Dodson et al., 1997; Melcher & Schooler, 1996; Westerman & Larsen, 1997), these data did not provide a more sensitive measure of face recognition accuracy than the (binary) identification data. This may be, as Perfect et al. (2002) suggested, due to a dissociation between confidence and accuracy in the verbal overshadowing (or in this case Navon effect) paradigm. In view of these negative findings (both here and in the remaining experiments in this thesis), the recognition data will not be reported for the later experiments.
2.4 Summary of Experiments 1 and 2

Experiment 1 attempted to reverse the direction of the processing shift by using featurally processed face stimuli (Scrambled faces) and global and local Navon letters. The experiment failed to confirm the TIPS hypothesis prediction. There was no effect of processing orientation on Scrambled face recognition. However, this cannot be considered a definitive test of the TIPS hypothesis and the processing shift reversal because there was no overshadowing or Navon effect for the Normal face conditions either. In fact, the results for the Macrae and Lewis (2002) replication were the reverse of those expected with participants in the Normal/Local group outperforming those in the Normal/Global group. Speculation was made that this may have occurred because identical encoding/test stimuli allow participants to focus on single, unchanging features of the face and this may encourage featural processing. Changing the appearance of the target between encoding and recognition in Experiment 2 appeared to eliminate the numerically-better recognition of the Normal/Local group in Experiment 1, but it did not result in a replication of Macrae and Lewis' results. This led to further speculation that there may be a problem with the Navon stimuli. Indeed, research reviewed by Kimchi (1992) supported the speculation that the Navon letters did not promote global processing, as Navon stimuli that subtend a large visual angle (as in Experiment 1) prevent holistic processing. In Chapter 3, the problem of locally-salient Navon stimuli was addressed and the Macrae and Lewis result was replicated and the processing shift successfully reversed.
2.5 Experiment 3

In Experiments 1 and 2 a set of Navon stimuli that subtended a large visual angle were used. It was speculated that the visual angle subtended by these stimuli, the high-density of the local elements, and the imperfect figure borders (for the global letter) may have prevented participants from engaging in holistic processing. Holistic processing is a necessary condition for the replication of the Macrae and Lewis (2002) study, and there is little point in attempting to reverse the processing shift if the standard processing shift condition cannot be replicated. Hence, the purpose of Experiment 3 was to replicate the Macrae and Lewis study before proceeding with the processing shift reversal.

There were two requirements necessary to replicate the Macrae and Lewis study: firstly, Navon stimuli that induce both local and global processing were required, and secondly, the target had to require participants to engage in holistic processing. The Navon letters had to be equally salient so as to induce featural and holistic processing to the same degree. The equally salient Navon letters used in this experiment were those used by Weston and Perfect (2005). The local elements were similar in density to those originally used by Navon (1977), and the global Navon letter subtended a visual angle of 12 degrees to prevent either a local or global advantage. The face stimuli used in this experiment were the head-and-shoulder faces from Experiment 2. The subtle differences between the encoding and test photographs were expected to require a holistic strategy for recognition. Finally, a change was made to the lineup procedure. Instead of the sequential lineup procedure used in Experiments 1 and 2, this experiment used a simultaneous lineup. This methodology was adopted because the majority of verbal overshadowing studies, and the studies by Macrae and Lewis (2002) and Perfect (2003), had used a simultaneous lineup.

The aim of Experiment 3 was to replicate the processing orientation outcomes of the Macrae and Lewis (2002) experiment. It was hypothesised that:

- The local Navon group would show poorer recognition of the target face than the global Navon and control groups due to the induced featural processing strategy.
Method

Design

Experiment 3 was a simple local Navon, global Navon or control condition between-subjects design.

Participants

Participants were 24 Caucasian individuals affiliated with the Australian National University either as students or staff. Participants received payment of $6 for participating in this experiment. There were 15 female, and 9 male participants whose ages ranged from 18 to 52 years ($M = 27.9, SD = 10.41$).

Apparatus

The personal computers were those used in previous experiments.

Materials

Face stimuli.

The head-and-shoulder faces were those used in Experiment 2 (see Figure 2.14).
Target face at encoding

Lineup faces (presented simultaneously). Target is in position 5.

*Figure 2.14. Experiment 3: Target and lineup head-and-shoulder faces.*
Navon letters.

The Navon letters used were the equally salient Navon letters of Weston and Perfect (2005) (see Figure 2.15). There were 195 Navon letters, and the position of the Navon letters on the screen was varied. Unlike Experiments 1 and 2, these Navon letters were not always centred on the screen.

\[
\begin{array}{c}
H H H H H H \\
H \\
H \\
H H H H H H \\
H \\
H \\
H H H H H H \\
\end{array}
\]

*Figure 2.15. Experiment 3: Equally salient Navon letter.*

Global and local Navon letter tasks.

There were two differences between the Navon tasks in this experiment and those of Experiments 1 and 2. Firstly, participants were asked to speak the Navon letter aloud rather than write it down. The experimenter recorded the Navon letter for the participant. Secondly, the Navon letters were presented at a rate of one every two seconds for a total period of 6.5 minutes.

Control task.

Participants were asked to read aloud a passage from a novel (cf. Macrae & Lewis, 2002) (see Appendix A.8).

Recognition test.

The recognition test was a six-person, target-present, untimed simultaneous lineup.
Other materials.

The experimental booklet and PowerPoint presentation were those used in Experiments 1 and 2. The lineup response sheets are shown in Appendix A.9 and Appendix A.10.

Procedure

The procedure was identical to that of Experiments 1 and 2 except participants said the Navon letters aloud, participants in the control group read aloud from a novel (instead of rating animal photographs), and the lineup was simultaneous, and untimed. The CSA program was not used in this experiment.

Results

Processing Orientation

The number of correct and incorrect identifications and the number of misses (lineup rejected) for each group are shown in Table 2.9.

Table 2.9

<table>
<thead>
<tr>
<th></th>
<th>Condition</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Global</td>
<td>Local</td>
<td>Total</td>
</tr>
<tr>
<td>Correct</td>
<td>1 (13%)</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
<td>9 (38%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>7 (87%)</td>
<td>2 (25%)</td>
<td>6 (75%)</td>
<td>15 (62%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(1)</td>
<td>(2)</td>
<td>(5)</td>
<td>(8)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (100%)</td>
<td>8 (100%)</td>
<td>8 (100%)</td>
<td>24 (100%)</td>
</tr>
</tbody>
</table>
Participants in the control condition performed very poorly with only 13% correctly identifying the target face. As predicted, there was a strong effect of processing orientation on face recognition, $\chi^2(2) = 7.47, p = .024, \varphi = 0.56$.

Participants in the global Navon condition were better at recognising the face than those in the control condition, using Yates' Correction for Continuity due to the small count in some cells, $\chi^2(1) = 4.06, p = .044, \varphi = 0.63$. Although a greater percentage of the global Navon group than the local group correctly identified the target, this difference was not significant, Yates Correction for Continuity, $\chi^2(1) = 2.25, p = .134, \varphi = -0.50$. The result is non-significant in terms of the $p$-value, but the medium to strong effect size of 0.5 suggests that it may be valid to reject the null hypothesis as an increase in sample size would almost certainly produce a significant $p$-value (Nakagawa & Foster, 2004). There was, however, no difference in recognition performance between participants in the local and control groups, $\chi^2(1) < 0.005, p < 1, \varphi = 0.16$.

**Discussion**

The purpose of Experiment 3 was to replicate the Macrae and Lewis results. Participants in the local Navon condition were expected to engage in featural processing which would impair recognition when compared to the control and global groups. The results showed that processing orientation did affect recognition in the manner anticipated, but the hypothesis that local Navon participants would perform more poorly than global Navon and control participants was not supported. Although global Navon participants numerically outperformed local Navon participants at recognition, the difference, 75% and 25% respectively, did not reach significance. This is likely to be due to the small number of participants. The effect size was large, 0.5, indicating a larger sample size would most likely produce a significant result (Leech, Barrett, & Morgan, 2005).

The results for the global and local Navon groups were as expected, but the results for the control group were surprising. Even fewer participants in the control condition (13%) than in the local condition (25%) were able to identify the target. Interpretation of this result is difficult. The stimuli required holistic processing, as evidenced by the global and local Navon group results, so if the control group defaulted to encoding faces in a holistic manner, they should have shown similar identification rates to global participants. Clearly, they did not. This suggests that either the reading aloud (control) task induced featural processing, or the participants encoded the face in...
a featural manner and only those in the global Navon condition were able to adopt the holistic processing required for recognition. It is unlikely that the control task induced featural processing as Schooler & Engstler-Schooler’s (1990), Macrae and Lewis’ (2002) and Perfect’s (2003) studies all used this control task successfully. This leaves the option that participants encoded the face in a featural manner.

In verbal overshadowing studies to-date, particularly those embracing the TIPS hypothesis, the assumption has always been that participants encode and recognise faces using holistic processing (Fallshore & Schooler, 1995; Schooler et al., 1996), and this suggestion has been supported by the findings of many experiments in the face processing literature (e.g., Diamond & Carey, 1986; Sergent, 1984; Tanaka & Farah, 1993; Young, Hellawell, & Hay, 1987). However, the face processing literature has asserted that although the principal form of processing for own-race faces is holistic, learning and recognising faces can, and does, engage holistic and featural processing (Bartlett, Searcy, & Abdi, 2003; Cabeza & Kato, 2000; Sergent, 1984). In fact, many researchers in this area support a dual-route hypothesis (featural and configural processing) for the perception and recognition of faces (Bartlett et al., 2003). This raises the question of whether it is correct to assume that the target face is always being encoded holistically, and of what factors may influence the degree to which one form of processing is used? While it is beyond the scope of this thesis to answer these questions, it is worth embracing the fact that we do not know the answers to these questions, and therefore cannot assume that participants in a verbal overshadowing study will encode a face using holistic or configural processing (Cook, personal communication, November 2004).
While the face processing literature shows that holistic processing is the principal form of processing for own-race faces, there are important differences between verbal overshadowing and face processing experiments. The latter usually involve participants learning several faces, rather than a single face (McKone, personal communication, 2006), and those faces are often learned in association with a name, such as “Larry” or “Bob”, so that participants can recognise the face as that person (cf. Tanaka & Farah, 1993). This learning phase usually involves seeing the faces for up to five seconds over 4 to 6 trials to become “familiar” with them (e.g., Cabeza & Kato, 2000; Tanaka & Farah, 1993; Tanaka & Sengco, 1997). The subsequent recognition task is often a two-alternative forced-choice decision with emphasis being on whether the face (or some part of the face) is “old” (one of the learned faces) or “new” (not seen before) (e.g., Tanaka & Farah, 1993; Tanaka & Sengco, 1997).

Overshadowing studies are different. Participants in Experiments 1, 2 and 3, for example, saw the face for period of about five seconds, but only once. The participants did not know they would be asked to recognise the face later. The recognition task involved a six-alternative non-forced choice decision. This methodology is quite different to the face recognition tasks in face processing experiments. Furthermore, recent research shows that there is a difference in how “familiar” and “unfamiliar” faces are processed. Megreya and Burton (2006) found that unfamiliar face recognition may not engage configural processing in the same way that many of the “familiar” face stimuli in face processing experiments do. They found a high association between matching unfamiliar upright faces and matching the same faces inverted, and argued that this suggests unfamiliar upright faces may engage the same processes as inverted faces. And it is well-known that inverted faces invoke featural processing (Yin, 1969). Megreya and Burton argued that similar processes underlie the inverted face and unfamiliar face recognition tasks, and that featural, rather than configural, processing is dominant when processing unfamiliar faces.

If control participants encoded the unfamiliar face primarily using a featural strategy, the results for the control group are not unexpected. This group’s results were similar to those of the local Navon participants, and neither group was given a task to enhance the holistic processing required for recognition. The results of Experiments 1 and 2 are consistent with this idea as well. Participants adopted a featural encoding strategy and engaged in a featurally biased task (locally biased Navon letters). Those in the local condition outperformed those in the global condition who were distracted from
featural processing by the global task. In Experiment 1, the recognition test suited a featural strategy because the task was matching identical images. When this was replaced by a less featural task in Experiment 2, there was no difference in the recognition rates of the local and global groups. But, this hypothesis has important implications for the TIPS hypothesis as it suggests that a processing shift, per se, may not be necessary to disrupt recognition. The important factor may be whether the “current” processing strategy matches that required by the stimuli rather than whether a processing shift has occurred. However, this hypothesis is based on a small amount of data and is speculative, so will be reserved for the general discussion in Chapter 6.
2.6 Experiment 4

Given the hypothesis that unfamiliar faces might be encoded and recognised featurally and not holistically (Megreya & Burton, 2006), it was decided to use these featurally processed stimuli and the highly featural recognition task from Experiment 1 (identical encoding and recognition stimuli) to reverse the processing shift. It was thought this stimulus set encouraged featural processing at encoding and recognition, providing a useful mechanism for reversing the direction of the processing shift. Both the standard and the reversed processing shift experiments were carried out with identical stimuli eliminating test-set difficulty or similarity as confounds. The only difference between the two experiments was the presentation of the faces. For this reason, the oval cut-out face set from Experiment 1 and the equally salient Navon stimuli from Experiment 3 were used in this experiment.

For Experiment 4, it was hypothesised that:

- If participants used a featural strategy to encode unfamiliar faces, inducing a holistic processing strategy through a global Navon task will result in poorer recognition by the global Navon group than the local Navon or control groups; and
- If encouraging local processing is beneficial to recognising stimuli best processed featurally, the local Navon group would outperform those in the global Navon and control groups in the recognition task.

Method

Design

Experiment 4 was a simple local Navon, global Navon or control condition between-subjects design.
Participants

Participants were 28 Caucasian individuals affiliated with the Australian National University either as students or staff. Participants received payment of $6 for participating in this experiment. There were 18 female, and 10 male participants whose ages ranged from 18 to 52 years ($M = 25.5, SD = 8.32$).

Apparatus

The personal computers used in Experiment 1 were used in this experiment.

Materials

Stimuli.

The oval, cut-out, normal (not scrambled) faces from Experiment 1 were used in this experiment (see Figure 2.16).
Target Face at Study

Lineup faces (presented sequentially). Target is in position 5.

Figure 2.16. Experiment 3: Target and lineup oval cut-out faces.

Navon letters.

The Navon letters used those used in Experiment 3.

Global and local Navon letter tasks.

As in Experiment 3, global and local Navon participants were asked to say each Navon letter aloud. The Navon letters were presented at a rate of one every two seconds for a total period of 6.5 minutes.

Control task.

As in Experiment 3, control participants read aloud a passage from a novel (see Appendix A.8).
Recognition test.

The recognition test was a six-person, target-present, sequential lineup as in Experiment 1. Each face was visible for 15 seconds.

Lineup response sheets.

The lineup response sheet from Experiment 1 was used (see Appendix A.4).

Other materials.

The experimental booklet and PowerPoint presentation from Experiment 3 were used.

Procedure

The procedure was identical to that of Experiment 3 except that the lineup was sequential and timed.
Results

Processing Orientation

The number of correct and incorrect identifications and the number of misses for each group are shown in Table 2.10.

Table 2.10
Experiment 4: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Global</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>6 (67%)</td>
<td>1 (10%)</td>
<td>7 (78%)</td>
<td>14 (50%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>3 (33%)</td>
<td>9 (90%)</td>
<td>2 (22%)</td>
<td>14 (50%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(1)</td>
<td>(1)</td>
<td>(0)</td>
<td>(2)</td>
</tr>
<tr>
<td>Total</td>
<td>9 (100%)</td>
<td>10 (100%)</td>
<td>9 (100%)</td>
<td>28 (100%)</td>
</tr>
</tbody>
</table>

Participants in the control condition again performed at a satisfactory level, and at a similar rate to the control groups in Experiments 1 and 2 with 67% correctly identifying the target face. As predicted, there was a strong effect of processing orientation on face recognition, $\chi^2(2) = 10.18, p = .006, \varphi = 0.60$. Participants in the global Navon condition were significantly worse at recognising the face than those in the control condition, Yates’ Correction for Continuity $\chi^2(1) = 4.33, p = .037, \varphi = 0.59$. Participants in the local Navon condition were better than those in the global condition, Yates Correction for Continuity $\chi^2(1) = 6.36, p = .012, \varphi = 0.69$. Although a greater percentage of the local Navon group than the control group correctly identified the face, the difference was not significant, $\chi^2(1) < 0.005, p < 1$. 

94
Discussion

Experiment 4 sought to reverse the direction of the processing shift to determine whether changing an individual’s processing style from featural to holistic produces a similar recognition impairment as the standard processing shift (holistic to featural). This would be represented by the global group showing poorer identification rates than those in the control or local groups. Processing orientation did affect recognition performance. Participants in the global Navon condition performed more poorly than those in the control or local Navon groups. Only 10% of global Navon condition participants recognised the target face. By encouraging a holistic processing strategy when the recognition task required featural processing, recognition was impaired. It appears that reversing the direction of the processing shift produces an outcome similar to that of the standard processing shift (Macrae & Lewis, 2002; Perfect, 2003).

Although identification rates of local condition participants (78%) were higher than those of control participants (67%), this difference was not significant. Macrae and Lewis found that participants who had the “appropriate” processing strategy enhanced (i.e., global Navon participants in that study) outperformed control participants who were hypothesised not to experience any change in processing mode. Yet, this finding seems difficult to replicate. Perfect was unable to replicate it, and this experiment has not succeeded either. It would seem that the interfering effect of “inappropriate” processing is stronger than the strengthening benefit of “appropriate” processing, at least in the case of Navon letter tasks.

The finding that reversing the direction of the processing shift leads to a similar impairment in face recognition as the standard processing shift adds strong support to a TIPS account of overshadowing in recognition. With a stimulus highly suited to featural encoding, it has now been shown that participants undertaking a task that encourages featural processing performed better at recognition than those given a task that encourages holistic processing. Regardless of the direction of the processing shift, featural to holistic or holistic to featural, recognition can be impaired when the type of processing used at identification is not the same as that used at encoding. Not only can a shift to featural processing interfere with recognition of holistically processed stimuli, but a shift to holistic processing can interfere with the recognition of featurally processed stimuli, the caveat being that the stimuli must be well suited to holistic
processing for the standard direction processing shift, and they must be well suited to featural processing for the reversed direction processing shift.

### 2.7 General Discussion

While previous verbal overshadowing and Navon effect experiments have focused on introducing a featural processing strategy to interfere with the optimal holistic processing mode required by a stimulus, this series of experiments shows that the processing shift hypothesis has wider validity. A processing shift from either holistic to featural or featural to holistic impairs subsequent face recognition depending on the form of processing required by the target face. Introducing a holistic processing strategy after participants have encoded a face featurally produces similar, or even identical, recognition impairment to the standard processing shift thought to underlie verbal overshadowing and the Navon effect.

In the process of demonstrating the processing shift reversal, other important findings were made. Experiment 1 provided converging evidence for Schooler and Engstler-Schooler’s (1990) suggestion that when a stimulus is identical at encoding and test, featural processing is encouraged by the image-matching task that results. Local Navon participants in Experiment 1 who were required simply to select an identical image at recognition to that presented at encoding performed better than the global Navon group. Participants in the global Navon condition performed more poorly because the stimulus did not lend itself to holistic processing. Contrasting these findings with the Experiment 2 results, we see that a slight change in the stimulus between study and test (such as covering the target’s hair) removes the advantage the local Navon group experience, presumably as a greater degree of holistic processing is now required to identify the target.

The results of Experiments 1 and 2 also show that considerable care must be taken in developing the Navon letters used for the interpolated Navon letter task. Navon letters that subtend a large visual angle can produce a local advantage (Kimchi, 1992). Similarly, although not evident in this series of experiments, Navon letters subtending a very small visual angle can produce a global advantage. It cannot be assumed that any set of Navon letters will produce the featural or holistic processing mode required to affect recognition, and this underscores an important point made in Chapter 1. In verbal
overshadowing studies to date, the tendency has been to assume that participants are engaging in a particular type of processing with little research to confirm these anticipated processing shifts. Weston and Perfect (2005) used a composite face task (which favours a featural processing strategy) to confirm that the local Navon group had engaged in featural processing during the local Navon task and that they had carried that processing strategy over to recognition - at least for the first few identification decisions. However, their study was the first to use a manipulation check. It was the first to address a weakness in the TIPS hypothesis - the assumption that the predicted processing shifts are taking place.

The results of the first four experiments of this thesis suggest that assumptions regarding processing style may be incorrect, and highlight the importance of manipulation checks to confirm predicted processing shifts are occurring. Chapter 3 will address this issue further by replicating the experiments with fTMT technology to seek psychophysiological support for the processing strategies thought to be induced by the global and local Navon tasks. It will also allow for a comparative evaluation of the control group’s processing strategy as defined by hemispheric activation.

**Comparing Control and “Appropriate” Processing Groups**

Another finding of interest from the experiment in this Chapter is that enhancing the “appropriate” strategy for recognition did not produce the improved performance seen in the Macrae and Lewis (2002) study. They found that participants who engaged in global processing outperformed control participants, but Perfect (2003) was unable to replicate this outcome. In Experiment 4 (the reversed-direction processing shift experiment) participants with an enhanced appropriate-processing mode did not perform better at recognition than those in the control condition. In fact, identification rates of appropriate-processing (local) group and control group in Experiment 4 were very similar to those in Perfect’s study. Those whose processing strategy was unchanged identified the target 78% and 80% of the time in Experiment 4 and Perfect’s study respectively, while control participant recognition rates were 67% and 70% respectively.

Perfect offered two explanations for the lack of improved performance by his global Navon group over the control group. Firstly, he argued, five minutes of global processing may be insufficient to produce improved performance, and secondly, his
control group’s performance was higher than that of Macrae and Lewis (2002). While participants in Experiment 4 spent longer on the Navon task than Perfect’s participants (6.5 minutes vs 5 minutes), Experiment 4 participants were given only the local or global Navon task to perform, not both. Given the appropriate-processing condition participants in Experiment 3 still did not outperform control group with the additional time on the Navon task and no opposing-processing task beforehand, it seems likely that the inability to replicate Macrae and Lewis’s findings is attributable to the differing recognition rate of the control groups. The higher recognition rates of the control groups in Perfect’s study and Experiment 4 may have made any significant improvement difficult to obtain, whereas the lower rate of Macrae and Lewis’s control group (60%) made such a difference more visible, particularly as their appropriate-processing group also performed at a slightly higher level.

This argument does, however, raise the issue of the control group’s performance in Experiment 3. An identification rate of only 13% for these participants is contradictory to earlier findings. One explanation may be the way in which participants encode the target face. It is assumed that participants encode an own-race face holistically, but, as was identified in the introduction to Experiment 4, some research suggests that, in fact, unfamiliar faces are encoded in a featural manner (Hancock, Bruce, & Burton, 2000; Megreya & Burton, 2006). Feedback from participants during the experiments suggested that this is correct. Comments were made such as “I focused on his bushy eyebrows”, “I looked at his nose and lips, and then compared the nose and lips of the faces in the lineup” or “I focused on his eyes, they were soft eyes”. Surprisingly, a very small number of participants were even able to identify that the target has one nostril slightly larger than the other. This attention to the details of the target’s face suggests that all participants, global Navon, local Navon and control condition participants, may have encoded the face in a featural manner rather than the holistic manner that has been assumed in previous overshadowing studies. If the assumption is made that participants used featural processing at encoding, the identification rate of the control group (67%) in Experiment 4 is consistent with the processing shift hypothesis. The target was high in encoding-test similarity which favours featural processing and the control group, encoding the face featurally.

10 The participants in Perfect’s study did either 5 minutes of the local Navon task followed by 5 minutes of the global Navon task, or the reverse. Hence, Perfect’s participants engaged in both forms of processing.
experienced no shift in processing. The problem is that the current TIPS hypothesis cannot account for this explanation if it is applied to the control group of Experiment 3 as they do not undergo any processing shift. It may be that rather than a processing shift, a processing strategy mismatch is required. This will be addressed in greater detail in the General Discussion (Chapter 6).

2.8 Summary

Experiment 1 attempted to replicate the Macrae and Lewis findings and to reverse the direction of the processing shift by using featurally processed face stimuli in the form of scrambled faces. However, the counter-intuitive results (the local Navon group outperformed the global Navon group in the normal face condition) highlighted that using an identical stimulus for encoding and test encourages featural encoding of normal faces eliminating the need to proceed with scrambled faces. This was helpful as overall recognition performance for scrambled faces was poor preventing any identification of an effect of processing orientation on recognition. The advantage shown by local Navon participants in Experiment 1 was eliminated in Experiment 2 by adding a cap to the target face at encoding and removing the cap for the lineup phase; however, processing orientation still did not affect recognition. Consideration of the nature of the Navon letters led to the hypothesis that the Navon letters were locally biased due to the large visual angle at presentation and the distorted forms of the local letters at the outlines of the global letters. Hence, in Experiment 3, the locally biased Navon letters were replaced with equally salient Navon letters and the more holistic lineup of Experiment 2 were used to replicate the findings of Macrae and Lewis (2002). This experiment was successful, but had the unexpected finding that control participants were extremely poor at identifying the target (13%). By way of explanation, a hypothesis was proposed that, in line with previous findings, unfamiliar faces may be encoded in a featural manner. Control participants were encoding the face featuraly and this strategy was not optimal for recognition. Hence, a processing shift may not be required to impair recognition; it may simply require a mismatch of current processing style and the style required by the recognition task. The weakness of this explanation is that previous verbal overshadowing studies have used a single photograph at encoding and control participants in those studies have performed at a satisfactory rate. Experiment 4 built on the knowledge from Experiment 1 by using the identical
encoding and test stimuli to encourage featural processing at encoding and test. This experiment successfully reversed the direction of the processing shift. Participants in the global Navon condition performed more poorly at recognition than those in the local Navon or control conditions.
Looking for Evidence of the Origins of the Processing Shift

Since Navon (1977) introduced the paradigm of the compound stimuli used in the previous four experiments, an extensive literature has resulted from researchers using these stimuli to investigate the global precedence effect, global and local processing, and associated hemispheric activation. Many of these studies, particularly the early ones, were able to show a left hemisphere advantage for the local task and a right hemisphere advantage for the global task by presenting the stimuli to the right or left visual field (e.g., Martin, 1979b). However, some later studies have produced conflicting results. For example, Blanca and Alarcon (2002) found no hemispheric lateralisation for global and local tasks, Boles and Karner (1996) found that local processing produced a shift to right hemisphere processing, and Evert and Kmen (2003) found that left hemisphere activation for local tasks was produced more often than right hemisphere activation for global tasks.

One reason for these differing results may be the physical characteristics of the Navon letter compound stimuli. Many factors have been shown to affect the results of global and local processing studies using compound stimuli including: the salience of the local or global letters (Yovel et al., 2001); the relative size of the Navon letters (Kimchi, 1992); the sparsity and number of local elements (Kimchi, 1992); the spatial frequency (Boeschoten, Kemner, Kenemans, & van Engeland, 2005); whether the global and local levels of the stimuli are congruent or conflicting (Volberg & Hubner, 2007); whether divided attention is required (Heinze et al., 1998); and the length of time spent viewing the stimuli (Andres & Fernandes, 2006; Ninose & Gyoba, 2003). It is clear that the nature of these compound stimuli can be critical in determining whether global and local processing are engaged in the manner expected, a fact that was also evident in Chapter 2.

Despite the somewhat inconsistent findings regarding hemispheric activation in the compound stimuli literature, there is still evidence to suggest that the left and right hemispheres of the brain are involved in processing global and local information in different ways (Volberg & Hubner, 2004). Studies involving ERP and fMRI technology have evinced differential hemispheric activation from Navon letters with greater activation of the right hemisphere resulting from global tasks and greater activation of
the left hemisphere from local tasks (e.g., Fink et al., 1997; Yamaguchi, Yamagata, & Kobayashi, 2000), and fMRI studies have found (frontal dorsal) right hemisphere activation for non-verbally encoded material and (frontal dorsal) left hemisphere activation for verbally-encoded information (Kelley et al., 1998; Opitz, Mecklinger, & Friederici, 2000). These findings suggest that measures of hemispheric activation during Navon or verbal overshadowing manipulations may be an effective way of investigating the hypothesised processing shift.

Finding converging physiological evidence for the processing shift would be beneficial because a major weakness of the TIPS hypothesis has been the assumption that the manipulations used in verbal overshadowing experiments are producing the expected processing shifts. Other than behavioural outcomes, no attempt has been made to determine whether participants are engaging in the form of processing in which the experimenter believes they are engaging. The lack of evidence that participants actually are employing the hypothesised processing strategy is an important issue not only with regard to the Navon and verbalisation tasks assumed to alter processing strategies, but also with regard to the control tasks used in verbal overshadowing experiments which are hypothesised not to affect processing strategy.

If the activation of one hemisphere can result in the dampening of the other, as Schooler (2002) postulated, and Navon letter tasks can produce differential hemispheric activation, it could be predicted that with appropriate Navon stimuli, the local Navon task would engage left hemisphere processes and the global Navon task right hemisphere processes. While such activity can be detected with physiological measures that monitor cerebral activity, for example fMRI, EEG and PET (Fink et al., 1997; Heinze et al., 1998; Volberg & Hubner, 2004), another, cheaper and more easily accessed technique is now available - functional Tympanic Membrane Thermometry (fTMT) (Cherbuin & Brinkman, 2004, 2007). The fTMT technology developed by Cherbuin and Brinkman provides an inexpensive yet sensitive measure for investigating the hemispheric activation of participants.

3.1 Functional Tympanic Membrane Thermometry (fTMT)

Meiners and Dabbs (1977) and Cherbuin and Brinkman (2004, 2007) have shown that changes in blood flow to the middle ear and tympanum associated with cerebral activity can be detected using temperature measurements. In particular, the
temperature of the ipsilateral tympanic membrane drops when cerebral activity increases and carotid blood flow increases (Cherbuin & Brinkman, 2004; Meiners & Dabbs). As blood is supplied to each hemisphere of the brain separately (Springer & Deutsch, 1993), the changes in carotid blood flow represent changes specific to each hemisphere. Blood flow to the brain can change quickly and these changes bring with them decreases or increases in brain temperature (Meiners & Dabbs). The tympanum is affected by these changes in blood flow because it is a thin, almost transparent membrane which has a very small thermal mass (Cherbuin & Brinkman, 2007). The temperature of the tympanum drops with increased carotid blood flow because blood from the body is cooler than blood from the head. Cherbuin and Brinkman (2004; 2007) explained that the head generates a large amount of heat because it uses 30% of the total available energy to the body despite representing only 5% of the body mass. This heat is dissipated in two ways: by radiation through the skull, and by blood circulation. Dissipation of heat from the head through blood circulation occurs as a result of cooler, circulating blood from the rest of the body replacing the heated blood from the head. As the carotid blood flow to the head increases, this cooler blood causes the tympanic membrane temperature (TMT) to drop. Hence, an increase in cerebral activity in one hemisphere of the brain is correlated with a decrease in tympanic membrane temperature of that (ipsilateral) ear. The changes in TMT were measured with sensitive infrared thermometer probes attached to a helmet in the studies by Cherbuin and Brinkman (2004; 2007). The medical-grade temperature probes are accurate to 0.01° C, and are pre-calibrated for the normal human physiological range. By attaching these probes to flexible arms mounted on a hard hat, Cherbuin and Brinkman were able to develop a technology that could be used to accurately measure TMT while participants engaged in cognitive tasks (see Figure 3.1).
3.2 Re-Running Experiments 1, 3 and 4 from Chapter 2

The purpose of this chapter was to investigate whether fTMT could produce evidence of global and local processing for the Chapter 2 Navon letter experiments. This was achieved by measuring participants’ TMT while they performed the various cognitive tasks required by those experiments. The fTMT technology was used to seek physiological evidence of the processing shift as well as to investigate the question of whether participants in the control condition experienced any processing shift whilst engaged in the control condition tasks.

Three of the four experiments from Chapter 2 were re-run using Cherbuin and Brinkman’s equipment. Participants wore the helmet and infrared temperature probes over the duration of the experiment. The TMT data for each ear were recorded in a data file on the computer, and during recording the experimenter could monitor the temperatures on the computer screen (see Figure 3.2). The top two displays in Figure 3.2 show the ear temperature changes over a short timeframe (100 seconds), and the bottom two displays show the ear temperature changes since the beginning of the experiment.

---

11 Experiment 2 was not re-run as this experiment produced no results of significance for this investigation.
Figure 3.2. fTMT computer program recording tympanic membrane temperatures.
3.3 Experiment 5

Experiment 5 was a replication of Experiment 1 with participants wearing the fTMT helmet. The aim of Experiment 5 was to seek physiological evidence of global and local processing, and to confirm that participants in the control groups did not experience a processing shift. For Experiment 5, it was hypothesised that:

- If the local Navon task engaged the left hemisphere to a greater extent than the right hemisphere, participants in that group would show a decline in left TMT relative to right TMT, and a decline in left TMT relative to the global Navon and control groups; and

- If the Navon letters from Experiment 1 were locally biased as hypothesised in Chapter 2, the global Navon task should not engage the right hemisphere to a greater extent than the left hemisphere, and participants in that group would not show a decline in right TMT relative to left TMT, nor would they show a decline in right TMT relative to the local Navon and control groups.

Method

Design

Experiment 5 was simple Navon local, Navon global or control condition between-subjects design. It did not include the scrambled face condition of Experiment 1.

Participants

Participants were 22 Caucasian individuals affiliated with the Australian National University either as students or staff. Participants received payment of $6 for participating in this experiment. There were 11 female, and 11 male participants whose ages ranged from 17 to 46 (M = 24.5, SD = 7.84). Of the 22 participants, 3 were left-
handed, and 19 were right-handed with scores on the Edinburgh Handedness Inventory ranging from -1 to +1 ($M = +0.8$, $SD = 0.54$).

**Apparatus**

*FTMT measurement.*

The fTMT apparatus used was that developed by Cherbuin and Brinkman (2004; 2007). The equipment consisted of two Exergen infrared medical temperature probes which were pre-calibrated for the normal human physiological range. These temperature probes were accurate to 0.01° C, and were used to measure the tympanic membrane temperature (TMT) in each participant’s left and right ear. The probes were attached by flexible arms to a helmet worn by participants. The signal from each temperature probe was converted to a digital signal using a National Instrument’s data acquisition card and National Instrument’s signal processing system software, and was recorded to a data file on an Acer 1000 MHz Pentium III computer with 256 Mb of RAM running the Microsoft Windows 2000 operating system. The monitor was an Acer V771 with a 16-inch viewable image size and a refresh rate of 65 kHz. The National Instrument software allowed for continuous recordings of temperatures at sampling rates of 1 kHz. In-house software allowed the experimenter to start and stop the recordings at any time, and to vary the sampling interval from 10 to 2000 milliseconds in 10 millisecond increments.

*Personal computer.*

The experiment was run on one of the personal computers from Experiment 1.

**Materials**

*Stimuli.*

This experiment used the same oval cut-out face stimuli as Experiment 1 (see Figure 3.3).
Lineup faces (presented *sequentially*). Target is in position 5.

*Figure 3.3. Experiment 5: Target and lineup oval cut-out faces.*

**Navon letters.**

The locally-salient Navon letters from Experiment 1 were used (see Figure 3.4).

*Figure 3.4. Locally-salient Navon letter.*
Other materials.

The Navon letter tasks, control task, recognition test, lineup response sheets and PowerPoint presentation were the same as those used in the Scrambled Face Experiment (Experiment 1).

Procedure

On arriving at the laboratory, participants completed the Edinburgh Handedness Inventory (Oldfield, 1971) (see Appendix B.1). They were then given a demonstration of how to wear the fTMT helmet and how to insert the temperature probes into their ears. Once they had fitted the helmet to their heads, they were given disposable plastic caps to place over the temperature probes and were asked to insert the probes into each ear. With the temperature probes in place, they were told that body movement could affect TMT. To demonstrate this, participants were asked to move their legs while viewing the screen display of temperature recordings. This allowed them to see the effect of movement on TMT. They were then asked to remain as still as possible for the duration of the experiment to minimise temperature spikes.

Participants were told the experiment would begin with a relaxation period so that a baseline temperature could be recorded for each ear. They were instructed to close their eyes and relax for three minutes. Relaxation instructions included suggestions to focus on breathing, to meditate, to refrain from thinking, or if none of these options were possible, to try and avoid problem-solving or thinking through specific problems. They were advised that the experimenter would tell them when three minutes had elapsed, and at that time they should open their eyes as the experiment would start 15 seconds later.

After being instructed to open their eyes, participants saw the target face for five seconds. This part of the experiment, and the remainder of the experiment, proceeded exactly as in Experiment 1. To summarise, participants in the Navon groups spent the next 10 minutes writing down each Navon letter as they identified it, and participants in the control group rated animal photographs for 10 minutes. At the end of 10 minutes, all participants saw a sequential lineup of the target and distractor faces. Each face was displayed for 15 seconds. Participants did not do the Cognitive Styles Analysis task given after the lineup in Experiment 1.
Results

Face Identification

Participants in the control group performed as expected with 62% correctly identifying the target face. The better recognition by local participants over global participants seen in Experiment 1 was not present with the small sample size of Experiment 5, however combining the data from Experiment 5 and Experiment 1 data did not change the outcomes of Experiment 1. Analysing the combined data showed that the effect of processing orientation on face recognition still only approached significance, \( \chi^2(2) = 4.76, p = .093, \phi = 0.23 \) (previously \( \chi^2(2) = 4.85, p = .089, \phi = 0.26 \)), and additional analyses showed that the local group were still more likely to correctly identify the face than the global group, \( \chi^2(1) = 4.72, p = .030, \phi = 0.28 \) (previously \( \chi^2(1) = 4.86, p = .027, \phi = 0.26 \)). The number of correct and incorrect identifications of the target and the number of misses for each group are shown in Table 3.1, and the combined data from Experiments 1 and 5 are shown in Table 3.2.

Table 3.1

Experiment 5: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Global</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>5 (62%)</td>
<td>5 (71%)</td>
<td>5 (71%)</td>
<td>15 (68%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>3 (38%)</td>
<td>2 (29%)</td>
<td>2 (29%)</td>
<td>7 (32%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(0)</td>
<td>(0)</td>
<td>(1)</td>
<td>(1)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (100%)</td>
<td>7 (100%)</td>
<td>7 (100%)</td>
<td>22 (100%)</td>
</tr>
</tbody>
</table>


Table 3.2

Experiments 1 and 5: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Global</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>21 (64%)</td>
<td>17 (55%)</td>
<td>25 (78%)</td>
<td>63 (66%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>12 (34%)</td>
<td>14 (45%)</td>
<td>7 (22%)</td>
<td>33 (34%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(3)</td>
<td>(4)</td>
<td>(4)</td>
<td>(11)</td>
</tr>
<tr>
<td>Total</td>
<td>33 (100%)</td>
<td>31 (100%)</td>
<td>32 (100%)</td>
<td>96 (100%)</td>
</tr>
</tbody>
</table>

Ear Temperature (fTMT) Data Recordings

The TMT for each ear was recorded every 50 milliseconds for each participant. Data for each participant were split into two files: one file for the baseline data and one file for the remainder-of-the-experiment data. A baseline temperature for each ear was calculated by averaging the final 10 recordings (500 milliseconds) of the three-minute baseline period.

Data in the second, post-baseline data file were “cleaned” of any temperature spikes associated with body movement in the following manner. The mean temperature for the entire file was calculated. Then, for any fTMT recording that was more than two standard deviations above or below that mean temperature of the entire file, that recording was replaced by a new reading. The new reading was the mean of the 5 readings immediately preceding it and the mean of the 5 readings immediately after it.

Baseline TMT Data

For ease of reading, important points on the experimental timeline will be referred to as Time 0, Time 1, Time 2 and Time 3. The mapping of these labels to activities is shown in Table 3.3.
Table 3.3

Mapping of Time Labels to Activities

<table>
<thead>
<tr>
<th>Activity Label</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of Baseline</td>
<td>Time 0</td>
</tr>
<tr>
<td>End of Baseline</td>
<td>Time 1</td>
</tr>
<tr>
<td>End of Navon/Control task</td>
<td>Time 2</td>
</tr>
<tr>
<td>End of Lineup</td>
<td>Time 3</td>
</tr>
</tbody>
</table>

Data from the 3 left-handed participants were omitted from the analysis. For the remaining 19 participants, the average tympanic membrane temperatures at the beginning of the baseline period were 37.60°C ($SD = 1.23$) for the right ear and 38.14°C ($SD = 1.01$) for the left ear. The right TMT was lower than the left TMT, $t_{(19)} = -2.102$, $p = .050^{13}$. There was, however, no significant difference in right or left TMT for gender ($p = .744$ and $p = .601$ respectively).

A 2 (right ear, left ear) x 2 (Time 0, Time 1) x 2 (male, female) split plot ANOVA showed that there was a small but significant ear by time interaction, Wilks $\Lambda = .758$, $F_{(1,17)} = 5.439$, $p = .032$, multivariate $\eta^2 = .242$, with both left and right TMT readings dropping over the course of the baseline period. There was, however, no effect of gender and the three-way interaction (ears by time by gender) was not significant.

Due to the differences in the way the brains of right-handed and left-handed individuals can be organised, it cannot be assumed that left-handers have language and verbal abilities lateralised to the left hemisphere (Hellige, 2001; Springer & Deutsch, 1993). Hence, only right-handed participants were included in the fTMT data analysis as over 95% of these participants can be expected to show left hemisphere dominance for language (Springer & Deutsch).

---

12 Due to the differences in the way the brains of right-handed and left-handed individuals can be organised, it cannot be assumed that left-handers have language and verbal abilities lateralised to the left hemisphere (Hellige, 2001; Springer & Deutsch, 1993). Hence, only right-handed participants were included in the fTMT data analysis as over 95% of these participants can be expected to show left hemisphere dominance for language (Springer & Deutsch).

13 This may be due to calibration of the equipment which is done manually. Cherbuin and Brinkman (2007) have analysed their results in terms of probe position (i.e., the helmet was worn both forwards and backwards by participants to ensure both left and right TMT were recorded with the same physical probe), and they found no effect of probe position. Hence, it is postulated that the separate, manual calibration of each temperature probe that was carried out before these experiments were run is responsible for a slightly lower reading from one probe. This probe recorded the right TMT of all participants.
The results of the analysis are shown in Table 3.4 and the TMT data for each group are shown in Figure 3.5.

Table 3.4

*Experiment 5: Multivariate and Between-Subject Statistics for Baseline Period (N=19)*

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>P</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.729</td>
<td>6.334</td>
<td>.022</td>
<td>.271</td>
</tr>
<tr>
<td>Time</td>
<td>.173</td>
<td>81.466</td>
<td>&lt;.001</td>
<td>.827</td>
</tr>
<tr>
<td>Gender¹</td>
<td>--</td>
<td>0.448</td>
<td>.512</td>
<td>.026</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.758</td>
<td>5.439</td>
<td>.032</td>
<td>.242</td>
</tr>
<tr>
<td>Ears x gender</td>
<td>&gt;.999</td>
<td>0.001</td>
<td>.972</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Time x gender</td>
<td>.901</td>
<td>1.877</td>
<td>.189</td>
<td>.099</td>
</tr>
<tr>
<td>Ears x time x gender</td>
<td>.987</td>
<td>0.215</td>
<td>.649</td>
<td>.013</td>
</tr>
</tbody>
</table>

¹Gender is the between-subjects variable.
Figure 3.5. Experiment 5: fTMT data for baseline period\textsuperscript{14}.

Post-Baseline TMT Data

A baseline temperature for each ear for each participant was calculated by averaging the final 10 readings of the baseline period. Baseline temperatures were then subtracted from all temperature measurements for all tasks, and the data were analysed to determine if there were differential changes in left and right TMT associated with the different cognitive tasks. A decrease in TMT is associated with greater activation of the same hemisphere. Hence, a decrease in left TMT indicates greater left hemisphere activation, and a decrease in right TMT indicates greater right hemisphere activation.

As can be seen in Figure 3.6, participants in the local Navon condition showed very different results for left and right TMT during the experiment with decreases in left TMT and increases in right TMT. In contrast, participants in the global Navon condition (Figure 3.7) showed little change in either left or right TMT during the experiment. Finally, participants in the control group (Figure 3.8) showed decreases in both left and right TMT which appeared to be similar in degree.

\textsuperscript{14} Unless indicated otherwise, all error bars on graphs are ± 2 SE.
Figure 3.6. Experiment 5: fTMT data for local Navon participants.

Figure 3.7. Experiment 5: fTMT data for global Navon participants.

Figure 3.8. Experiment 5: fTMT data for control participants.
**TMT Changes during the Control and Navon Tasks**

To investigate the changes in TMT during the control and Navon tasks, a 2 (right ear, left ear) x 2 (Time 1, Time 2) x 3 (control, global Navon, local Navon) split plot ANOVA was performed. The only non-significant result was the strong main effect for time ($p = .081$). All other results were significant including the moderate three-way (ear by time by condition) interaction, Wilks $\Lambda = .569$, $F(2, 16) = 6.069$, $p = .011$, multivariate $\eta^2 = .431$. The results of the split plot ANOVA are shown in Table 3.5.

**Table 3.5**

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>$F$</th>
<th>$p$</th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.733</td>
<td>5.822</td>
<td>.028</td>
<td>.267</td>
</tr>
<tr>
<td>Time</td>
<td>.822</td>
<td>3.463</td>
<td>.081</td>
<td>.178</td>
</tr>
<tr>
<td>Condition¹</td>
<td>--</td>
<td>5.076</td>
<td>.020</td>
<td>.388</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.642</td>
<td>8.928</td>
<td>.009</td>
<td>.358</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.598</td>
<td>5.374</td>
<td>.016</td>
<td>.402</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.594</td>
<td>5.476</td>
<td>.015</td>
<td>.406</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.569</td>
<td>6.069</td>
<td>.011</td>
<td>.431</td>
</tr>
</tbody>
</table>

¹Condition is the between-subjects (local, global, control) variable.

The three-way interaction between ears, time and condition indicates that there was a differential effect of each task on each TMT over the duration of the task. Participants in the local Navon condition appeared to engage the left hemisphere but not the right as they recorded a decrease in left TMT, and a slight increase in right TMT (see Figure 3.9). In contrast, the right and left TMT of participants in the global Navon condition rose slightly during this task suggesting that participants may not have engaged either hemisphere to any significant degree (see Figure 3.10). Participants in the control condition showed similar decreases in both left and right TMT readings suggesting that both hemispheres were engaged to a similar extent (see Figure 3.11).
Figure 3.9. Experiment 5: fTMT data for local Navon task only.

Figure 3.10. Experiment 5: fTMT data for global Navon task only.

Figure 3.11. Experiment 5: fTMT data for control task only.
For each group, planned comparisons were carried out to confirm that the baseline left and right TMT values did not differ significantly, and to determine whether the left and right TMT readings differed on completion of the control and Navon tasks. In addition, planned comparisons were used to examine whether the left and right TMT changed significantly from Time 1 to Time 2. The mean temperature deviations for each group at each time are shown in Table 3.6.

Table 3.6

<p>| Experiment 5: Mean TMT Readings for Time 1 and Time 2 for each Condition |
|---------------------------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 1</th>
<th>Mean (SD) at Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>+0.042 (.13)</td>
<td>+0.329 (.38)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.004 (.13)</td>
<td>-0.368 (.35)</td>
</tr>
<tr>
<td>Global</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>+0.017 (.06)</td>
<td>+0.098 (.40)</td>
</tr>
<tr>
<td>Left</td>
<td>+0.042 (.06)</td>
<td>+0.119 (.38)</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.030 (.08)</td>
<td>-0.324 (.14)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.024 (.04)</td>
<td>-0.399 (.19)</td>
</tr>
</tbody>
</table>

Local Navon group.

For participants in the local Navon group, planned comparisons showed that, as expected, the left and right TMT did not differ significantly at the end of the baseline period (Time 1). They did differ, however, on completion of the local Navon task, \(t(5) = 3.523, p = .017\), with the left TMT being significantly lower than the right TMT. The drop in left TMT over the duration of the local Navon task was also significant, \(t(5) = 3.522, p = .017\), indicating that this task resulted in left hemisphere activation. The increase in right TMT between baseline and the end of the Navon task was not significant. These results suggest that the local Navon task activated the left hemisphere, but not the right. The results of all planned comparisons for the local Navon group are shown in Table 3.7.
**Global Navon group.**

For participants in the global Navon group, planned comparisons showed that the left and right TMT did not differ significantly at any point. As expected, there was no difference in left and right TMT at the end of the baseline period. The change (increase) in right TMT over the duration of the global Navon task was not significant, and the left TMT increase from baseline was also non-significant. The results of all planned comparisons for the global Navon group are shown in Table 3.5.

**Control group.**

For participants in the control group, planned comparisons showed again that the left and right TMT did not differ significantly at the end of the baseline period. In addition, the left and right TMT readings did not differ on completion of the control task either. This suggests that the control task (rating animal pictures) activated both hemispheres to a similar degree as there was a significant drop in both left ($t(5) = 5.193, p = .003$) and right ($t(5) = 5.618, p = .002$) TMT from the end of the baseline period to the end of the control task. The results of all planned comparisons for the control group are shown in Table 3.5.
Table 3.5

Experiment 5: Planned Comparisons for Time 1 and Time 2 for Each TMT for Each Condition

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference (SD)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong>^1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right and left TMT at Time 1</td>
<td>0.046 (.08)</td>
<td>1.458</td>
<td>.205</td>
</tr>
<tr>
<td>Right and left TMT at Time 2</td>
<td>0.696 (.48)</td>
<td>3.523</td>
<td>.017</td>
</tr>
<tr>
<td>Right TMT at Time 1 and Time 2</td>
<td>-0.286 (.33)</td>
<td>-2.112</td>
<td>.088</td>
</tr>
<tr>
<td>Left TMT at Time 1 and Time 2</td>
<td>0.364 (.25)</td>
<td>3.522</td>
<td>.017</td>
</tr>
<tr>
<td><strong>Global</strong>^2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right and left TMT at Time 1</td>
<td>-0.026 (.10)</td>
<td>-0.675</td>
<td>.525</td>
</tr>
<tr>
<td>Right and left TMT at Time 2</td>
<td>-0.021 (.40)</td>
<td>-0.140</td>
<td>.893</td>
</tr>
<tr>
<td>Right TMT at Time 1 and Time 2</td>
<td>-0.082 (.39)</td>
<td>-0.559</td>
<td>.596</td>
</tr>
<tr>
<td>Left TMT at Time 1 and Time 2</td>
<td>-0.077 (.34)</td>
<td>-0.597</td>
<td>.572</td>
</tr>
<tr>
<td><strong>Control</strong>^3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right and left TMT at Time 1</td>
<td>-0.006 (.08)</td>
<td>-0.187</td>
<td>.859</td>
</tr>
<tr>
<td>Right and left TMT at Time 2</td>
<td>0.080 (.30)</td>
<td>0.607</td>
<td>.570</td>
</tr>
<tr>
<td>Right TMT at Time 1 and Time 2</td>
<td>0.294 (.13)</td>
<td>5.618</td>
<td>.002</td>
</tr>
<tr>
<td>Left TMT at Time 1 and Time 2</td>
<td>0.375 (.18)</td>
<td>5.193</td>
<td>.003</td>
</tr>
</tbody>
</table>

^1 N = 6
^2 N = 7
^3 N = 6
Comparison of Control and Navon Task Effects on each Hemisphere

Right TMT and hemisphere activation.

Planned comparisons to investigate whether the control and Navon tasks produced differential right hemisphere activity were carried out with a univariate ANOVA with right TMT at the end of the control/Navon task as the dependent variable, and condition as the independent variable. Results showed that participants in the control group experienced greater right TMT decreases than those in the local and global Navon groups, $p = .004$ and $p = .029$ respectively, suggesting that participants in the control group engaged their right hemisphere to a greater extent than participants in either the global or local Navon groups. This task did not produce differential right hemisphere activation for the Navon groups as there was no difference in right TMT for local and global Navon participants, $p = .232$ (see Figure 3.9).

Figure 3.9. Experiment 5: Right TMT data for control and Navon conditions.
**Left TMT and hemispheric activation.**

Planned comparisons to investigate whether the control and Navon tasks produced differential left TMT activity were carried out with a univariate ANOVA with left TMT at Time 2 (end of control/Navon task) as the dependent variable, and condition as the independent variable. Results showed that participants in the local Navon and control groups experienced greater left TMT decreases than those in the global Navon condition, $p = .010$ and $p = .015$ respectively. This suggests that participants in the local Navon and control groups engaged their left hemisphere to a greater extent than participants in the global Navon task. There was no difference in left TMT for local Navon and control participants ($p = .867$) as both groups showed significant left TMT decreases. These two groups activated the left hemisphere to a similar extent (see Figure 3.10).

![Figure 3.10. Experiment 5: Left TMT data for control and Navon conditions.](image)

**Hemispheric Activation during the Lineup Task**

To determine whether hemispheric activation changed during the lineup task, planned comparisons were computed for each group. There were no significant changes in left or right TMT readings from the beginning of the lineup task to the end of the
lineup task for any group. This suggests that hemispheric activation did not change for any participant during the lineup task. The mean temperatures for each condition are shown in Table 3.6, and the results of the planned comparisons are shown in Table 3.7.

Table 3.6

Experiment 5: Mean TMT Readings for Time 2 and Time 3 for each Condition

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 2</th>
<th>Mean (SD) at Time 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Right</td>
<td>+0.329 (.38)</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>-0.368 (.35)</td>
</tr>
<tr>
<td>Global</td>
<td>Right</td>
<td>+0.098 (.40)</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>+0.119 (.38)</td>
</tr>
<tr>
<td>Control</td>
<td>Right</td>
<td>-0.324 (.14)</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>-0.399 (.19)</td>
</tr>
</tbody>
</table>
### Table 3.7

*Experiment 5: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition*

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference (SD)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>-0.072 (.11)</td>
<td>-1.617</td>
<td>.167</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.007 (.08)</td>
<td>0.224</td>
<td>.831</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>-0.019 (.09)</td>
<td>-0.574</td>
<td>.587</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.003 (.07)</td>
<td>0.123</td>
<td>.906</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>0.032 (.06)</td>
<td>1.317</td>
<td>.245</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.035 (.06)</td>
<td>1.495</td>
<td>.195</td>
</tr>
</tbody>
</table>

1. N = 6
2. N = 7
3. N = 6

\( \cdot \)
Discussion

This experiment looked for converging evidence from fTMT for the processing shifts associated with the global and local Navon tasks performed by participants in Experiment 1. It also sought confirmation that control participants did not experience a processing shift and that participants did not experience a change in processing during the lineup phase. A decrease in TMT is associated with increased activation of the ipsilateral hemisphere, so evidence of a shift toward local processing was hypothesised to manifest as a decrease in left TMT. Similarly, evidence of a shift toward global processing was hypothesised to manifest as a decrease in right TMT. Finally, control participants were expected to either show no change in left and right TMT if the control task had no effect on processing strategy, or to show a decrease in right TMT if the control task enhanced global processing. Analysis of the fTMT data showed that there was a significant ear by time by condition interaction indicating that the tasks differentially affected left and right TMT over the duration (10 minutes) of the task between encoding and lineup, but not during the lineup phase itself.

Local Navon Condition

The first hypothesis included two predictions. The first prediction, that participants in the local Navon condition would show more left hemisphere activation than right hemisphere activation, was supported. Local Navon participants exhibited a significant drop in left TMT over the course of the local Navon task, and participants' left TMT was significantly lower than their right TMT at the end of this task. The right TMT of participants in this group did not decrease at all during this task, rather it increased, but not to a significant degree. The meaning of an *increase* in TMT is not clear. Meiners and Dabbs (1977) suggested that increases in TMT might be associated with anxiety, a failure to concentrate, or perhaps any condition that involved general arousal. In this situation, general arousal could be assumed to be the result of interaction with an experimenter who was unknown to the participants. However, although right TMT increased, this change was not significant suggesting that further interpretation of these results is not necessary at this stage.

The second prediction of this hypothesis, that local Navon participants would show greater left hemisphere activation than global Navon or control participants, was
only partially supported. Local Navon participants showed a significantly greater drop in left TMT than participants in the global Navon condition, but not those in the control condition. Overall, the results for the local Navon participants suggest these participants engaged their left hemisphere to a greater degree than their right during the local Navon task, and the task produced greater left hemisphere activation than that produced by the global Navon task.

**Global Navon Condition**

For the global Navon condition participants, it was hypothesised that participants would not engage their right hemispheres to a greater degree than their left because of the local bias of these Navon letters. This hypothesis was supported. Participants in the global Navon group showed no decrease in right TMT over the duration of the task. In fact, both right and left TMT increased, however this increase was slight and not significant. It was also predicted that participants in the global Navon group would not show greater right hemisphere than those in the local or control groups. Again, this hypothesis was supported as there was no difference in right hemisphere activation for global and local Navon participants, and the control group engaged their right hemispheres to a greater degree than global Navon participants. The results suggest that these Navon stimuli were locally biased and, as hypothesised in Chapter 2, participants in the global Navon group were not able to engage in the global processing expected with such a task.

**Control Condition**

The third hypothesis concerned the control group and was exploratory. It was firstly predicted that if the control participants did not experience any change in processing style, their left and right TMT would not change significantly over the duration of the picture-rating task. This hypothesis was not supported. Participants in the control group experienced significant decreases in both left and right TMT during the control task with very similar activation of both hemispheres.
**Lineup**

Participants in all groups showed minimal change in left and right TMT during the lineup task, none significant, suggesting that hemispheric activation did not change as a result of this task.

**Summary**

The results of this experiment confirm the suggestion from Chapter 2 that these particular Navon letters have a local bias that prevents participants from engaging in global processing. While strong left hemisphere activation was evident for the local Navon participants, there was no corresponding right hemisphere activation for global Navon participants. Interestingly, the control group results showed that in a task hypothesised not to favour one hemisphere over the other, participants engaged both hemispheres equally and to a significant degree. Unfortunately, the applicability of this result is limited as this control task has not been used in any other Navon or verbal overshadowing studies. The results do indicate, however, that participants in the control condition engaged their left hemisphere to a similar degree as those in the local Navon condition. This was unexpected, and perhaps suggests that the local bias manifests as a result of greater left hemispheric activation *without* the greater right hemispheric activation also seen with the control group. Lastly, the results suggest that processing mode does not change during the lineup task. It would appear that whatever form of processing is engaged before lineup, the identification task itself does not alter this. As the remainder of this chapter investigated the hemispheric activation evidenced by TMT changes for several experiments and these findings are somewhat complex, the (cumulative) findings have been summarised in a table at the end of each discussion (see Table 3.8 for Experiment 5 findings).
Table 3.8
Experiment 5: Summary of Hemispheric Activation for Each Condition and Phase

<table>
<thead>
<tr>
<th>Condition</th>
<th>Phase</th>
<th>Significant Increase in LH Activation</th>
<th>Significant Increase in RH Activation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Navon task</td>
<td>✔ (and &gt; RH, &gt; Global)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lineup</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Global</td>
<td>Navon task</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td></td>
<td>Lineup</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td></td>
<td>Picture rating</td>
<td>✔ (and &gt; Global)</td>
<td>✔ (and &gt; Local, &gt; Global)</td>
</tr>
<tr>
<td>Control</td>
<td>Lineup</td>
<td>❌</td>
<td>❌</td>
</tr>
</tbody>
</table>

*p < .05
3.4 Experiment 6

The results of Experiment 5 provided fTMT data which supported the notion that the locally biased Navon letters inhibited global processing. Participants in the global condition of Experiment 5 did not experience any decrease in right TMT during the Navon task. In Experiment 6, the equally salient Navon stimuli were used. Experiment 6 is the presentation of the fTMT data collected during the Macrae and Lewis (2002) replication (Experiment 3). In Experiment 3, the local Navon group were poorer at recognition than the global Navon group. The unexpected finding of that study was the extremely poor identification rates of control participants. As these Navon letters produced the behavioural outcomes associated with global and local processing, it was predicted that if the equally salient Navon letters allowed participants to engage in global and local processing to the same extent, the right and left TMT decreases associated with global and local processing would be evident. Hence, in Experiment 6 it was hypothesised that:

- The local Navon group would show greater left than right hemisphere activation, and as a result would show a greater decrease in left TMT than right, and a greater decrease in left TMT than the global Navon and control groups; and

- The global Navon group would show greater right than left hemisphere activation which would manifest as a greater decrease in right TMT than left, and a greater decrease in right TMT than the local Navon and control groups.

Method

Design

Experiment 6 was a simple Navon local, global or control condition between-subjects design.
Participants

Participants were 24 Caucasian individuals affiliated with the Australian National University either as students or staff. Participants received payment of $6 for participating in this experiment. There were 15 female, and 9 male participants whose ages ranged from 18 to 52 years ($M = 27.9$, $SD = 10.41$). All 24 participants were right-handed with scores on the Edinburgh Handedness Inventory ranging from +0.7 to +1 ($M = +0.9$, $SD = 0.12$).

Materials

The head-and-shoulder faces from Experiments 2 and 3, and the equally salient Navon letters from Experiments 3 and 4 were used for this experiment. These stimuli are shown here in Figure 3.11 and Figure 3.12 for clarity.
Procedure

The procedure for this experiment was identical to that of Experiment 3 as this data was collected during Experiment 3.

Results

Face Identification and Discrimination Ratings

For full results see Experiment 3. In summary, recognition was affected by processing orientation with global condition participants outperforming those in the control condition. The difference between global and local participants did not reach significance possibly due to the small sample size.

Ear Temperature (fTMT) Data Recordings

The tympanic membrane temperature for each ear was recorded every 50 milliseconds for each participant. Data for one participant were unavailable, but data for the remaining 23 participants were “cleaned” of any temperature spikes as in Experiment 5. The TMT data violated normality as kurtosis of left ear temperatures was +13.2. Further investigation found that one participant’s left ear data were more than 3 standard deviations outside the mean. These data were considered outliers and removed from the analysis. As a result, kurtosis for left ear temperature data returned to an acceptable level of +2.6.
Baseline fTMT Data

The average tympanic membrane temperatures for the remaining 22 participants at the beginning of the baseline period were 38.05° C (SD = 0.83) for the right ear and
38.44° C (SD = 0.78) for the left ear. As in Experiment 5, the right TMT was lower than the left TMT, \( t_{21} = -3.273, p = .004 \). There was no significant difference in right TMT for gender (\( p = .113 \)), however males (\( M = 37.87 \) (SD = 0.38)) had a significantly lower left TMT than females, \( t_{(10.05)} = -3.075, p = .012^{15} \), with mean left TMT of 37.87° C (SD = 0.38) and 38.83° C (SD = 0.88) respectively.

A 2 (right ear, left ear) x 2 (Time 0, Time 1) x 2 (male, female) split plot ANOVA showed a medium effect for ear, Wilks \( \Lambda = .697, F_{(1,20)} = 8.702, p = .008 \), multivariate \( \eta^2 = .303 \), a medium effect for gender, \( F_{(1,20)} = 9.644, p = .006 \), partial \( \eta^2 = .325 \), and a strong effect for time, Wilks \( \Lambda = .116, F_{(1,20)} = 152.122, p < .001 \), multivariate \( \eta^2 = .884 \). None of the interactions were significant. The results of the analysis are shown in Table 3.9, and it can be seen from Figure 3.13 that both left and right TMT dropped for males and females over the duration of the baseline period. As the remainder of the analysis depends only on temperature changes relative to the baseline (rather than absolute temperatures), and there was no interaction between gender and time or ear, the data will be analysed without accounting for gender separately.

---

\(^{15}\) Equal variances not assumed as Levene’s test of equality of variances was violated, \( p = .045 \).
Table 3.9

Experiment 6: Multivariate and Between-Subject Statistics for Baseline Period (N=22)

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>p</th>
<th>Partial ( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.697</td>
<td>8.702</td>
<td>.008</td>
<td>.303</td>
</tr>
<tr>
<td>Time</td>
<td>.116</td>
<td>152.122</td>
<td>&lt;.001</td>
<td>.884</td>
</tr>
<tr>
<td>Gender(^1)</td>
<td>--</td>
<td>9.644</td>
<td>.006</td>
<td>.325</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.996</td>
<td>0.085</td>
<td>.774</td>
<td>.004</td>
</tr>
<tr>
<td>Ears x gender</td>
<td>.885</td>
<td>2.600</td>
<td>.123</td>
<td>.115</td>
</tr>
<tr>
<td>Time x gender</td>
<td>.982</td>
<td>0.369</td>
<td>.551</td>
<td>.018</td>
</tr>
<tr>
<td>Ears x time x gender</td>
<td>.874</td>
<td>2.895</td>
<td>.104</td>
<td>.126</td>
</tr>
</tbody>
</table>

\(^1\)Gender is the between-subjects variable.

![Figure 3.13. Experiment 6: fTMT data for baseline period.](image-url)
Post-Baseline fTMT Data

As in Experiment 5, a baseline temperature for each ear for each participant was calculated by averaging the final 10 readings of the baseline period. These baseline readings were then subtracted from all temperature measurements for all tasks, and the data were analysed to investigate hemispheric activation. Participants in the local and global Navon groups showed similar decreases in right and left TMT readings over the duration of the experiment (see Figure 3.14 and Figure 3.15), while participants in the control condition appeared to exhibit greater left TMT decreases than right (see Figure 3.16).
Figure 3.17. Experiment 6: fTMT data for local Navon participants.

Figure 3.18. Experiment 6: fTI* data for global Navon participants.

Figure 3.19. Experiment 6: fTMT data for control participants.
**TMT Changes during the Control and Navon Tasks**

To investigate the changes in TMT during the control and Navon tasks, a 2 (right ear, left ear) x 2 (Time 1, Time 2) x 3 (control, global Navon, local Navon) split plot ANOVA of the fTMT data was performed. There was a main effect for ear and a main effect for time. There was no effect of condition, and no interactions were significant. The results of the split plot ANOVA are shown in Table 3.12.

<table>
<thead>
<tr>
<th>Table 3.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 3.12</td>
</tr>
<tr>
<td>Experiment 6: Multivariate and Between-Subjects Statistics for Navon and Control Tasks</td>
</tr>
<tr>
<td>(N=22)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.619</td>
<td>11.681</td>
<td>.003</td>
<td>.381</td>
</tr>
<tr>
<td>Time</td>
<td>.463</td>
<td>22.007</td>
<td>&lt;.001</td>
<td>.537</td>
</tr>
<tr>
<td>Condition¹</td>
<td>--</td>
<td>0.512</td>
<td>.608</td>
<td>.051</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.891</td>
<td>2.319</td>
<td>.144</td>
<td>.109</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.809</td>
<td>2.236</td>
<td>.134</td>
<td>.191</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.973</td>
<td>0.261</td>
<td>.773</td>
<td>.027</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.864</td>
<td>1.493</td>
<td>.250</td>
<td>.136</td>
</tr>
</tbody>
</table>

¹Condition is the between-subjects (local, global, control) variable.

Participants in both the local and global Navon conditions experienced decreases in both left and right TMT suggesting that these participants engaged both hemispheres to a similar degree. However, the local Navon group did experience a larger drop than the global Navon group (see Figure 3.20 and Figure 3.21). Participants in the control condition showed a strong drop in left TMT and a smaller drop in right TMT (see Figure 3.22). The lack of an effect of condition is suggested by a consistent drop in left TMT across all conditions and a lesser drop in right TMT.
Figure 3.20. Experiment 6: fTMT data for local Navon task only.

Figure 3.21. Experiment 6: fTMT data for global Navon task only.

Figure 3.22. Experiment 6: fTMT data for control task only.
As in Experiment 5, planned comparisons were carried out to confirm that the left and right baseline TMT values did not differ, and to determine whether the final left and right TMT readings differed as expected. Finally, planned comparisons were done to determine whether there was a significant change in left or right TMT as a result of each task. The mean temperature deviations for Time 1 and Time 2 for each group are shown in Table 3.13.

Table 3.13

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 1</th>
<th>Mean (SD) at Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.010 (.05)</td>
<td>-0.230 (.12)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.062 (.07)</td>
<td>-0.278 (.14)</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.003 (.03)</td>
<td>-0.139 (.19)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.043 (.05)</td>
<td>-0.207 (.21)</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.026 (.06)</td>
<td>-0.127 (.32)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.122 (.22)</td>
<td>-0.383 (.33)</td>
</tr>
</tbody>
</table>

**Local Navon group.**

Results for participants in the local Navon group showed that, as expected, left and right TMT did not differ significantly at the end of the baseline period ($p = .143$). However, there was a significant decrease in both right and left TMT during the local Navon task, $t(6) = 4.400$, $p = .005$ and $t(6) = 3.259$, $p = .017$ respectively. There was no difference in the level of activation of the two hemispheres ($p = .354$) suggesting that neither hemisphere was preferentially engaged.

**Global Navon group.**

As expected, the global Navon group showed no difference in left and right TMT at the end of the baseline period ($p = .100$). This group showed a smaller drop in right and left TMT than the local Navon group. Drops in both right and left TMT approached, but did not reach, significance ($p = .089$ and $p = .070$ respectively). Again, there was no preferential engagement of one hemisphere ($p = .308$).
Control group.

There was no difference in the end of baseline readings for left and right TMT in the control group ($p = .350$). Unlike the Navon groups, this group only showed significant activation of the left hemisphere over the duration of the task, $t_{(6)} = 4.074$, $p = .007$, and the activation of the left hemisphere was significantly greater than that of the right, $t_{(6)} = 3.640$, $p = .011$.

Comparison of Control and Navon Task Effects on each Hemisphere

Right TMT and hemispheric activation.

Planned comparisons to investigate whether the control and Navon tasks produced differential right hemisphere activity were carried out. A univariate ANOVA was performed with right TMT at the end of the control/Navon task as the dependent variable, and condition as the independent variable. Results showed no effect of condition on right hemisphere activation $F_{(2,19)} = 0.447$, $p = .646$ (see Figure 3.20). Contrasts confirmed there were no differences across the three groups (control and global, $p = .923$; local and global, $p = .441$; and local and control, $p = .403$).

Figure 3.20. Experiment 6: Right TMT data for control and Navon conditions.
**Left TMT and hemispheric activation.**

Planned comparisons to investigate whether the control and Navon tasks produced differential left TMT activity were carried out with a univariate ANOVA using left TMT at the end of control/Navon task as the dependent variable, and condition as the independent variable. As with right TMT, results showed no effect of condition, $F_{(2,19)} = 1.011, p = .383$ (see Figure 3.21). This was confirmed by contrasts across the three groups (control and global, $p = .172$; local and global, $p = .573$; and local and control, $p = .423$).

![Figure 3.21. Experiment 6: Left TMT data for control and Navon conditions.](image)

**Hemispheric Activation during the Lineup Task**

To investigate the changes in TMT during the lineup task, a 2 (right ear, left ear) x 2 (Time 2, Time 3) x 3 (control, global, local) split plot ANOVA of the fTMT data was performed. The only significant result was a moderate main effect for ear.

---

16 As this lineup was untimed, it was not possible to determine an “end of lineup” point in time. For this reason, an arbitrary timeframe of 50 seconds was allocated to the lineup task as this was the shortest time for the lineup by any participant.
indicating that there were differences in left and right TMT readings, Wilks $\Lambda = .627$, $F_{(1, 19)} = 11.315$, $p = .003$, multivariate $\eta^2 = .373$. The mean temperature deviations from the end of the control/Navon task to the end of the lineup task are shown in Table 3.12, and the results of the split plot ANOVA are shown in Table 3.13.

Table 3.12

*Experiment 6: Mean TMT Readings for Time 2 and Time 3 for each Condition*

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 2</th>
<th>Mean (SD) at Time 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.240 (.14)</td>
<td>-0.274 (.14)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.340 (.13)</td>
<td>-0.358 (.18)</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.142 (.20)</td>
<td>-0.144 (.18)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.249 (.22)</td>
<td>-0.290 (.26)</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.154 (.34)</td>
<td>-0.132 (.29)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.505 (.54)</td>
<td>-0.385 (.28)</td>
</tr>
</tbody>
</table>

Table 3.13

*Experiment 6: Multivariate and Between-Subject Statistics for Lineup Tasks (N=22)*

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>$F$</th>
<th>$p$</th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.627</td>
<td>11.315</td>
<td>.003</td>
<td>.373</td>
</tr>
<tr>
<td>Time</td>
<td>.996</td>
<td>0.068</td>
<td>.796</td>
<td>.004</td>
</tr>
<tr>
<td>Condition$^1$</td>
<td>--</td>
<td>0.442</td>
<td>.649</td>
<td>.044</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.951</td>
<td>0.969</td>
<td>.337</td>
<td>.049</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.861</td>
<td>1.535</td>
<td>.241</td>
<td>.139</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.895</td>
<td>1.112</td>
<td>.349</td>
<td>.105</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.793</td>
<td>2.476</td>
<td>.111</td>
<td>.207</td>
</tr>
</tbody>
</table>

$^1$Condition is the between-subjects (control, global, local) variable.
To determine whether hemispheric activation changed during the lineup task, planned comparisons were computed for each group. There were no significant changes in left or right TMT readings from Time 2 to Time 3 for any groups. The results of the planned comparisons are shown in Table 3.14.

Table 3.14
Experiment 6: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference (SD)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>0.034 (.06)</td>
<td>1.492</td>
<td>.186</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.018 (.07)</td>
<td>0.737</td>
<td>.489</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>0.002 (.05)</td>
<td>0.102</td>
<td>.922</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.041 (.07)</td>
<td>1.643</td>
<td>.144</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>-0.022 (.17)</td>
<td>-0.352</td>
<td>.737</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>-0.119 (.31)</td>
<td>-1.004</td>
<td>.354</td>
</tr>
</tbody>
</table>

1 N = 7
2 N = 8
3 N = 7
Discussion

This experiment examined the hemispheric activation associated with a Navon letter task that used equally salient compound stimuli to replicate Macrae and Lewis' study (2002). It sought evidence of left hemisphere activation for the local Navon task and right hemisphere activation for the global Navon task. In addition, it explored the hemispheric activity associated with the control task of reading aloud. The results did not show differential hemispheric activity across conditions. The TMT changes were similar across manipulations with all groups showing a drop in left TMT, and a lesser drop in right TMT.

Local Navon condition.

The first hypothesis included two predictions. The first prediction that participants in the local Navon condition would show greater left hemisphere activation than right hemisphere activation was not supported. Although local Navon participants did show a significant drop in left TMT over the course of the local Navon task, the difference between left and right TMT readings at the end of the Navon period was not significant. The second prediction that local Navon participants would show greater left hemisphere activation than global Navon or control participants was not supported either. Local Navon participants showed a numerically greater decrease in left TMT than global Navon participants, but this difference was not significant. These results suggest that while the equally salient Navon letters produced left hemisphere activation for local Navon participants, it was not greater than the right hemisphere activation.

Global Navon condition.

For the global Navon condition, it was hypothesised that participants would engage their right hemispheres to a greater degree than their left. This hypothesis was not supported. The global Navon group showed a similar pattern of hemispheric activation to the local Navon group, but to a lesser extent. The activation of both right and left hemispheres approached, but did not reach, significance. This may be due to the small cell sizes of this experiment. It was also predicted that participants in the global Navon group would show greater right hemisphere than those in the local or control groups, but once again, this hypothesis was not supported. There was no difference in right hemisphere activation for global, local or control participants.
Control condition.

Hemispheric activation for the control group was slightly different to that of the Navon groups. Although the control group showed significant left hemisphere activation during the reading aloud task, there was no significant right hemisphere activity. These results suggest that such a task engages the left hemisphere preferentially over the right.

Lineup

The results of the lineup must be interpreted with some caution as this lineup was untimed and each participant did not spend an identical amount of time on the lineup task. It cannot be assumed that each participant was doing the same task at the analysis point chosen. However, this exploratory analysis showed that there was no change in hemispheric activation during the lineup task.

Summary

The results of this experiment were a little surprising. Given the strong left hemisphere activation in Experiment 5 that resulted from locally biased Navon letters, it was predicted that the equally salient Navon letters in this experiment would produce the left hemisphere activation associated with local Navon tasks and the right hemisphere activation associated with global Navon tasks seen in previous research (Fink et al., 1997; Yamaguchi et al., 2000). However, the results suggest a left hemisphere bias for all conditions even though some results only approached significance due to the small sample size. This left hemisphere bias may be due to the intrinsically verbal nature of the Navon stimuli and the reading task. The results are not consistent with the hypothesis that the processing shift may be due to direct competition between left and right hemispheres. It is possible that the inherently verbal nature of the Navon task overshadowed any right hemisphere activation associated with holistic processing. Finally, analysis of the lineup fTMT data indicates that there is no increase or decrease in hemispheric activation during this task, suggesting that the hemispheric activation in place before the recognition task is maintained during this task. A summary of the hemispheric activation of each group in Experiments 5 and 6 is presented in Table 3.15.
Table 3.15
Experiments 5 and 6: Summary of Hemispheric Activation for Each Condition and Phase

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Condition</th>
<th>Phase</th>
<th>Significant Increase</th>
<th>Significant Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>In LH Activation</td>
<td>In RH Activation</td>
</tr>
<tr>
<td>Exp 5¹</td>
<td>Local</td>
<td>Navon task</td>
<td>✓ (and &gt; RH, &gt; Global)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Global</td>
<td>Navon task</td>
<td>✓</td>
<td>✓ (and &gt; Local, &gt; Global)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Pictures</td>
<td>✓ (and &gt; Global)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Exp 6²</td>
<td>Local</td>
<td>Navon task</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Global</td>
<td>Navon task</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Reading</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>aloud</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

¹Locally biased Navons, oval cut-out faces, sequential lineup.
²Equally salient Navons, head-and-shoulder faces, simultaneous lineup.
' p < .05
3.5 Experiment 7 – Reversed TIPS Experiment with TMT

The results of Experiment 6 suggested that the equally salient Navon letter stimuli activate both hemispheres and induce a left hemisphere bias that may be due to the inherently verbal nature of the stimuli. However, while the results for the local Navon group were significant, the similar results for the global Navon group only approached significance. It was suggested in Experiment 6 that a larger sample size may have seen these results reach significance. Experiment 7 provided an opportunity to increase the sample sizes for the Navon and control analyses because the Navon and control tasks for Experiments 6 and 7 were identical. The sample size for the lineup tasks cannot be increased, however, since the encoding stimulus and lineup tasks were different in these two experiments.

When the Navon and control task data from Experiments 6 and 7 were combined, it was hypothesised that:

- The local and global Navon groups would show greater left than right hemisphere activation which would manifest as a greater decrease in left TMT than right; however, these participants would not show a greater decrease in left TMT than the control group due to the inherently verbal nature of the Navon stimuli and the reading task; and

- The control group would experience both left and right hemispheric activation, but the reading aloud task would engage the left hemisphere to a greater degree than the right hemisphere resulting in greater decreases in left TMT than right TMT.
Method

Design

Experiment 7 was a simple Navon local, global or control condition between-subjects design.

Participants

Participants were 28 Caucasian individuals affiliated with the Australian National University either as students or staff. Participants received payment of $6 for participating in this experiment. There were 18 female, and 10 male participants whose ages ranged from 18 to 52 years ($M = 25.5, SD = 8.32$). Two of the participants were left-handed (scoring below zero), one participant scored zero on the handedness inventory and the remaining 25 participants were right-handed. Scores on the Edinburgh Handedness Inventory ranged from -0.7 to +1.0 ($M = 0.7, SD = 0.48$). The data for this experiment was collected during the running of Experiment 4.

Materials

The materials were the same as those used in Experiment 4. The faces and Navon letters are shown again in Figure 3.22 and Figure 3.23 for clarity.
Target face at study

Lineup faces (presented \textit{sequentially}). Target is in position 5.

\textit{Figure 3.22}. Experiment 7: Target and lineup oval cut-out faces.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure322}
\caption{Experiment 7: Target and lineup oval cut-out faces.}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure323}
\caption{Experiment 7: Equally salient Navon letter.}
\end{figure}
Procedure

The procedure was identical to that of Experiment 4 as this data was collected when Experiment 4 was run.

Results

For full details see Experiment 4. In summary, recognition was affected by processing orientation with local and control condition participants outperforming those in the global condition.

Ear Temperature Changes

There were no ear data for two participants as these participants elected not to wear the fTMT helmet, and TMT data for a further 4 participants were excluded from the analysis for the following reasons: two participants were left-handed, one participant scored zero on the Edinburgh Handedness Inventory, and one participant reported (at the end of the experiment) that she had begun to think about what she would be making for dinner halfway through the Navon task. This last participant’s ear data are presented separately in Appendix B.2, and are important as they provide evidence that it cannot be assumed participants are completely focused on the allocated task, particularly when a task does not require their complete attention. This may have implications for psychophysiological data such as fTMT data. Data from the remaining 22 participants were included in the following analysis.

Ear Temperature (fTMT) Data Recordings

The tympanic membrane temperature for each ear was recorded every 50 milliseconds for each participant. Data from 22 participants were “cleaned” of any temperature spikes as in Experiments 5 and 6. The mean TMT at the beginning of the baseline period was 37.66°C (SD = 1.07) for the right ear and 38.24°C (SD = 0.97) for the left ear. As in Experiment 5, the right TMT was lower than the left ($t_{(21)} = -2.793$, $p = .011$), but there was no significant difference in right or left TMT for gender ($p = .584$ and $p = .550$ respectively).
A 2 (right ear, left ear) x 2 (Time 0, Time 1) x 2 (male, female) split plot ANOVA showed a large effect for ear, Wilks $\Lambda = .777$, $F(1,20) = 5.752$, $p = .026$, multivariate $\eta^2 = .223$, and a strong effect for time, Wilks $\Lambda = .279$, $F(1,20) = 51.755$, $p < .001$, multivariate $\eta^2 = .721$, with both left and right TMT readings decreasing over the baseline period. There was no main effect for gender and no interactions were significant. As these results are similar to those of Experiments 5 and 6, and are not of consequence to the cognitive tasks being investigated, the full details of the analysis including the graphs have been omitted and only significant results for the baseline period have been reported.

Post-Baseline fTMT Data

As in Experiments 5 and 6, a baseline temperature for each ear for each participant was calculated by averaging the final 10 readings of the baseline period, and baseline temperatures were then subtracted from all temperature measurements to determine if there were differential changes in left and right tympanic membrane temperatures associated with the different cognitive tasks. The local Navon group showed decreases in left and right TMT over the duration of the experiment (see Figure 3.24). The global Navon group showed a decrease in left TMT but no change in right TMT (see Figure 3.25). Finally, the control group showed decreases in both left and right TMT over the duration of the experiment (see Figure 3.26).
A 2 (right ear, left ear) x 2 (Time 0, Time 1) x 2 (male, female) split plot ANOVA showed a large effect for ear, Wilks $\Lambda = .777$, $F_{(1,20)} = 5.752$, $p = .026$, multivariate $\eta^2 = .223$, and a strong effect for time, Wilks $\Lambda = .279$, $F_{(1,20)} = 51.755$, $p < .001$, multivariate $\eta^2 = .721$, with both left and right TMT readings decreasing over the baseline period. There was no main effect for gender and no interactions were significant. As these results are similar to those of Experiments 5 and 6, and are not of consequence to the cognitive tasks being investigated, the full details of the analysis including the graphs have been omitted and only significant results for the baseline period have been reported.

Post-Baseline fTMT Data

As in Experiments 5 and 6, a baseline temperature for each ear for each participant was calculated by averaging the final 10 readings of the baseline period, and baseline temperatures were then subtracted from all temperature measurements to determine if there were differential changes in left and right tympanic membrane temperatures associated with the different cognitive tasks. The local Navon group showed decreases in left and right TMT over the duration of the experiment (see Figure 3.27). The global Navon group showed a decrease in left TMT but no change in right TMT (see Figure 3.28). Finally, the control group showed decreases in both left and right TMT over the duration of the experiment (see Figure 3.29).
Figure 3.27. Experiment 7: fTMT data for local Navon participants.

Figure 3.28. Experiment 7: fTMT data for global Navon participants.

Figure 3.29. Experiment 7: fTMT data for control participants.
Combining Experiment 6 and 7 Navon and Control Data

As the control and Navon tasks in this experiment were identical to those in Experiment 6, the data from both experiments were included in the analysis to increase the sample size. This resulted in a doubling of the sample size to 44 participants. A 2 (Experiment 6, Experiment 7) x 2 (right ear, left ear) x 2 (Time 1, Time 2) x 3 (control, global Navon, local Navon) split plot ANOVA of the fTIVL data was performed. As can be seen from Table 3.16, there was no main effect for Experiment, and no interactions involving Experiment were significant. From the Navon/control task analysis the data from both experiments will be treated as a single experiment.

Table 3.16
Experiment 7: Multivariate and Between-Subjects (Experiment) Statistics for Navon and Control Tasks (N=44)

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment¹</td>
<td>--</td>
<td>0.427</td>
<td>.427</td>
<td>.011</td>
</tr>
<tr>
<td>Ears x experiment</td>
<td>.999</td>
<td>0.037</td>
<td>.848</td>
<td>.001</td>
</tr>
<tr>
<td>Time x experiment</td>
<td>.995</td>
<td>0.209</td>
<td>.650</td>
<td>.005</td>
</tr>
<tr>
<td>Condition x experiment</td>
<td>--</td>
<td>0.181</td>
<td>.835</td>
<td>.009</td>
</tr>
<tr>
<td>Ears x time x experiment</td>
<td>.969</td>
<td>1.231</td>
<td>.274</td>
<td>.031</td>
</tr>
<tr>
<td>Time x condition x experiment</td>
<td>.957</td>
<td>0.850</td>
<td>.435</td>
<td>.043</td>
</tr>
<tr>
<td>Ears x time x condition x experiment</td>
<td>.969</td>
<td>0.602</td>
<td>.553</td>
<td>.031</td>
</tr>
</tbody>
</table>

¹Experiment was included as a between-subjects variable to confirm there was no difference between the data from Experiment 6 and Experiment 7.

TMT Changes during the Control and Navon Tasks

To investigate the changes in TMT during the control and Navon tasks, a 2 (right ear, left ear) x 2 (Time 1, Time 2) x 3 (control, global Navon, local Navon) split plot ANOVA of the fTMT data was performed. There was a main effect for ear, a main effect for time, and a significant ear by time interaction. The results are shown in full in Table 3.17, and the mean temperature deviations from baseline are shown in Table 3.18.
Table 3.17

Experiment 1: Multivariate and Between-Subjects (Condition) Statistics for Navon and Control Tasks (N=44)

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.672</td>
<td>20.006</td>
<td>&lt;.001</td>
<td>.328</td>
</tr>
<tr>
<td>Time</td>
<td>.496</td>
<td>41.706</td>
<td>&lt;.001</td>
<td>.504</td>
</tr>
<tr>
<td>Condition¹</td>
<td>--</td>
<td>2.563</td>
<td>.089</td>
<td>.111</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.592</td>
<td>28.295</td>
<td>&lt;.001</td>
<td>.408</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.910</td>
<td>2.033</td>
<td>.144</td>
<td>.090</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.899</td>
<td>2.314</td>
<td>.112</td>
<td>.101</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.888</td>
<td>2.578</td>
<td>.088</td>
<td>.112</td>
</tr>
</tbody>
</table>

¹ Condition is the between-subjects (local, global, control) variable.

Table 3.18

Experiment 1: Mean TMT Readings for Time 1 and Time 2 for each Condition

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 1</th>
<th>Mean (SD) at Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.016 (.05)</td>
<td>-0.181 (.20)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.051 (.07)</td>
<td>-0.297 (.18)</td>
</tr>
<tr>
<td>Global</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.018 (.05)</td>
<td>-0.067 (.29)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.029 (.05)</td>
<td>-0.224 (.24)</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.021 (.05)</td>
<td>-0.191 (.30)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.096 (.17)</td>
<td>-0.517 (.43)</td>
</tr>
</tbody>
</table>
Overall, participants in all three groups experienced decreases in both tympanic membrane temperatures. The local Navon group experienced similar drops in left and right TMT (see Figure 3.30). This task activated the two hemispheres to a similar degree. The global Navon group only experienced a very slight drop in right TMT, but experienced a larger drop in left TMT (see Figure 3.31). The control group showed a drop in both left and right TMT (see Figure 3.32), with the suggestion of greater left hemisphere activation than right.

Contrasts showed the only significant difference across groups was between the control and global groups, $p = .029$. The difference between control and local Navon participants was not significant ($p = .200$), nor was the contrast between global and local Navon participants ($p = .306$).
Figure 3.30. Experiment 7: fTMT data for local Navon task only.

Figure 3.31. Experiment 7: fTMT data for Global Navon task only.

Figure 3.32. Experiment 7: fTMT data for control task only.
Local Navon group.

For participants in the local Navon group, planned comparisons confirmed that the left and right TMT did not differ significantly at the end of the baseline period. Over the course of the local Navon task, the left TMT dropped significantly, $t_{(15)} = -6.165, p < .001$, as did right TMT, $t_{(15)} = -3.551, p = .003$. The left TMT drop was greater than the right indicating that there was more left than right hemispheric activation, $t_{(15)} = 2.494, p = .025$.

Global Navon group.

As expected, there was no difference in left and right TMT at the end of the baseline period. The drop in left TMT over the course of the global Navon task was significant, $t_{(17)} = -3.547, p = .003$, but the decrease in right ear TMT was not ($p = .467$). As with the local Navon group, the global Navon group showed greater left than right hemisphere activation, $t_{(15)} = 2.435, p = .028$.

Control group.

Again, planned comparisons showed that the left and right TMT did not differ significantly at the end of the baseline period. The control group showed a significant drop in left TMT, $t_{(11)} = -5.081, p < .001$, but the right TMT drop only approached significance ($p = .059$). The difference in left and right TMT at Time 2 was significant indicating greater left hemisphere activation than right as a result of the reading aloud task, $t_{(11)} = 3.400, p = .006$. 
Comparison of Control and Navon Task Effects on each Hemisphere

**Right TMT and hemispheric activation.**

Planned comparisons to investigate whether the control and Navon tasks produced differential right hemisphere activity were carried out with a univariate ANOVA using right TMT at the end of the control/Navon task as the dependent variable, and condition as the independent variable. Results showed that there was no difference in right TMT across conditions, $F_{(2,41)} = 1.037, p = .364$. Contrasts confirmed there were no differences across groups (control and global Navon groups, $p = .223$; control and local Navon groups, $p = .920$; and the local and global Navon groups, $p = .227$). This indicates that there was no difference in the degree to which participants in the different conditions engaged their right hemispheres.

![Figure 3.30](image-url)  
*Figure 3.30. Experiment 7: Right TMT data for control and Navon conditions.*
**Left TMT and hemispheric activation.**

Planned comparisons to investigate whether the control and Navon tasks produced differential left TMT activity were carried out with a univariate ANOVA using left TMT at Time 2 as the dependent variable, and condition as the independent variable. Results showed that there was a medium effect of condition on left TMT, $F_{(2,41)} = 3.724$, $p = .033$, partial $\eta^2 = .15$. Contrasts showed that participants in the control group experienced greater left hemisphere activation than those in the global Navon condition, $p = .011$, and almost significantly greater left hemisphere activation than those in the local Navon condition, $p = .052$. There was, however, no difference in left TMT for those in the global and local Navon conditions ($p = .475$). The data suggest that the control condition produced greater left hemisphere activation than either Navon task, and the Navon tasks themselves, although purportedly engaging very different processing styles, produced similar left hemisphere activation.

![Figure 3.31. Experiment 7: Left TMT data for control and Navon conditions.](image-url)
Hemispheric Activation during the Lineup Task

To determine whether hemispheric activation changed during the lineup task, planned comparisons were computed for each group\textsuperscript{17}. There were no significant changes in left or right TMT readings from the beginning to the end of the lineup task for either the global or local Navon groups; however, there was a difference for the control group. Participants in the control group showed a significant increase in left TMT during the lineup phase, $t(4) = -3.069$, $p = .037$. This suggests that hemispheric activation did not change for any participants in the manipulation conditions, but there was a lessening of left hemisphere activation for control participants. These results should be interpreted with caution because the data previously shown in Figure 3.26 indicate considerable variability at the start of the lineup task. It is possible this significant result is due to the analysis point cutting the data at a trough at Time 2 and a peak at Time 3. The results of the planned comparisons are shown in Table 3.20, and the mean TMT readings for each group are shown in Table 3.19.

\begin{table}
\centering
\caption{Experiment 7: Mean TMT Readings for Time 2 and Time 3 for each Condition}
\begin{tabular}{llcc}
\hline
TMT & Mean (SD) at Time 2 & Mean (SD) at Time 3 \\
\hline
Local & & \\
Right & -0.193 (.28) & -0.126 (.23) \\
Left & -0.279 (.19) & -0.291 (.22) \\
Global & & \\
Right & -0.016 (.34) & +0.003 (.41) \\
Left & -0.253 (.27) & -0.276 (.30) \\
Control & & \\
Right & -0.257 (.21) & -0.328 (.31) \\
Left & -0.547 (.30) & -0.512 (.30) \\
\hline
\end{tabular}
\end{table}

\textsuperscript{17}The remaining analyses are for Experiment 7 data only. Experiment 6 involved an untimed, simultaneous lineup and Experiment 7 a timed, sequential lineup. For this reason, the lineup data cannot be combined.
Table 3.20

Experiment 7: Planned Comparisons for Time 2 and Time 3 for each TMT for each Condition

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference (SD)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>-0.067 (.11)</td>
<td>-1.781</td>
<td>.113</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.013 (.12)</td>
<td>0.322</td>
<td>.755</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>-0.019 (.14)</td>
<td>-0.385</td>
<td>.712</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.023 (.10)</td>
<td>0.663</td>
<td>.529</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>0.716 (.13)</td>
<td>1.189</td>
<td>.300</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>-0.035 (.03)</td>
<td>-3.069</td>
<td>.037</td>
</tr>
</tbody>
</table>

1 N = 9  
2 N = 8  
3 N = 5

Discussion

This experiment examined the hemispheric activation associated with the Navon tasks and the reading aloud control task. It sought further evidence of the left hemisphere bias apparent from Experiment 6. The results confirmed the left hemisphere bias for the inherently verbal Navon stimuli, and provided evidence again that tasks given to control participants can generate significant left and right hemisphere activity.

Local and Global Navon Conditions

The first hypothesis included two predictions. Firstly, the prediction that participants in the local and global Navon conditions would show greater left hemisphere activation than right was supported. Both local and global Navon participants showed a significant drop in left TMT over the course of the Navon task, and left hemisphere activation was significantly greater than right for both groups.
Participants in the local Navon group also showed significant right hemisphere activation. Participants in the global Navon group, who may have been expected to show right hemisphere activation, did not. This group showed almost no right hemisphere activation during the Navon task.

The second prediction, that local and global Navon participants would not show greater left hemisphere activation than control participants due to the intrinsically verbal nature of all the tasks in the experiment was supported. Participants in the local and global Navon conditions did not show greater left hemisphere activation than those in the control condition. However, participants in the control condition showed greater left hemisphere activation than those in the global Navon condition, but not those in the local Navon condition. This suggests that the control group engaged their left hemisphere to a greater degree than the global Navon group.

**Control Condition**

For the control group, only the left hemisphere was engaged to a significant degree, and it was engaged to a greater degree than the right hemisphere. This result mirrors the findings of Experiment 6 for the control group.

**Lineup.**

Participants in the local and global Navon groups showed no change in left and right TMT during the lineup task; however, the control group did show a significant increase in left TMT as a result of this task. If this is to be interpreted, it would be viewed as a reduction in left hemisphere activation. However, the variability of the control group data during the lineup task was high, and the timeframe for measuring changes short. It is highly likely that the significant result occurred due to the Time 2 reading falling in a trough of the TMT data and the Time 3 reading falling on a peak. Participants are likely to have shuffled and moved when they shifted from the control task to the lineup task. They may have closed the book from which they were reading and pushed it aside. Hence, these results must be interpreted with caution.

**Summary**

The results of this experiment were consistent with those of Experiment 6. The Navon and reading tasks produce a strong left hemisphere bias most likely due to the
inherently verbal nature of those tasks. A summary of the hemispheric activation for Experiments 5, 6 and 7 is presented in Table 3.15.

Table 3.21

*Experiments 5, 6 and 7: Summary of Hemispheric Activation for Each Condition and Phase*

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Condition</th>
<th>Phase</th>
<th>LH Activation</th>
<th>RH Activation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp 5'</td>
<td>Local</td>
<td>Navon task</td>
<td>✓ (and &gt; RH, &gt; Global)</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Exp 5'</td>
<td>Global</td>
<td>Navon task</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Control</td>
<td>Picture rating</td>
<td>✓ (and &gt; Global)</td>
<td>✓ (and &gt; Local, &gt; Global)</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Exp 6'</td>
<td>Local</td>
<td>Navon task</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Exp 6'</td>
<td>Global</td>
<td>Navon task</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Control</td>
<td>Reading aloud</td>
<td>✓</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Exp 7'</td>
<td>Local</td>
<td>Navon task</td>
<td>✓ (and &gt; RH)</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Exp 7'</td>
<td>Global</td>
<td>Navon task</td>
<td>✓ (and &gt; RH)</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Control</td>
<td>Reading aloud</td>
<td>✓ (and &gt; RH, &gt; Global)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lineup</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
</tbody>
</table>

1 Locally biased Navons, oval cut-out faces, sequential lineup.
2 Equally salient Navons, head-and-shoulder faces, simultaneous (untimed) lineup.
3 Equally salient Navons (data from Exps 6 & 7), oval cut-out faces, sequential lineup (Exp 7 only).
\* p < .05
3.6 General Discussion

Experiments 5, 6 and 7 are the first to investigate the origin of the processing shift through the use of physiological measures, and the first to investigate the hemispheric activation associated with a control task. The results indicate strong left hemisphere activation in all conditions which most likely results from the intrinsically verbal nature of all tasks including the control task.

The local and global Navon letter tasks used in these experiments required participants to either identify and record the local or global letter in writing (Experiment 5), or verbally (by speaking). Analysis of fTMT data was confined to right-handed participants based on the assumption that 95% of these participants would show left hemisphere dominance for language (Springer & Deutsch, 1993). When equally salient Navon stimuli were used, results showed that for both local and global Navon groups, the left hemisphere was activated to a greater degree than the right. This was despite the fact that behavioural outcomes suggested participants in the global condition were engaged in holistic processing. The left hemisphere activation, it could be argued, was due in part to the left hemisphere activity associated with the production of speech or writing (Hellige, 2001), although it should be noted that Lassen, Ingvar and Skinhoj (cited in Springer & Deutsch, 1993) reported very similar blood-flow patterns to both hemispheres even during the highly lateralised activity of speech. However, the results of Experiment 5 argue against this explanation. Participants in Experiment 5 wrote their responses yet the global Navon group showed no significant left hemisphere activation. Furthermore, control participants were required to write their responses also. They recorded half the responses of the Navon participants (60 vs 120), yet their left hemisphere activation was no different to that of the local Navon group. However, the local and global Navon groups who wrote an equal number of responses showed very different left hemisphere activation patterns.

The role of written responses and verbal responses in fTMT has not been investigated, so the contribution of these activities to changes in TMT is unclear. Cherbuin and Brinkman (2004; 2007) overcame this confound by asking participants to respond by pressing a mouse button with their index finger, and alternating the hand with which responses were made. So it may be argued that such accommodations should be made. However, this is not feasible in verbal overshadowing studies as both control and verbalisation tasks generally require written responses. Furthermore, if the
processing shift is associated with greater activation of one hemisphere and the associated dampening of the other (Schooler, 2002), the hemispheric activation must be robust enough to withstand any contribution of a written task. The results from this chapter are problematic for the hypothesis adopted in this thesis that the processing shift may be attributable to competition between the left and right hemispheres of the brain. While the shift may be attributable to a contest of resources which sees one hemisphere activated to a greater extent than the other, this activation is not evident in the fTMT data which has clearly indicated a left hemisphere bias for all tasks. It seems unlikely given the data from these experiments that we can attribute the processing shift to a simple left-brain right-brain conflict.

3.7 Summary

Experiment 5 investigated the left and right hemisphere activity associated with the locally biased Navon letter stimuli from Chapter 2. There was a clear left hemisphere bias for participants in the local Navon condition, and no right hemisphere activity. The global Navon group did not show any right or left hemisphere activity. The control group (rating animal photographs) showed similar left and right hemispheric activation, and left hemisphere activity was similar to that of the local Navon group. No participants experienced a change in hemispheric activity during the lineup task. Experiments 6 and 7 provided results of a more applied nature as the Navon stimuli were equally salient and appeared, from a behavioural viewpoint, to engage local and global processing as predicted. In addition, the control task used in these experiments was the same as that used in some studies in the verbal overshadowing and Navon literature (e.g., Macrae & Lewis, 2002; Schooler & Engstler-Schooler, 1990). Interestingly, the results of these studies showed strong left hemisphere activation in all conditions. Local, global and control participants all showed more left hemisphere activity than right. This was attributed to the highly verbal nature of the Navon stimuli, and the verbal nature of the control task (reading aloud), rather than the left-hemisphere-engaging writing and speech components of the tasks. The results of these three experiments led to the consideration that the processing shift underlying the verbal overshadowing and Navon effects is probably not a straightforward left-brain right-brain competition for resources.

The question that remains is what happens to hemispheric activation during a verbal description task? The Navon task results would suggest that there might be a left
hemisphere bias due to the verbal nature of a description task. However, if the processing shift is not due to a straightforward left-brain right-brain competition for resources, then a left hemisphere bias for the description task would not necessarily be expected. The issue of hemispheric activation for the verbal description and category generation tasks will be addressed in Chapter 5.
4.1 Experiment 8

The purpose of Experiment 8 was to run a standard verbal overshadowing experiment using fTMT technology to investigate hemispheric activation for the verbalisation and control tasks in a “typical” verbal overshadowing experiment. The results from Chapter 3 showed that all tasks, including the global Navon task, produced greater left than right hemisphere activation. This was incongruent with the hypothesis that physiological measures would show evidence of asymmetric hemispheric activation due to the processing shift induced by the Navon tasks. The results of Chapter 3 showed that the inherently verbal nature of the Navon stimuli produced a left hemisphere bias and no evidence of differing left and right hemisphere activation associated with the processing shift. Hence, the purpose of Experiment 8 was to explore the activation associated with the interpolated tasks in a “typical” verbal overshadowing study.

_A Typical Verbal Overshadowing Experiment_

Despite the many differences in verbal overshadowing studies, analysis of the published literature suggests there is a common underlying procedure. Excluding studies that have 1) used stimuli other than own-race faces, 2) attempted to release participants from verbal overshadowing, or 3) investigated non-face recognition and verbal overshadowing (e.g., colour, wine, problem-solving), there are four distinct phases evident in these studies. They are: encoding, post-encoding filler, verbalisation/control, and the lineup phase. The formats of these phases have been quite consistent across published verbal overshadowing studies (see Appendix C.1).

The _encoding phase_ requires participants to learn an unfamiliar face from either a static photograph or a video recording. The majority of experiments using a video recording have used the Schooler and Engstler-Schooler (1990) video which is 30 seconds in duration. Experiments using a static photograph at encoding generally allow five seconds for participants to learn the face and then use a physically different photograph at lineup (e.g., formal pose vs casual pose).
The duration of the *post-encoding filler phase* in the majority of experiments is five minutes. Some studies have opted for tasks of 15 to 20 minutes (Meissner, 2002; Schooler & Engstler-Schooler, 1990; Westerman & Larsen, 1997); however, a five-minute task appears to provide a sufficient delay between encoding and describing the face to ensure that participants rely on their long-term memory rather than their short-term memory or visual perception of the face (Ryan & Schooler, 1998). The nature of this post-encoding filler task has most frequently been a crossword, digital search puzzle, or a reading-comprehension activity.

In the third phase, the *verbalisation/control phase*, participants either generate a verbal description of the face or they engage in the control task. The verbal description activity involves asking participants to write a description of the encoded face in as much detail as possible with particular focus on facial features. Meissner and Brigham (2001) have shown that it is critical in this phase to encourage participants to continue writing for the duration of the task. Participants in forced-recall verbalisation conditions are significantly more likely to experience verbal overshadowing than those in free-recall verbalisation conditions. For the control task, the majority of verbal overshadowing experiments have used a category generation task in which participants are instructed to write a list of as many exemplars as they can of a particular category (e.g., states of the USA, presidents, countries or state capitals).

The final phase of a typical verbal overshadowing experiment is the *recognition phase*. This involves a lineup of six or eight verbally-similar faces presented simultaneously. Participants are given unlimited time to determine which face is the target face. Most experiments use a modified forced-choice procedure that allows participants to reject the lineup by saying the target face is “not present”.

Ryan and Schooler (1998) also identified these common elements of successful verbal overshadowing experiments as the “basic verbal overshadowing face-recognition procedure” which they implemented in their study. In Ryan and Schooler’s experiment, participants spent five seconds encoding the target face. They then worked on a crossword puzzle for two minutes, and subsequently spent four minutes describing the target face (verbalisation condition) or generating exemplars (control condition) before being given a six-alternative, forced-choice, untimed lineup. In Experiment 8, a similar procedure was adopted with two minor changes. Firstly, the slightly longer task
durations common to most verbal overshadowing experiments were used\textsuperscript{18}, and secondly, the encoding time was limited to three seconds as the results from Chapter 2 suggest that a five-second encoding task allowed participants to engage in a featural processing strategy. If participants were to use a featural processing strategy at encoding in a verbal overshadowing experiment, a decrease in identification rates by verbalisation participants may not be evident. This was particularly true for Experiment 8 as the encoding and test images of the target face were modifications of the same photograph. The structure of the typical verbal overshadowing experiment for Experiment 8 is shown in Figure 4.1.

Figure 4.1. The typical verbal overshadowing study format.

**Processing Shifts**

Participants were expected to engage in both holistic and featural processing at encoding. The reduced encoding time for the target face was expected to prevent participants from engaging solely in featural processing as the limited time should have made it difficult to focus on the individual facial features. It was predicted that

\textsuperscript{18} The crossword task and control/verbalisation tasks were 5 minutes instead of 2 minutes and 4 minutes.
participants would engage in a greater degree of holistic processing at encoding due to the time limitations of the task.

It was expected that engaging in the crossword puzzle filler task would not produce a bias towards featural processing as this task has been used successfully in other verbal overshadowing studies as a control task that did not disrupt processing mode (e.g., Ryan & Schooler, 1998). Instead, it was anticipated that this task would produce similar activation to other commonly used control tasks such as the reading aloud task used in Experiments 3 and 4. Participants in the verbalisation condition were expected to engage in the featural processing normally associated with this task, while participants in the control condition were hypothesised to experience no shift in processing. The simultaneous lineup required holistic processing (cf. the results of Chapter 2), and was expected to produce poorer recognition results by verbalisation participants who were engaged in featural processing.

Some of the participants in Experiment 8 did the experiment while wearing the fTMT helmet. The aim of collecting this fTMT data was to look for converging evidence that the featural processing associated with the verbalisation tasks in verbal overshadowing experiments was clearly linked to greater left hemispheric activation. In addition, the experiment provided insight into the hemispheric activation associated with common control and filler tasks. For Experiment 8, it was hypothesised that:

- As in previous verbal overshadowing studies, participants who were asked to give a written description of the target face would perform more poorly on the recognition test than those who undertook the control (category-generation) task;
- During the crossword puzzle task, participants should experience similar decreases in left and right TMT as both hemispheres should be engaged to a similar extent;
- If verbalisation engages the left hemisphere, the verbalisation group should experience a greater decrease in left TMT than right TMT, and a larger decrease in left TMT, than control group; and
- The control group will engage left and right hemispheres to a similar degree with similar decreases in left and right TMT.
Method

Design

Experiment 8 was a single factor (control or verbalisation) between-subjects design. The experiment consisted of four phases: encoding, post-encoding delay, verbalisation/control task, and recognition test.

Participants

Participants were 101 students and staff affiliated with the Australian National University (ANU). Participants received either 30 minutes research credit or $6 in payment for their time. There were 63 female and 38 male participants whose ages ranged from 17 to 60 years ($M = 21.9$, $SD = 7.32$). The fTMT data was collected from 16 of those participants, 8 male and 8 female, who ranged in age from 18 to 47 years ($M = 26.9$, $SD = 10.02$).

Materials

Stimuli.

The head-and-shoulder faces from Experiments 2, 3, and 6 were used (see Figure 4.2).
Target face at encoding

Lineup faces (presented simultaneously). Target is in position 5.

Figure 4.2. Experiment 8: Target and lineup head-and-shoulder faces.

**Post-encoding filler task.**

Participants were asked to work on a pen-and-paper crossword puzzle (see Appendix C.2) for a period of five minutes.

**Verbal description task.**

Participants in the verbalisation condition were given the following forced-recall instructions (also in Appendix C.3) adapted from Meissner (2002):

We would like you to spend the next 5 minutes describing the face you saw at the beginning of the experiment. In the space below, please describe each facial feature in as much detail as possible. Try not to leave out any details about the face even if you think they are not important. The more details you provide, the more helpful it will be.
As describing a face is often a difficult task, it is important that you concentrate and stay focused for the next few minutes.

Again, please provide as much detail as possible and continue writing for the full 5 minutes. You will be told when to stop.

**Control task.**

Participants in the control condition were asked to spend five minutes writing down the names of as many different types of animals as they could (see Appendix C.4). They were encouraged to keep writing for the full five minutes also.

**Recognition test.**

The recognition test involved the untimed, six-person, target-present lineup from Experiments 2, 3 and 6 (see Figure 4.2). As before, the position of the target was counterbalanced across all positions.

**Lineup response sheets.**

The response sheets were those used in Experiments 2, 3 and 6 (see Appendix A.9 and Appendix A.10).

**Experimental booklet.**

The post-encoding filler task, verbalisation and control tasks, and lineup response sheets were presented in an experimental booklet. The cover page of this booklet collected the same demographic information as previous experiments (see Appendix A.5).

**PowerPoint presentation.**

The target face, task instructions, and the lineup were presented on computer using a PowerPoint presentation that ran automatically.

**Procedure**

Participants were tested in groups of between 1 and 23 people, and were randomly assigned to the verbalisation or control conditions.
**Experimental group.**

At the start of the experiment, participants saw the target face for three seconds. They spent the next five minutes working on the crossword puzzle. At the end of this period, they did the verbal description task for a further five minutes. They were told it was important to keep writing for the full five minutes. Finally, participants were instructed to turn to the lineup response sheets, and were given the following verbal instructions by the experimenter:

You are about to see a lineup of six male faces. The original face you saw may be in the lineup, or it may not. We want you to look at each face and decide if the original face is there. If you think it is, circle the face number that corresponds to the face in the lineup that you think is the original face. If you think the face is not in the lineup, circle "not in the lineup". Once you have done this, indicate how certain you are of your decision by circling "somewhat sure", "reasonably sure" or "very sure".

Once you have finished this task, turn over to the last page, and for each face that you did not select as the original face, tell us how sure you are that those faces are not the original face. So if you selected a face from the lineup you would rate how certain you are that the remaining five faces are not the original face, and if you selected “not in the lineup” you would tell us how sure you are that all six faces are not the original face.

There is no time limit on these tasks.

When participants had completed the two lineup response sheets, the experiment was complete and they were debriefed.

**Control group.**

The procedure for the control group was the same as that for the experimental group with one exception. In place of the verbal description task, control group participants were given the category-generation task.

**fTMT group.**

A subset of 16 participants was tested individually using the fTMT helmet. Eight participants were assigned to the experimental condition, and eight to the control
condition. For all 16 participants, the procedures were identical to those described above with the addition of the fTMT procedures as described in Experiment 5.

Results

Behavioural Data

Overshadowing effect.

The number of correct and incorrect identifications and the number of misses for each group are shown in Table 4.1.

Table 4.1
Experiment 8: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Verbalisation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>30 (60%)</td>
<td>20 (40%)</td>
<td>50 (50%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>20 (40%)</td>
<td>31 (60%)</td>
<td>51 (50%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(2)</td>
<td>(14)</td>
<td>(16)</td>
</tr>
<tr>
<td>Total</td>
<td>50 (100%)</td>
<td>51 (50%)</td>
<td>101 (100%)</td>
</tr>
</tbody>
</table>

Participants in the verbalisation condition performed more poorly on the recognition test than those in the control condition, $\chi^2(1) = 4.36$, $p = .037$, $\phi = -0.21$. Only 40% of those in the verbalisation condition correctly identified the target face, whereas 60% of those in the control group were correct in their lineup choice.

Ear Temperature Changes

Of the 16 participants in the fTMT group, 15 were right-handed. Data from the left-handed participant was omitted from analysis, and scores on the Edinburgh Handedness Inventory for the remaining 15 participants ranged from +0.5 to +1.0 ($M = 0.9$, $SD = .14$).
**Ear Temperature (fTMT) Data Recordings**

For ease of reading, important points on the experimental timeline will be referred to as Time 0, Time 1, Time 2, Time 3, Time 4 and Time 5. The mapping of these labels to activities is shown in Table 4.2.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of Baseline</td>
<td>Time 0</td>
</tr>
<tr>
<td>End of Baseline</td>
<td>Time 1</td>
</tr>
<tr>
<td>End of Crossword</td>
<td>Time 2</td>
</tr>
<tr>
<td>End of Navon/Control</td>
<td>Time 3</td>
</tr>
<tr>
<td>End of Lineup Instructions(^\text{19})</td>
<td>Time 4</td>
</tr>
<tr>
<td>End of Lineup</td>
<td>Time 5</td>
</tr>
</tbody>
</table>

The tympanic membrane temperature for each ear was recorded every 50 milliseconds for each participant. Data were “cleaned” of any temperature spikes as in previous experiments. The average TMT at the beginning of the baseline period was 37.19°C (SD = 0.95) for the right ear and 37.82°C (SD = 0.93) for the left ear. As in previous experiments, the right TMT was lower than the left, \(t_{(13)} = -2.778, p = .016\), but there was no significant difference in right or left TMT for gender (\(p = .172\) and \(p = .594\) respectively).

As in previous experiments, a 2 (right ear, left ear) x 2 (Time 0, Time 1) x 2 (male, female) split plot ANOVA was performed. The only significant result was a very large main effect for time, Wilks \(\Lambda = .235\), \(F_{(1,13)} = 42.234, p < .001\), multivariate \(\eta^2 = .765\), with both left and right TMT readings decreasing over the baseline period. There was no effect for gender or ear, and there were no significant interactions.

\(^{19}\) The lineup instructions took approximately 45 seconds.
Post-Baseline fTMT Data

Once again, a baseline temperature for each ear for each participant was calculated by averaging the final 10 readings of the baseline period, and baseline temperatures were then subtracted from all temperature measurements to determine if there were differential changes in left and right tympanic membrane temperatures associated with the different cognitive tasks. The fTMT data violated normality as kurtosis of right ear temperatures was +7.4. Further investigation found that one participant’s right ear data were more than 3 standard deviations outside the mean. These data were considered outliers and removed from the analysis. As a result, kurtosis for right ear temperature data returned to an acceptable level of +2.3.

Participants in the control condition showed decreases in both left and right TMT over the course of the experiment, although right TMT did increase briefly at the beginning of the category generation task (see Figure 4.3). For participants in the verbalisation condition, left and right TMT dropped during the experiment, perhaps to a lesser degree than those in the control condition, and right TMT increased during the lineup instructions and identification task (see Figure 4.4).
**Figure 4.3.** Experiment 6: fTMT data for control participants.

**Figure 4.4.** Experiment 6: fTMT data for verbalisation participants.
**Ear Temperature Changes for Crossword Task**

Participants showed decreases in both left and right TMT during the crossword task. To investigate the changes, a 2 (right ear, left ear) x 2 (Time 1, Time 2) x 2 (control, verbalisation) split plot ANOVA of the fTMT data was performed. As expected, there was no effect for condition as all participants were doing the same task. The only significant result was a very strong main effect for time, Wilks $\Lambda = .398, F_{(1,12)} = 18.165, p = .001$, multivariate $\eta^2 = .602$. The results of the split plot ANOVA are shown in Table 4.3.

Table 4.3

*Experiment 8: Multivariate and Between-Subject Statistics for Crossword Task for Verbalisation and Control Groups (N=14)*

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>$F$</th>
<th>$p$</th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.959</td>
<td>0.508</td>
<td>.489</td>
<td>.041</td>
</tr>
<tr>
<td>Time</td>
<td>.398</td>
<td>18.165</td>
<td>.001</td>
<td>.602</td>
</tr>
<tr>
<td>Condition$^1$</td>
<td>--</td>
<td>1.209</td>
<td>.293</td>
<td>.092</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.999</td>
<td>0.007</td>
<td>.933</td>
<td>.001</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.983</td>
<td>0.212</td>
<td>.654</td>
<td>.017</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.849</td>
<td>2.141</td>
<td>.169</td>
<td>.151</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.992</td>
<td>0.092</td>
<td>.766</td>
<td>.008</td>
</tr>
</tbody>
</table>

$^1$Condition is the between-subjects (verbalisation, control) variable

Participants in the control condition experienced strong decreases in left and right TMT during the crossword task (see Figure 4.5). Participants in the verbalisation condition, doing the same task, experienced the same activation (see Figure 4.6).
Figure 4.5. Experiment 8: fTMT data for crossword task (Control group).

Figure 4.6. Experiment 8: fTMT data for crossword task only (Verbalisation group).
Planned comparisons showed that left and right TMT did not differ at the start of the crossword task. However, both left and right TMT readings dropped significantly over the course of the crossword task \((t_{(13)} = -3.725, p = .003\) and \(t_{(13)} = -2.702, p = .018\) respectively) indicating both hemispheres were engaged. The difference between right and left TMT at the end of the crossword task was not significant \((p = .624)\) suggesting the task did not engage one hemisphere preferentially. The mean temperature deviations from baseline are shown in Table 4.4.

Table 4.4  
*Experiment 8: Mean TMT Readings for Time 1 and Time 2 for each Condition*

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 1</th>
<th>Mean (SD) at Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.039 (.06)</td>
<td>-0.321 (.21)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.129 (.21)</td>
<td>-0.394 (.45)</td>
</tr>
<tr>
<td><strong>Verbalisation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.050 (.11)</td>
<td>-0.169 (.38)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.053 (.07)</td>
<td>-0.202 (.20)</td>
</tr>
</tbody>
</table>
**TMT Changes during the Control and Verbalisation Tasks**

To investigate the changes in TMT during the experimental task, a 2 (right ear, left ear) x 2 (Time 2, Time 3) x 2 (control, verbalisation) split plot ANOVA of the data was performed. There was no effect of condition or ear. The only significant result was a large main effect for time, Wilks $\Lambda =.708$, $F(1,12) = 4.953$, $p = .046$, multivariate $\eta^2 = .292$. The results of the split plot ANOVA are shown in Table 4.5.

Table 4.5

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>$F$</th>
<th>$p$</th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.934</td>
<td>0.853</td>
<td>.374</td>
<td>.066</td>
</tr>
<tr>
<td>Time</td>
<td>.708</td>
<td>4.953</td>
<td>.046</td>
<td>.292</td>
</tr>
<tr>
<td>Condition¹</td>
<td>--</td>
<td>1.790</td>
<td>.206</td>
<td>.130</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.803</td>
<td>2.939</td>
<td>.112</td>
<td>.197</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.989</td>
<td>0.137</td>
<td>.717</td>
<td>.011</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.994</td>
<td>0.069</td>
<td>.798</td>
<td>.006</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.957</td>
<td>0.540</td>
<td>.476</td>
<td>.043</td>
</tr>
</tbody>
</table>

¹Condition is the between-subjects (verbalisation, control) variable.

The control group experienced a slight decrease in left TMT and no decrease in right TMT during the category generation task (see Figure 4.7). Participants in the verbalisation condition experienced similar changes in TMT (see Figure 4.8). The mean temperature deviations from the end of the crossword task to the end of the control/verbalisation task are shown in Table 4.6.
Table 4.6

*Experiment 8: Mean TMT Readings for Time 2 and Time 3 for each Condition*

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 1</th>
<th>Mean (SD) at Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.321 (.21)</td>
<td>-0.331 (.15)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.394 (.45)</td>
<td>-0.545 (.44)</td>
</tr>
<tr>
<td><strong>Verbalisation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.169 (.38)</td>
<td>-0.204 (.45)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.202 (.20)</td>
<td>-0.294 (.22)</td>
</tr>
</tbody>
</table>
Figure 4.7. Experiment 8: fTMT data for control task.

Figure 4.8. Experiment 8: fTMT data for verbalisation task.
Control group.

For the control group, planned comparisons showed no significant differences in left and right TMT at the end of the crossword period, or on completion of the category generation task. Although both left and right TMT readings dropped during the control task, the drop was not significant for the left or right TMT, suggesting this activity did not produce substantial activation of either hemisphere. The results of all planned comparisons for the control group are shown in Table 4.7.

Verbalisation group.

Results for the verbalisation group were similar to those for the control group; left and right TMT did not differ significantly at any point. There was no difference in left and right TMT at the end of the crossword task, nor at the end of the verbalisation task. Furthermore, there was no significant activation of either hemisphere during this task as neither the right nor the left TMT showed significant decreases during the description phase. The results of all planned comparisons for the verbalisation group are shown in Table 4.7.
<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference (SD)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong>(^1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right and left TMT at Time 2</td>
<td>0.073 (.33)</td>
<td>0.533</td>
<td>.617</td>
</tr>
<tr>
<td>Right and left TMT at Time 3</td>
<td>0.214 (.39)</td>
<td>1.327</td>
<td>.242</td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>0.010 (.19)</td>
<td>0.134</td>
<td>.899</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.151 (.19)</td>
<td>1.970</td>
<td>.106</td>
</tr>
<tr>
<td><strong>Verbalisation</strong>(^2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right and left TMT at Time 2</td>
<td>0.033 (.42)</td>
<td>0.221</td>
<td>.831</td>
</tr>
<tr>
<td>Right and left TMT at Time 3</td>
<td>0.089 (.50)</td>
<td>0.509</td>
<td>.626</td>
</tr>
<tr>
<td>Right TMT at Time 2 and Time 3</td>
<td>0.036 (.13)</td>
<td>0.794</td>
<td>.453</td>
</tr>
<tr>
<td>Left TMT at Time 2 and Time 3</td>
<td>0.092 (.15)</td>
<td>1.729</td>
<td>.127</td>
</tr>
</tbody>
</table>

\(^1\) N = 6  
\(^2\) N = 8
Comparison of Control and Verbalisation Task Effects on each Hemisphere

Right TMT and hemispheric activation.

Planned comparisons to investigate whether the control and Navon tasks produced differential right hemisphere activity were carried out with a univariate ANOVA using right TMT at the end of the control/verbalisation task as the dependent variable, and condition as the independent variable. Results showed that there was no difference in the TMT changes experienced by each group, $F_{(1,12)} = 0.436, p = .52$, suggesting that both groups experienced the same degree of right hemisphere activation despite the different tasks they were given (see Figure 4.9).

![Figure 4.9. Experiment 8: Right TMT data for control and verbalisation conditions.](image-url)
*Left TMT and hemispheric activation.*

Planned comparisons to investigate whether the control and verbalisation tasks produced differential left TMT activity were carried out with a univariate ANOVA using left TMT at Time 3 the end of control/verbalisation task as the dependent variable, and condition as the independent variable. As with the right TMT analysis, results showed that the control and verbalisation groups did not record significantly different left TMT readings, $F_{(1,12)} = 1.987, p = .184$. Again, this suggests that the verbalisation group did not show greater left hemisphere activation than in the control group (see Figure 4.10).

![Figure 4.10. Experiment 8: Left TMT data for control and Navon conditions.](image-url)
Hemispheric Activation during the Lineup Instructions

To investigate the changes in TMT during the lineup instructions, a 2 (right ear, left ear) x 2 (Time 3, Time 4) x 2 (control, verbalisation) split plot ANOVA of the data were performed. There were no significant results from the analysis suggesting that this period did not affect hemispheric activation for participants of either group. The results of the split plot ANOVA are shown in Table 4.8, and the mean temperature deviations from the end of the control/verbalisation task to the end of the lineup instructions period are shown in Table 4.9.

Table 4.8
Experiment 8: Multivariate and Between-Subject Statistics for Lineup Instructions Period (N=14)

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>p</th>
<th>Partial η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.806</td>
<td>2.893</td>
<td>.115</td>
<td>.194</td>
</tr>
<tr>
<td>Time</td>
<td>.998</td>
<td>0.028</td>
<td>.869</td>
<td>.002</td>
</tr>
<tr>
<td>Condition¹</td>
<td>--</td>
<td>2.439</td>
<td>.144</td>
<td>.169</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.908</td>
<td>1.221</td>
<td>.291</td>
<td>.092</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.985</td>
<td>0.181</td>
<td>.678</td>
<td>.015</td>
</tr>
<tr>
<td>Time x condition</td>
<td>&gt;.999</td>
<td>0.006</td>
<td>.942</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.992</td>
<td>0.095</td>
<td>.763</td>
<td>.008</td>
</tr>
</tbody>
</table>

¹Condition is the between-subjects (verbalisation, control) variable.
**Hemispheric Activation during the Lineup Task**

To investigate any changes in TMT during the lineup task, a 2 (right ear, left ear) \( \times \) 2 (Time 4, Time 5\(^\text{20}\)) \( \times \) 2 (control, verbalisation) split plot ANOVA of the fTMT data was performed\(^\text{21}\).

There were no significant results from the analysis. The results suggest that both groups displayed similar changes in TMT during the lineup task. The results of the split plot ANOVA are shown in Table 4.10, and the mean temperature deviations from the end of the lineup instructions to the end of the lineup task are shown in Table 4.11.

---

\(^{20}\) As this lineup was untimed, it is not possible to determine an “end of lineup” point. For this reason, the timeframe of 50 seconds was used for the end-of-lineup period to maintain consistency with Experiment 6 which also used this lineup task.

\(^{21}\) Box’s M was violated (\( p = .001 \)), but this is an overly-sensitive test (Tabachnick & Fidell, 2001). Normally the recommendation would be to use Pillai’s Trace (Tabachnick & Fidell), but as there are only two levels, the Wilks’ and Pillai’s values are identical. For ease of reading, the Wilks’ statistic has been reported here as in previous studies.
Table 4.10

*Experiment 8: Multivariate and Between-Subject Statistics for Lineup Tasks (N=14)*

<table>
<thead>
<tr>
<th></th>
<th>Wilks</th>
<th>F</th>
<th>p</th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>.752</td>
<td>3.963</td>
<td>.070</td>
<td>.248</td>
</tr>
<tr>
<td>Time</td>
<td>.930</td>
<td>1.599</td>
<td>.230</td>
<td>.118</td>
</tr>
<tr>
<td>Condition*</td>
<td>--</td>
<td>4.273</td>
<td>.061</td>
<td>.263</td>
</tr>
<tr>
<td>Ears x time</td>
<td>.994</td>
<td>0.068</td>
<td>.799</td>
<td>.006</td>
</tr>
<tr>
<td>Ears x condition</td>
<td>.976</td>
<td>0.293</td>
<td>.598</td>
<td>.024</td>
</tr>
<tr>
<td>Time x condition</td>
<td>.930</td>
<td>0.905</td>
<td>.360</td>
<td>.070</td>
</tr>
<tr>
<td>Ears x time x condition</td>
<td>.775</td>
<td>3.488</td>
<td>.086</td>
<td>.225</td>
</tr>
</tbody>
</table>

*Condition is the between-subjects (verbalisation, control) variable.*

Table 4.11

*Experiment 8: Mean TMT Readings for Time 4 and Time 5 for each Condition*

<table>
<thead>
<tr>
<th>TMT</th>
<th>Mean (SD) at Time 4</th>
<th>Mean (SD) at Time 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.292 (.12)</td>
<td>-0.315 (.16)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.572 (.25)</td>
<td>-0.645 (.32)</td>
</tr>
<tr>
<td><strong>Verbalisation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.143 (.46)</td>
<td>-0.182 (.38)</td>
</tr>
<tr>
<td>Left</td>
<td>-0.350 (.22)</td>
<td>-0.324 (.21)</td>
</tr>
</tbody>
</table>
As condition approached significance in the analysis of the lineup fTMT data \( p = .061 \), planned comparisons were carried out to investigate any differences. Once again, two univariate ANOVA’s were performed, one with left TMT at Time 5 as the dependent variable and the other with right TMT at Time 5 as the dependent variable. Condition was the independent variable. Analysis showed no effect of condition on right TMT \( p = .444 \), however, there was an effect on left TMT, \( F_{1,12} = 5.162, p = .042 \). This manifested as a decrease in left TMT, or greater left hemisphere activation for the control group than the verbalisation group.

**Discussion**

The aim of this experiment was to investigate the hemispheric activation associated with standard verbal overshadowing tasks. The experiment used a typical verbal overshadowing paradigm and fTMT technology to detect any changes in the temperature of the left and right tympanic membranes. The experiment produced a standard verbal overshadowing outcome, and fTMT results indicated similar, and significant, activation of left and right hemispheres during the crossword task, but no significant activation during the control or verbalisation tasks.

The first hypothesis predicted a standard verbal overshadowing outcome. This hypothesis was supported as participants in the verbalisation condition performed more poorly on the identification task than those in the control condition. The second hypothesis predicted that during the crossword puzzle filler task, participants would experience similar decreases in left and right TMT because the control groups of the experiments in Chapter 3 had shown that other control tasks (e.g., reading aloud) had produced this type of activation. The crossword task is one that has been used in other verbal overshadowing studies without interfering with processing mode, so it was hypothesised to produce similar hemispheric activation. The hypothesis was supported as participants engaged both left and right hemispheres to a significant degree over the course of the crossword task, and neither hemisphere was engaged preferentially.

The third hypothesis for this study involved the verbalisation task that is believed to produce featural processing in verbal overshadowing studies. It was predicted that the verbalisation group would show greater levels of left hemisphere activation than right, and would produce greater left hemisphere activation than the
control group. The first of these predictions was not supported as there was no difference in left and right hemisphere activation for the verbalisation group. However, despite showing a slight decrease in left TMT during the description phase, this activation was not significant. The second component of the hypothesis, that verbalisation participants would not engage their left hemisphere to a greater extent than the control group, was not supported either. There was no difference in left hemisphere activation between verbalisation and control groups, quite likely due to the fact that neither group showed significant left or right hemisphere activity over the course of the interpolated task.

The fourth hypothesis concerned the control group and predicted that this group would engage both hemispheres to a similar degree as had been seen with the control tasks of Experiments 5, 6 and 7. This hypothesis was not supported as the control group did not engage either hemisphere to a significant degree. The control task produced similar levels of activation to the verbalisation task, that is, a decrease in TMT but not to a significant degree.

Finally, only the control group showed any significant change in hemispheric activation during the lineup. This group showed a significant decrease in left TMT suggesting increased left hemisphere activity during the recognition task. As with Experiment 6, this data must be interpreted with caution as the lineup was not timed and it cannot be assumed that each participant was performing the same task at the chosen analysis point.

Clearly, the results of this experiment failed to provide the physiological evidence of hemispheric activation that would be predicted if the origin of the processing shift is competition between left and right brain regions. It must be concluded on the strength of these results that neither the verbalisation nor the control task produced the expected hemispheric lateralisation. The lack of hemispheric asymmetry was reminiscent of the results of the Navon tasks in Chapter 3. An argument was made in Chapter 3 that strong left hemisphere activity was associated with the verbal nature of the Navon task, and it is hard to account for why the verbal description task in this experiment is any less “verbal” than a Navon task. But, it is possible that the problem lies in the tendency to equate “verbal” and “featural” in the overshadowing literature. The Navon task is inherently verbal in nature; however, describing the features of a face from memory requires more than simply verbal processing. The image of the face must be recalled, details noted, and words and sentences that accurately
convey that information must be compiled. These activities are more complex than the simple recognition of a single letter. The neuroscience literature suggests that more difficult or complex tasks recruit both hemispheres, whereas a simple task can be optimally performed with the activation of one hemisphere (Hellige, 2001). This may account for some of the differences in activation of two “verbal” tasks, local Navon letter identification and generating a written description of a face.

Another possibility regarding the lack of hemispheric activation during the control and verbalisation tasks may be that the strong decrease in TMT during the crossword task accounted for the majority of the TMT changes. The TMT changes may have levelled off during the control and verbalisation tasks due to a floor limit being reached not long after the beginning of the control/verbalisation task. There will be some finite range of tympanic membrane temperature movement during cognitive tasks. Indeed, the decreases in TMT evident in Cherbuin and Brinkman’s (2004; 2007) studies were less than 0.2°C during 20 minutes of cognitive activities and those of Meiners and Dabb’s (1977) study were less than 0.1°C. In contrast, the decreases at the end of the control and verbalisation tasks in Experiment 8 range from a minimum of 0.2°C to over 0.5°C.

It is not clear whether a floor effect was responsible for the lack of further TMT changes during the control/verbalisation tasks; however, the results of this study are in keeping with those of Chapter 3. Tasks hypothesised to invoke global processing cannot be assumed to produce predominately right hemisphere activation, and tasks thought to require local or featural processing cannot be assumed to result in left hemisphere activation. The results of this experiment and Chapter 3 simply do not accommodate this explanation of the processing shift.

4.2 Summary

Experiment 8 investigated the left and right hemisphere activity associated with a typical verbal overshadowing study. While there was strong left and right hemisphere activation during the filler crossword task, the results indicated there was neither differential nor significant left or right hemisphere activation during the control and verbalisation tasks. Two possible explanations were given for these results. Firstly, it may be incorrect to label the verbalisation task a “verbal task” and assume it will result
in predominately left hemisphere activity. The verbalisation task is considerably more complex than the inherently verbal Navon task which did produce a significant left hemisphere bias in Chapter 3. In addition, it was proposed that participants may have achieved a limit in the degree to which tympanic membrane temperature decreases during a cognitive task whilst still engaged in the crossword task. The strong activation from the crossword task may have produced optimal decreases in tympanic membrane temperature leaving little room for further decreases during the control and verbalisation tasks. However, what does seem evident from the results of this experiment and Chapter 3 is that we cannot assume that global or holistic tasks will necessarily result in right hemisphere activation, and local or featural tasks will always produce left hemisphere activation. The results of these studies do not support the postulate that the origin of the processing shift lies in excitation of one hemisphere at the expense of the other.
4.1 Summary

Experimental results indicated that the test can be performed with a typical software overhead. Initial tests were performed with right-handed and left-handed participants. The results showed that the test was able to accurately determine the hand dominance of the participants. Further testing is needed to validate these findings and to improve the software's accuracy.
A SERENDIPITOUS FINDING

After all the data for this thesis had been collected, the co-ordinator of the first year psychology unit approached the candidate to run a verbal overshadowing study to fill a gap in the laboratory sessions for that semester. As there was limited time to prepare the experiment and the data were not expected to form part of the thesis, it was decided to re-run Experiment 8. The paper chosen for the students to read was the Melcher and Schooler (1996) paper. Unlike Experiment 8 participants, the student participants in this experiment were to have read an article about verbal overshadowing in advance, a fact that the experimenter was unaware of until the week of the laboratory session.

Also unknown to the experimenter was the fact that participants in Experiment 9 were introduced to the phenomenon of verbal overshadowing very briefly in their first year lecture (about 10 minutes) one week before the laboratory session. Participants were given the Melcher and Schooler paper in the week of the lecture, and were told that the following week their weekly quiz of 5 short-answer questions would be based on this paper. They were aware also that some form of verbal overshadowing experiment would be run during the laboratory session, and that they would have the opportunity to write their laboratory report for the semester on the results of this experiment. Although it is likely some students would not have read the Melcher and Schooler paper, the majority would have done so and would not have been naïve about verbal overshadowing when they participated in the experiment.

---

22 The other choice for their laboratory report was the Stroop effect which had been covered in the previous week’s laboratory session.
5.1 Experiment 9 – Non-Naïve Participants

As explained, the purpose of Experiment 9 was to run a standard verbal overshadowing experiment in a first year psychology laboratory session. For this reason, the only hypothesis was that:

- Participants who described the target face would perform more poorly on the recognition task than those who did not.

Method

Design

Experiment 9 was a simple verbalisation or control condition between-subjects design.

Participants

Participants were 160 ANU first-year undergraduate psychology students, 98 were female, and 62 were male with ages ranging from 17 to 60 years ($M = 20.0$, $SD = 5.63$).

Materials

Face stimuli.

The head-and-shoulder faces from Experiment 8 were used for this experiment (see Figure 5.1).
Lineup faces (presented *simultaneously*). Target is in position 5.

*Figure 5.1. Experiment 9: Head-and-shoulder faces*

*PowerPoint presentation and participation booklets.*

These materials were the same as those used in Experiment 8.

*Procedure*

The procedure was identical to that of Experiment 8 except that these participants did the experiment as part of a scheduled cognitive psychology laboratory session. Participants had the option of not participating in the experiment, and they had the option of requesting that their results be omitted from analysis.
Results

Face Identification

Participants in both control and verbalisation conditions performed on a par. As can be seen from Table 5.1, there was no difference in recognition rates for verbalisation and control participants, \( \chi^2(1) = 0.022, p = .882 \).

Table 5.1
Experiment 9: Correct and Incorrect Responses by Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Verbalisation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>48 (63%)</td>
<td>54 (64%)</td>
<td>102 (64%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>28 (37%)</td>
<td>30 (36%)</td>
<td>58 (36%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(13)</td>
<td>(9)</td>
<td>(22)</td>
</tr>
<tr>
<td>Total</td>
<td>76 (100%)</td>
<td>84 (100%)</td>
<td>160 (100%)</td>
</tr>
</tbody>
</table>

These results were surprising given that this was a replication of Experiment 8 and that experiment had produced a verbal overshadowing effect. Given that participants were not naïve, it was decided to introduce the factor of naïvety and combine the data from Experiments 8 and 9 for further investigations.

Combining Experiment 8 (Naïve) and Experiment 9 (Non-Naïve) Data

To ensure both experiments had equal sample sizes, the data of 59 participants were randomly selected for deletion from the data of Experiment 9. Analysis was then undertaken using naïvety as an additional independent variable, and the opportunity was taken to investigate any differences in the quality of description between naïve and non-naïve participants. It is reasonable to hypothesise that participants who are not naïve may censor their descriptions to avoid including information of which they are not sure. It is likely that non-naïve participants will produce more accurate, and possibly shorter, descriptions, and it is also likely that understanding the experimental procedure will
make them more attentive to the face at encoding, possibly resulting in better recognition performance.

**Face Identification**

Identification rates for naïve and non-naïve conditions are shown in Table 5.2 and Figure 5.1.

Table 5.2

*Experiment 9: Correct and Incorrect Responses by Condition for Naïve and Non-Naïve Participants*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control</th>
<th>Verbalisation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>30 (60%)</td>
<td>20 (40%)</td>
<td>50 (50%)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>20 (40%)</td>
<td>31 (60%)</td>
<td>51 (50%)</td>
</tr>
<tr>
<td>(Misses)</td>
<td>(2)</td>
<td>(14)</td>
<td>(16)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50 (50%)</strong></td>
<td><strong>51 (50%)</strong></td>
<td><strong>101 (100%)</strong></td>
</tr>
</tbody>
</table>

| Correct   | 33 (65%)| 31 (62%)      | 64 (64%) |
| Incorrect | 18 (35%)| 19 (38%)      | 37 (37%) |
| (Misses)  | (9)     | (7)           | (16)   |
| **Total** | **51 (50%)** | **50 (50%)** | **101 (100%)** |

A logistic regression was performed with naïvety (naïve, non-naïve) and condition (control, verbalisation) as the predictor variables, and identification as the dependent variable. The result indicated a main effect for naïvety and a main effect for condition on face identification. Non-naïve participants were 2.5 times more likely than naïve participants to correctly identify the face, $W_{(1)} = 5.15, p = .023$, and control participants were 2.3 times more likely than verbalisation participants to correctly identify the face, $W_{(1)} = 4.30, p = .038$. There was no naïvety by condition interaction, $p$
The full model was an acceptable fit for the data, $-2 \text{ Log Likelihood} = 268.24$. Hosmer and Lemeshow, $\chi^2(2) < 0.005$, $p < 1$, change in deviance of $\chi^2(3) = 8.44$, $p = .038$, and the model accounted for between 4.1% (Cox and Snell) and 5.5% (Nagelkerke) of the variance in face identification.

Figure 5.2. Experiment 9: Percent correct for naïve and non-naïve participants by condition

**Discrimination Ratings**

Discrimination ratings were calculated as in previous experiments, and analysis of variance showed a large main effect for naïveté, $F_{(1,198)} = 188.09$, $p < .0005$, partial $\eta^2 = .49$. Non-naïve participants showed better discrimination of the target face than naïve participants. The significance level for this analysis was set at $p < .01$ to accommodate the violation of Levene's test of equality, however the result was clearly still significant.

As in the previous experiments, there was no main effect of condition on discrimination ratings, $F_{(1,198)} = 2.29$, $p = .13$, and there was no naïveté by condition condition.

---

23 According to Pallant (2005), when Levene's test is violated, a more stringent significance level must be adopted to overcome the unequal variance of the dependent variable across the groups.
interaction, $F_{(1,198)} = 0.01, p = .94$. The mean discrimination ratings for each group are shown in Table 5.3, and the absence of an interaction can be seen in Figure 5.3.

Table 5.3

Experiment 9: Discrimination Ratings by Condition for Naïve and Non-Naïve Participants

<table>
<thead>
<tr>
<th>Condition</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naïve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>-5.0</td>
<td>+5.0</td>
<td>-1.2 (2.20)</td>
</tr>
<tr>
<td>Verbalisation</td>
<td>-5.6</td>
<td>+4.6</td>
<td>-1.7 (2.15)</td>
</tr>
<tr>
<td>Non-Naïve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>-1.8</td>
<td>+6.0</td>
<td>+3.4 (2.64)</td>
</tr>
<tr>
<td>Non-Naïve</td>
<td>-1.8</td>
<td>+6.0</td>
<td>+2.9 (2.44)</td>
</tr>
</tbody>
</table>

Figure 5.3. Experiment 9: Discrimination ratings for naïve and non-naïve participants
Description quality

Quality of the descriptions for both naïve and non-naïve participants was investigated using a procedure similar to that of Meissner and his colleagues (2002; Meissner et al., 2001). Two independent coders each generated a description of the target face and, in consultation, developed a description of the target face which included descriptors that were correct, incorrect and subjective (see Appendix C.1). Correct details were those that represented facial information available from the target photograph. Incorrect details were items such as eye colour which did not match the photograph (it was black and white), and subjective details were ambiguous features or any detail that could not be verified from the photograph such as “he had a pleasant face” (Finger & Pezdek, 1999; Meissner, 2002; Meissner et al., 2001).

After training on 15 example descriptions to a criterion of 85%, the coders independently rated all 101 descriptions of the target face. An intraclass correlation using a two-way mixed model was performed to generate interrater reliabilities for the two judges. The interrater reliabilities were good at $r = .95$ for correct details, $r = .92$ for incorrect details and $r = .84$ for subjective details. The range and means for descriptors for the naïve and non-naïve groups are shown in Table 5.4.
Table 5.4
Experiment 9: Descriptors for Naïve and Non-Naïve Conditions

<table>
<thead>
<tr>
<th>Descriptors</th>
<th>Condition</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>Naïve</td>
<td>2.0</td>
<td>10.0</td>
<td>5.0 (1.90)</td>
</tr>
<tr>
<td></td>
<td>Non-Naïve</td>
<td>1.0</td>
<td>9.0</td>
<td>5.4 (1.80)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>Naïve</td>
<td>0</td>
<td>9.5</td>
<td>3.2 (1.99)</td>
</tr>
<tr>
<td></td>
<td>Non-Naïve</td>
<td>0</td>
<td>10.0</td>
<td>3.2 (2.14)</td>
</tr>
<tr>
<td>Subjective</td>
<td>Naïve</td>
<td>0</td>
<td>3.5</td>
<td>1.0 (0.96)</td>
</tr>
<tr>
<td></td>
<td>Non-Naïve</td>
<td>0</td>
<td>4.5</td>
<td>1.5 (1.11)</td>
</tr>
<tr>
<td>Total Correct and</td>
<td>Naïve</td>
<td>3.5</td>
<td>13.5</td>
<td>8.2 (2.48)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>Non-Naïve</td>
<td>2.0</td>
<td>14.5</td>
<td>8.6 (2.61)</td>
</tr>
<tr>
<td>Total Correct, Incorrect and Subjective</td>
<td>Naïve</td>
<td>4.0</td>
<td>15.5</td>
<td>9.2 (2.65)</td>
</tr>
<tr>
<td></td>
<td>Non-Naïve</td>
<td>2.0</td>
<td>16.0</td>
<td>10.1 (3.05)</td>
</tr>
</tbody>
</table>

A multivariate analysis of variance was performed to investigate the effect of naïvety on description quality. The three dependent variables used were mean number of correct descriptors, mean number of incorrect descriptors and mean number of subjective descriptors. There were no multivariate outliers as the maximum Mahalanobis distance was 11.59 and the critical Mahalanobis value was 16.27. In addition, multicollinearity was not a factor as correlations between the three dependent variables were low (see Table 5.5).
Analysis showed that naïvety had no effect on the number of correct, incorrect or subjective descriptors generated by participants in the verbalisation condition, $F_{(1,99)} = 2.29, p = .083$, Wilks’ $\Lambda = .93$. As the result approached significance, pairwise comparisons were performed for each of the dependent variables. The significance level was reset to $p = .02$ using a Bonferroni correction. These comparisons showed that correct descriptors did not differ between naïve and non-naïve participants ($p = .281$), nor did incorrect descriptors ($p = .991$); however, the results for subjective descriptors just failed to reached significance with naïve participants producing fewer subjective descriptors than non-naïve participants ($p = .022$).

**Misses (incorrectly rejecting the lineup)**

The number of misses (rejecting the lineup when the target was present) for each group appeared to vary between naïve and non-naïve participants (see Table 5.6).
Participants who were not naïve experienced a similar rate of misses in both conditions; however, verbalisation participants who were naïve appeared to show a greater propensity to rejecting the lineup than naïve control participants. A logistic regression with predictor variables naïvety (naïve, non-naïve) and condition (control, verbalisation) and “miss” as the dependent variable found a main effect for condition, $W(1) = 5.850, p = .016$, $\text{Exp}(\beta) = 0.135$ with verbalisation condition participants 7.4 times more likely to reject the lineup than control participants. There was no effect for naïvety ($p = .564$), however the naïvety by condition interaction was significant, $W(1) = 5.697, p = .017$, $\text{Exp}(\beta) = 12.706$. The odds increased that control participants would reject the lineup when they understood the phenomenon as opposed to being naïve, and the reverse was true for verbalisation participants. Knowledgeable verbalisation participants were less likely to reject the lineup than naïve verbalisation participants. This interaction is evident in Figure 5.4.

The full model was an acceptable fit for the data, $-2 \text{ Log Likelihood} = 105.65$, Hosmer and Lemeshow, $\chi^2(2) = 0.999, p < 1$, change in deviance of $\chi^2(2) = 9.716, p = .021$, and accounted for between 10.5% (Cox and Snell) and 14.3% (Nagelkerke) of the variance in rejecting the lineup.

---

24 SPSS coded Control as 1 and Verbalisation as 0. This means that control participants were 0.135 times less likely to reject the lineup than verbalisation participants, or verbalisation participants were 7.4 ($1 / 0.135$) times *more* likely to reject it than control participants.
Discussion

The initial aim of Experiment 9 was to provide first year psychology students with a simple verbal overshadowing experiment they could write up as part of their introductory psychology course. However, the standard hypothesis that the verbalisation group would perform more poorly than the control group at recognition was not supported despite an earlier, successful execution of the same experiment. The lack of verbal overshadowing evident from this instantiation of the experiment can be attributed to the fact that participants were not naïve about the theoretical underpinnings of the phenomenon nor about the verbal overshadowing experimental procedures.

Analysis of the combined data from Experiments 8 and 9 revealed that naïvety was a predictive factor in the results. Participants who had read and studied the Melcher and Schooler (1996) paper were 2.5 times more likely than naïve participants to correctly recognise the target. This is evident from the identification rates of the different groups. Control participants in the original study (Experiment 8) identified the face 60% of the time. Control participants in Experiment 9 had an identification rate of
63% and verbalisation participants in Experiment 9 had a similar identification rate of 64%. In contrast, naïve verbalisation participants from Experiment 8 only identified the face 40% of the time.

Analysis of the incorrect responses showed that control participants who were not naïve had a higher probability of rejecting the lineup than control participants who were naïve. This suggests that understanding the phenomenon increases the level of doubt control participants experience about whether or not they can accurately pick the target from the lineup. In contrast, verbalisation participants who have described the face experienced less doubt concerning their ability to select the target as the odds were lower that they would reject the lineup altogether. This finding suggests there is merit in Clare and Lewandowsky’s (2004) notion that response criteria may affect verbal overshadowing outcomes. Clare and Lewandowsky believed it was the participants’ uncertainty about their ability to generate a description that led to their reluctance to choose a face from the lineup. These results support that contention as the verbalisation group were 7.4 times more likely to reject the lineup than control participants. Hence, the control group who did not identify the target were more likely to choose a distractor than to reject the lineup entirely. The opposite appears to be true for the verbalisation group. However, while the verbalisation group do appear to experience more doubt and raise their response criterion by rejecting the lineup altogether, it is not clear that this is due to their uncertainty about generating a description of the face. The non-naïve results suggest otherwise. They suggest that knowledgeable control participants are reluctant to choose a face from the lineup and are more likely to reject it and verbalisation participants are less likely to reject the lineup and more likely to select a foil the lineup. If the uncertainty arose from the verbalisation task, verbalisation participants should have been more likely to reject the lineup not less likely.

An initial prediction concerning the difference between naïve and non-naïve participants might be that once participants were no longer naïve about the nature of the experiment and the effect a verbal description could have on subsequent identification, they would be highly likely to censor their descriptions to avoid including any misleading information or information of which they were not sure. However, analysis of the quality of the descriptions produced by both naïve and non-naïve participants showed that this was not the case. There was no difference in description quality. Non-naïve participants produced the same number of correct, incorrect and subjective descriptors as the naïve participants. Non-naïve participants, although aware that
limitations of language produce biased and inaccurate descriptions of faces, did not alter their descriptions accordingly. It cannot be argued that these participants limited the length of their descriptions, or limited themselves to information of which they were certain. In fact, non-naive participants produced a numerically greater number of subjective descriptors than participants in the naive condition. While this might be attributed to the use of less definitive descriptors because this group were aware of the limitations of language, the fact that they produced the same number of correct and incorrect descriptors counters this argument.

A pertinent question is whether reading the Melcher and Schooler (1996) paper enabled students to overcome the effects of verbal overshadowing. Perhaps the knowledge participants gained from studying verbal overshadowing provided them with a means of successfully monitoring the source of their memories, or allowed them to focus on the visual mental representation rather than the verbal representation at identification. It is difficult to answer this question as no information was gathered on how well participants understood the phenomenon and whether that understanding was correlated with correct identification. The analysis of this data was not completed until after the semester had ended, and the only information available was the short-answer questions from the tutorial quiz (see Appendix D.2) but not the students' responses to those questions. Future experiments investigating this aspect of verbal overshadowing might add an analysis of the information gleaned about the phenomenon by non-naive participants. This could contribute to understanding how being knowledgeable assists participants in overcoming the effect.

Another possibility would be to try and interpret these findings from a processing mode perspective. Non-naive participants were aware that they would be asked to describe the face and they were aware that facial descriptions predominantly involve featural information. In an effort to produce more accurate descriptions, and thus reduce the likelihood that their limited verbal ability would interfere with identification, participants may have been particularly keen in studying the face at encoding. This could have led to a featural rather than holistic approach to encoding. Hence, whilst this evidently did not improve their descriptions, it may have changed the way participants encoded the face. If these participants did encode the face featurally,

25 These questions (and answers) may be of interest as they were produced by a teaching assistant who did not know the verbal overshadowing literature.
then the introduction of the verbalisation task would not have produced the traditional “shift in processing” associated with impaired recognition under the TIPS hypothesis. Both groups, verbalisation and control, would have encoded the face featurally and experienced no change in processing mode before identification. Although the results are consistent with “no processing shift means no impaired recognition”, they challenge the basic concept of the phenomenon – that using a featural processing style impairs recognition of holistically processed stimuli. Furthermore, this explanation is flawed from the perspective of the hypothesis put forward in Chapter 2. It was suggested in Chapter 2 that rather than a processing shift impairing recognition, it may be a mismatch of final processing styles that results in poorer recognition. And, it was argued in Experiment 8 that this particular lineup requires a greater degree of holistic processing than featural processing. Hence, if participants had engaged in a featural processing strategy, and the lineup required holistic processing, recognition should have been impaired for both groups, and it was not. It would seem that the TIPS hypothesis and the RI hypothesis fail to accommodate these results.

There is, however, a parallel between the findings of Experiment 9 and the findings of verbal overshadowing studies with multiple trials. The evidence from these studies is that verbal overshadowing is present on the first trial but attenuates over subsequent trials (e.g., Fallshore & Schooler, 1995; Melcher & Schooler, 1996, 2004; Schooler et al., 1996). The commonality here is that participants in Experiment 9 and participants doing subsequent trials in verbal overshadowing experiments are no longer naïve to the experimental procedure. Fallshore and Schooler argued that it is only on the first trial that participants are truly naïve. Once participants have undergone one trial of the study, they know that they will be asked to describe a face, they will have had practice describing a face, and they will expect to be asked to identify that face later in the experiment. Furthermore, participants will be familiar with the type of targets and distractors used at identification in the subsequent trials. While participants in Experiment 9 were not practised at describing the face, nor would they have known the type of target and distractor they would encounter, they were aware of the experimental format. From this it would seem that participants can avoid impairment in recognition when they are familiar with the experimental procedures. This is important because the one clear finding from this experiment is that individuals are capable of overcoming the impairment in recognition associated with verbal overshadowing if they are made aware of the theoretical explanation for the phenomenon and the experimental procedures.
involved. If verbal overshadowing interferes with identification in a forensic context, it would appear that explaining the identification procedures and giving eyewitnesses a basic understanding of how verbal descriptions can impair identification may help to eliminate the possibility of it occurring. Furthermore, given that the quality of non-naïve participants' descriptions did not differ to that of naïve participants, we can be confident that asking knowledgeable eyewitnesses to give a description will not result in any censoring of the information provided. Educating eyewitnesses can help, rather than hinder, the identification process.

5.2 Summary

Experiment 9 was an unplanned study which took the form of a standard verbal overshadowing experiment (identical to Experiment 8). It was run for the convenience of a first year psychology course, but provided an interesting finding. The participants in this study were not naïve to the theoretical accounts of verbal overshadowing or the experimental procedures, and those in the verbalisation condition did not experience impaired recognition. A logical assumption would be that knowledgeable participants would censor their descriptions to only include information of which they were certain; however, analysis of the descriptions from both Experiment 8 (naïve participants) and this experiment found this was not the case. There were no differences in description quality. A parallel was drawn between the attenuation of verbal overshadowing over multiple trials in previous experiments and the fact that participants in Experiment 9 were similarly knowledgeable about the experimental procedure. It would appear that procedural knowledge assists individuals in overcoming the effect.
This thesis provided evidence for the TIPS hypothesis of verbal overshadowing by showing that the processing shift thought to underlie the phenomenon produces the characteristic face recognition impairment when the direction of that processing shift is reversed. In accord with the TIPS hypothesis, a featural processing task interferes with holistic processing of faces. The novel contribution of this thesis is in demonstrating that a holistic processing task can interfere with featural processing of faces. The thesis also investigated whether the processing shift might have its origins in hemispheric activation, specifically in the form of competition between brain hemispheres, due to increased activation of one hemisphere at the expense of the other. However, the evidence here was not convincing. The Navon letter tasks produced a strong left hemisphere bias, although this was possibly due to the inherently verbal nature of the task. Although a left hemisphere bias might have been expected due to the verbal nature of the standard verbal overshadowing tasks (verbal description and category generation), both these tasks produced similar activation of both hemispheres, casting doubt on the hypothesis that the processing shift results from competition between left and right hemispheres. Finally, and quite by chance, there was the finding that if participants are knowledgeable about the theoretical perspectives of the phenomenon and the experimental procedures used in verbal overshadowing experiments, they do not succumb to the effect, nor, importantly, do they censor their verbal descriptions.

6.1 Featural or Holistic?

Perhaps the most important outcome of the thesis was the finding that the processing shift produces impairment in face recognition when the direction of the putative processing shift is reversed. Most verbal overshadowing and Navon effect studies to-date have investigated the phenomenon from the perspective of impairing recognition of holistically processed stimuli by introducing featural processing between encoding and retrieval of the original event. The exception is the Weston and Perfect (2005) study which found that a local Navon task improved performance on the composite-face task due to the featural nature of both activities. But, if a processing shift is a major underlying factor in the occurrence of the phenomenon, then a shift from
either holistic encoding to featural processing or featural encoding to holistic processing should produce similar deleterious effects on retrieval because of the mismatch in processing strategy and task demands induced prior to recognition. The challenge in creating such an experiment lies in identifying stimuli that will result in the appropriate encoding and recognition processing styles. It is difficult to produce a target face that requires featural encoding, but the unexpected findings of Experiment 1 proved to be advantageous in this regard.

In Experiment 1, the group processing local (featural) Navon letters in the interpolated task were more accurate at recognition than the group processing global (holistic) Navon letters. This was at the reverse of results in the published literature, and suggested that the processing associated with the encoding of these faces might not, as assumed, always be holistic; rather, for some faces a featural mode of processing might be induced. The assumption in the overshadowing literature has been that the encoding and recognition of upright, own-race faces always requires predominately holistic processing, an assumption arising from the face processing literature (e.g., Tanaka & Farah, 2003; Tanaka et al., 2004). Indeed, the faces used in Experiment 1 were similar to those used in many face processing experiments, being devoid of external, featural information such as hair, neck, shoulders and clothing (e.g., Rhodes et al., 1989).

However, in Experiment 1, the target face to be learned was presented in an identical manner at recognition, and participants had five seconds in which to learn the face. This allowed participants time to take in the details of each facial feature. When the identical photograph was presented for recognition, participants could then rely on the features, and the placement and lighting of those features, to determine which of the six faces matched the original photograph. In essence, participants could engage in an image-matching strategy rather than a face recognition activity (Brown & Lloyd-Jones, 2002a). Contrast this with the fact that over 95% of verbal overshadowing studies have used a different image of the target at encoding and recognition (Appendix A.7). The encoding and recognition stimuli in almost all verbal overshadowing studies either mixed the media of presentation or the style of photograph (casual vs formal). In all these cases, the lighting and angle of the face differs between encoding and recognition. These changes, and any change in the target’s expression, make it more difficult to match the face on the basis of a single, unchanged feature. Participants must rely instead on identifying the face from the configuration of its features, and this form of
recognition requires a greater degree of holistic processing, a factor that was identified by Schooler and Engstler-Schooler (1990).

Yet, in contrast to the verbal overshadowing literature, the use of identical images is not uncommon in the face processing literature (e.g., Lahaie et al., 2006; Leder & Carbon, 2006). Why should face processing studies produce consistent holistic processing outcomes with identical encoding and recognition stimuli when Experiment 1 did not? The explanation proposed in this thesis was that participants in face processing studies learn many faces, not a single face, and learning many faces requires a greater degree of holistic processing. This may explain why face processing studies are not hampered by the featural bias seen in Experiment 1 (McKone, personal communication, April 2007). But it is not only that there are multiple faces to encode, it is also possible that familiarity with faces has an effect on processing style. Hancock et al. (2000) and Megreya and Burton (2006) showed the “unfamiliar” faces are encoded in a featural manner, whereas “familiar” faces are encoded using holistic processing. Participants in face processing studies are often required to “learn” a face. They become familiar with a face over several short encoding sessions, and it is not uncommon for participants to be asked to associate that face with a particular name, for example, one face might be learned as “Ann”, another as “Clare” (e.g., Robbins & McKone, 2003). Learning faces encourages familiarity with those faces, and learning multiple faces minimises the opportunity for participants to remember each “familiar” face on the basis of individual features, hence participants must adopt a more holistic strategy at recognition to differentiate similar stimuli.

Though it might seem at first glance that such small procedural differences should not matter, the outcome of Experiment 1 indicates that they do. When participants have five seconds in which to learn a single face, they have time to take in the details of each facial feature. If an identical photograph is presented at lineup, they can engage in an image-matching strategy relying solely on the features, their placement and their lighting to determine which of the six faces (or images) matches the original. In contrast, when participants learn several faces or are presented with a photograph at recognition taken under different conditions to the encoding photograph, they cannot rely on individual features, particularly as the stimuli are chosen because the features are not distinctive. Hence, participants must rely on differences in configuration of the faces, or holistic processing.
While the findings of Experiment 1 initially proved problematic because the Macrae and Lewis (2002) study was not replicated in the standard face condition, they also proved fortuitous. The finding that identical encoding and recognition stimuli promoted featural processing provided the stimuli for a successful reversed-direction processing shift experiment in Experiment 4. When these stimuli were combined with equally salient Navon letters that produced both global and local processing, the global Navon group performed more poorly at recognition than the local Navon group. Experiment 4 produced this reversed processing shift using the same target, distractors and interpolated tasks as the replication of Macrae and Lewis’ experiment (Experiment 3) which induced the standard processing shift. The difference between the two experiments lay only in the type of processing required by each set of faces. The recognition task demands in Experiment 4 were highly featural due to the image-matching task and sequential lineup; the recognition task demands in Experiment 3 were more holistic as the target photograph changed between encoding and recognition. Hence, the symmetry of these two experiments made the results highly comparable, and provides strong support for the TIPS hypothesis.

However, one finding from this series of experiments was puzzling. In all experiments presented as part of this thesis, control group recognition rates were satisfactory (between 60% and 70% identified the target) with the exception of the control group in the Macrae and Lewis (2002) replication (Experiment 3). In Experiment 3, the control group showed unexpectedly poor recognition. Their recognition rates were similar to those of the local Navon group (who experienced impaired recognition due to a processing shift to featural processing). There are two possible explanations for this. Firstly, this result could be attributed to the small sample sizes and resultant low power of Experiments 3 and 4. This may have been a contributing factor in the anomalies of statistical significance seen in the results across experiments (e.g., in Experiment 4 there was a significant difference between control and global groups, but the significant difference between local and global groups seen in Experiment 1 was no longer evident), and the lack of power might explain the

26 Schooler (personal communication, January 2005) suggests the optimal control rate for verbal overshadowing should be 65% to 75%.

27 Another exception was the scrambled/control group recognition rate in Experiment 1; however, it is reasonable to assume that this was indicative of the difficulty of the task of identifying scrambled faces.
unusually poor performance of the control group; such a small sample size may have resulted in a statistical happenstance. However, it could also be postulated that the low performance by the control group is due to the type of processing these individuals were using. They may have engaged in featural processing at recognition, and may have experienced impaired recognition because the lineup required holistic processing. The problem with this supposition, however, is that these (control) participants had not undertaken an interpolated task purported to induce such a processing shift to featural processing, and the TIPS hypothesis states that it is a transfer-inappropriate processing shift that impairs recognition. Schooler (2002, p. 992) suggested that “verbal overshadowing effects are assumed to occur because verbalization induces inappropriate processing operations which, when carried over at the time of test, are incommensurate with the processes required for successful recognition performance”.

The question is which explanation applies to these results? Testing these explanations should be done by re-running the studies with a larger number of participants. If a larger sample size produced similar results, it is likely that the control group’s poor recognition in Experiment 3 was not due to a shift in processing, but rather to a mismatch in processing styles resulting from different task demands; such a mismatch in processing styles could have produced the impaired recognition. As suggested briefly at the end of Chapter 2, all participants, including those in the control group, may have encoded the faces in a featural manner. Unlike the global Navon group, the local Navon and control groups did not undertake an interpolated task that redirected their processing style to a more holistic mode. The control group and the local Navon group were left with a featural processing strategy for a recognition task that demanded holistic processing. In other words, the final task demanded a different processing style to that of the encoding activity. Hence, the mismatch occurred not due to a shift from one style of processing to another, but due to the fact that a processing shift did not occur when task demands did change between the two experimental phases. It is possible to present a target face in such a way that encoding requires one form of processing and identification requires another. In this case, the fundamental modality mismatch supposition of verbal overshadowing would still apply, but to the nature of the task demands.
6.2 Processing Shift or Task Demands?

The TIPS hypothesis suggests that if a processing shift does not occur, then recognition will not be impaired. But, in Experiment 3 this was clearly not the case. If "unfamiliar" faces are encoded featurally, and the recognition task requires holistic processing, recognition can still be impaired as in Experiment 3. The control group did not experience a processing shift during the interpolated task, so were left with the same form of processing (featural) at recognition as they had engaged at encoding (featural). Yet, the nature of processing required for the encoding and recognition tasks was different. Encoding encouraged featural processing and recognition demanded holistic processing. For the TIPS hypothesis to accommodate these results, it must address the nature of the task demands, rather than the simple existence of a processing shift. Just as the assumption cannot be made that participants will encode a face holistically, nor can the assumption be made that a recognition task requires the same processing strategy as the encoding task. Hence, recognition impairment can result from a mismatch between participants' carried-over processing strategy and the different processing strategy required by the recognition task.

If this hypothesis is valid, it raises two obvious questions: firstly, are all unfamiliar faces in verbal overshadowing studies encoded featurally, and secondly, if they are, why did Macrae and Lewis' (2002) and Perfect's (2003) control groups not perform as poorly as those in Experiment 3? The answer to these questions may lie in the familiarity of the target face. Participants are not familiar with the target face before beginning an overshadowing experiment. This raises the question of whether any face with which individuals do not have experience is "unfamiliar", and the answer may be not necessarily. Megreya and Burton (2006, Exp 6) found that exposure to a 30-second silent video of an unfamiliar face significantly improved later recognition of that face. So, longer exposure to an unknown face improves familiarity and could alter the way in which the face is encoded. If we consider the face processing literature, the dominant view is that faces are processed and encoded holistically. But as was mentioned in Chapter 2, participants in face processing experiments are often exposed to 4 to 6 five-second trials (cf. Cabeza & Kato, 2000; Tanaka & Farah, 1993), and such exposure and "familiarity" is analogous to the exposure participants in some overshadowing experiments experience, specifically those using the Schooler and Engstler-Schooler video (Dodson et al., 1997, Exp 1; Finger, 2002; Macrae & Lewis, 2002; Perfect, 2003; Schooler & Engstler-Schooler, 1990; Westerman & Larsen, 1997). This 30-second
video provides front and side views of the face as well as different expressions encouraging a more holistic memory encoding. In addition, participants watch the activity that unfolds around the target. This is likely to produce a different form of encoding to viewing a single, static photograph for five full seconds. As both Macrae and Lewis and Perfect used the Schooler and Engstler-Schooler (1990) video, it could be argued that these experiments provided sufficient encoding time for participants to become “familiar” with the target face and engage in a greater degree of holistic processing (cf. face processing experiments). In fact, it is interesting to note that the duration of encoding was not a predictor variable evaluated by Meissner and Brigham (2001) in their meta-analysis of verbal overshadowing. They considered the manner of stimulus presentation (video or photograph) and found it was not a significant predictor, but they did not evaluate the duration of the stimulus presentation. It is possible that when participants develop some familiarity with the target face due to longer encoding times, a more holistic or configural form of processing can result. For these participants a processing shift would then be necessary to impair recognition; hence, only verbalisation or local Navon groups would exhibit poorer recognition.

The important point here is that the processing shift may be secondary. Participants can encode a face using featural, holistic or both types of processing (Bartlett et al., 2003). What may be critical is whether the task demands at recognition match the type of processing required by the recognition task. Up until now, the assumption has been that the same type of processing required at encoding and recognition. This can be true. When it is true, as in many overshadowing studies, a processing shift must occur for recognition to suffer. But, it may not always be the case. Situations can be created in which one form of processing is useful at encoding and another at recognition. It would appear that in such cases participants do not need to experience a processing shift to perform poorly at recognition. In fact, if they do not experience a processing shift, they will perform poorly on recognition because the processing strategy they carryover from encoding to recognition will be less than optimal. It may be that a “transfer-inappropriate processing strategy” (due to task

---

28 This may even explain some fragility of the phenomenon. Researchers who have been unable to show overshadowing outcomes may have been working with encoding and test stimuli that required different forms of processing. In these circumstances, a shift in processing style could align the participants' processing style with that required for identification, rather than impede it. It must be noted, however, that this is only conjecture.
demands) rather than a “transfer-inappropriate processing shift” impairs face recognition (see Figure 6.1).
Figure 6.1. Transfer-inappropriate processing shift or transfer-inappropriate processing *strategy*?
If we adopt this hypothesis, then the results of the Experiments 4 (reversed processing shift) and 3 (Macrae and Lewis replication) can be interpreted as follows. In Experiment 4, the global Navon group performed poorly because they experienced a processing shift between encoding and test, and, in line with the TIPS hypothesis, the optimal encoding and recognition strategies required were the same for both activities (see Figure 6.2). In Experiment 3, however, this was not the case. Featural processing was optimal at encoding, but holistic processing was required for recognition because the target differed between encoding and test. The local Navon and control groups performed poorly because they did not experience a processing shift and the optimal processing mode for recognition was different to that for encoding (see Figure 6.3).

![Figure 6.2. Experiment 4 (reversed processing shift) results in terms of processing strategy.](image-url)
Participants in both Experiments 3 and 4 encoded the same face (albeit without the cap and shoulders in Experiment 3) over the same period of time. The interpolated tasks for both experiments were the same (global Navon, local Navon or reading aloud). The difference was in the recognition test. Participants in Experiment 4 saw a sequential lineup with a target photograph that was identical to the one shown at encoding. This allowed those with a featural processing strategy to engage in image-matching based on individual features. In addition, the sequential lineup may have been more conducive to featural processing because the faces were presented one at a time replicating the single-face encoding presentation mode, and encouraging absolute-judgement. In Experiment 3, however, participants were given a simultaneous lineup in which the target photograph was different from the encoding photograph. This required participants to rely on holistic processing to a greater extent, and disadvantaged those whose primary processing strategy at recognition was still featural. A simultaneous lineup is unlikely to be conducive to featural processing because of the confusion produced when trying to evaluate the features of all six faces at once, particularly when such a task encourages relative-judgement strategy (Brewer & Wells, 2006).
While this account of the processing shift hypothesis explains the results of the experiments in Chapter 2, it is not without weakness. If it is argued that participants encode a face from a static photograph in a featural manner, particularly in a single-face encoding task, then verbal overshadowing studies that have used a static photograph at study and test should have produced similar poor control group results, and they have not. Generally, control groups in the published literature have identified the target at a rate of 65% to 75%, and adopting the above hypothesis would conflict with these results (Brown & Lloyd-Jones, 2002b; Dodson et al., 1997, Exp 2 & 3; Fallshore & Schooler, 1995; Meissner, 2002; Ryan & Schooler, 1998). It is difficult to account for the difference between these studies and the control group in Experiment 3, but it might suggest that the nature of the faces used plays an important role. In the present set of experiments, the need to create both the encoding and test stimuli from the same original photograph may have led to facilitated recognition by a single, unchanged feature across encoding and test due to the identical placement and lighting of that feature. The features that constitute the configural face information, the inner face, were identical in encoding and recognition photographs. Each feature, and its form and lighting and shading, remained constant between encoding and test. No other verbal overshadowing studies (with the possible exception of Kitagami et al. (2002)) have used such stimuli. The use of two different photographs taken at different times must result in different lighting and shading, and possibly shape, of the features. Eyes may be more open or closed, the mouth’s shape can be altered by a slight change in expression, and light and shadow can appear to slightly change the form of facial features. In other overshadowing studies there have been these subtle differences between the encoding and test “internal” face image, but not in this thesis. Furthermore, it should be noted also that the duration of encoding could be a factor. Control participants in Experiment 8 (the standard verbal overshadowing experiment) experienced the same encoding and recognition stimuli as the control participants in Experiment 3, but the recognition rate of the control group in Experiment 8 was 60%. The only difference was in the duration of encoding. The Experiment 8 control group were given only 3 seconds to encode the face whereas the Experiment 3 control group were given 5 seconds. While extended encoding periods may improve familiarity without encouraging featural processing when multiple faces are involved, this is unlikely to be the case with a single-photograph encoding task. In such circumstances, increasing the duration of encoding
would simply allow participants more time to remember specific features. Further investigation into these factors would provide a better understanding of the effects of encoding presentation and time on processing style.

6.3 Origin of the Processing Shift?

The second major undertaking of the thesis was an investigation into the origin of the processing shift. Schooler (2002) hypothesised that the processing shift might arise from competition between brain regions, for example between left and right hemispheres. He argued that Kosslyn (1987) suggested that there might be a single repository of activation available to both hemispheres of the brain, and strong activation of one hemisphere could result in a drawing away of activation from the other. This would result in a dampening of activation in one hemisphere due to the increased activation of the other. Indeed, as Schooler suggested, the difference in the types of stimuli affected by verbal overshadowing, and the nature of the interpolated task, are consistent with such an idea. Face recognition, and the associated holistic processing, have been shown to engage the right hemisphere; the verbal description task, involving language, is known to produce left hemisphere activation in all but a few individuals (Springer & Deutsch, 1993).

In Chapter 3, physiological measures were used to investigate the activation of the left and right hemispheres in an attempt to find corroborating evidence of the processing shifts. A relatively new technology, fTMT, was used to determine whether differential hemispheric activation occurred during the cognitive tasks undertaken during the experiments in Chapter 2. The findings from Chapter 3 were that a strong left hemisphere bias existed for both local and global Navon tasks, and little right hemisphere activation was evident for tasks purported to engage holistic or global processing. A possible explanation might be that writing or speaking, as required by Experiments 5, 6 and 7, produced a left hemisphere bias. In Experiment 5, participants were asked to write the Navon letters, and in Experiments 6 and 7 they were asked to speak the Navon letters aloud. Writing (particularly for right-handed individuals) and speech production are both left hemisphere tasks (Hellige, 2001; Springer & Deutsch, 1993), hence this bias might be attributed to those tasks. However, in Experiment 5, the global Navon group, who also wrote the Navon letters, showed no left hemisphere
activation at all, suggesting that the left hemisphere bias is more likely to be due to the intrinsically verbal nature of the stimuli than the associated writing and speaking activities.

The greater overall left hemisphere activation seen in Experiments 6 and 7 is consistent with some previous findings. In an fMRI study using hierarchical polygons, instead of letters, Martinez et al. (1997) found that while right hemisphere activity decreased during local trials, the left hemisphere was activated during both local and global trials. They argued that during the global and local tasks, the asymmetrical activation of the two hemispheres is not equivalent. Other researchers, for example Blanca and Alarcon (2002), have not been able to produce evidence of hemispheric specialisation for global and local processing, and some have found right hemisphere global asymmetries were demonstrated less frequently than left hemisphere local asymmetries (Evert & Kmen, 2003; Martin, 1979a).

fTMT data was also collected in Chapter 4 for a standard verbal overshadowing experiment incorporating the verbalisation task and reading aloud control task used in Experiments 6 and 7 and other verbal overshadowing studies (Macrae & Lewis, 2002; Schooler & Engstler-Schooler, 1990). Surprisingly, there was a lack of left hemisphere activation for participants engaged in the verbalisation task. This was a highly verbal and featurally descriptive task, yet this group showed similar activation of both left and right hemispheres. In fact, they showed numerically less right and left hemisphere activity than those who were reading aloud in the control group. The lack of asymmetry for left hemisphere activity in the verbalisation task could have been due to the task requiring more than simple verbal expression; participants needed to recall the face, evaluate the details of the face they could remember, and then compose sentences and phrases while searching their vocabularies for accurate descriptors to convey that information. Such a task is far more complex than a simple Navon letter recognition task, and the complexity of such a task may recruit both hemispheres (Hellige, 2001; Springer & Deutsch, 1993).

The reading aloud control task produced a similar pattern of activation (both hemispheres activate), as did the animal photograph rating task and the crossword puzzle task. But, it was only the first of these tasks in each experiment that produced a significant level of hemispheric activation. For Experiments 5, 6 and 7, the animal rating and reading aloud tasks were the first and only activities, hence they produced the
significant activation. In Experiment 8, the crossword task was the first task, followed by the verbal description and control tasks. Only the crossword task produced significant levels of activation. The suggestion was made in the discussion of Chapter 4 that the crossword puzzle task had produced such strong left and right hemispheric activation that any subsequent activation from the verbalisation and control tasks may not have reached significance because a maximum decrease in tympanic membrane temperature had been achieved, or almost achieved, during the crossword task. Subsequent significant hemispheric activation may not have been evident due to a floor effect in TMT change. Indeed, the decreases in TMT observed by Cherbuin and Brinkman (2004; 2007) were less than 0.2° C during 20 minutes of cognitive activities, and Meiners and Dabbs (1977) recorded decreases of less than 0.1° C. In contrast, the decreases at the end of the control and verbalisation tasks in Experiment 8 (Chapter 4) ranged from a minimum of 0.2° C to more than 0.5° C, and similar drops were seen for the picture rating and reading aloud tasks in Experiments 5, 6 and 7.

It was evident across all fTMT experiments that the pattern of hemispheric activation did not change during the lineup task, although only limited conclusions can be drawn from this data. It can only be concluded that if there is a link between hemispheric activation and processing style, and it must be cautioned that such a link has not been evident from these experiments, then the processing style in effect before the lineup task may continue through the recognition phase. However, it would be incorrect to draw this conclusion on the basis of these experiments alone. The data only suggest that it might be worthwhile investigating this possibility due to its importance to the TIPS hypothesis.

The final, and unexpected, finding of the thesis was that participants who are knowledgeable about the theory and experimental procedures of verbal overshadowing are not affected by the phenomenon. However, it was not clear why this is so. In a finding that challenges the RI hypothesis, the non-naïve group produced descriptions equivalent in content to the naïve group, yet the non-naïve group did not experience verbal overshadowing. The lack of verbal overshadowing in this experiment can only be attributed either to participants’ knowledge about the RI and TIPS hypotheses, their procedural knowledge about verbal overshadowing experiments, or the decreased likelihood that those knowledgeable about the phenomenon would reject the lineup when they had given a description. The naïvety by condition interaction showed the
naïve verbalisation group were more likely than the non-naïve verbalisation group to reject the lineup by choosing the “not present” option. This lends some weight to Clare and Lewandowsky’s (2004) proposal that a stricter response criterion can lead to verbalisation participants rejecting the lineup when the “not present” option is available. However, it will require further studies to tease apart whether response criteria or the procedural knowledge known to attenuate verbal overshadowing in multiple-trial studies accounts for immunity to the effect.

6.4 Conclusion

The underlying cause of verbal overshadowing appears to be the result of a mismatch in the processing strategy demanded by a task and the processing strategy of participants. This thesis has added some important information to what we know about this processing shift. Firstly, it is clear that the processing shift, as evidenced by the behavioural data, is bi-directional. Not only does introducing featural processing impair recognition of holistically processed stimuli, but the reverse is also true. If a stimulus is encoded featurally and featural processing is needed for optimal recognition, introducing an intervening holistic processing style prior to identification can impair recognition. In determining this, however, other questions have been raised. For example, do participants encode single faces holistically, and is an intervening processing shift necessary to impair recognition? Can recognition impairment occur simply because of a mismatch between the participants’ current processing style and the task demands of recognition? Can a change in task demands between encoding and recognition result in impaired recognition because there has not been a processing shift? Is it the processing shift or the final processing strategy elicited by the task that impairs recognition? These questions can only be answered by further investigation into the processing used by participants for encoding single and multiple faces, “familiar” and “unfamiliar” faces, and tasks that encourage different processing styles for encoding and recognition. In the latter case, for example, an experiment that investigates the outcome of a holistic encoding task and a lineup that requires featural processing will help to support or dispute this suggestion. Such an experiment might use the Schooler and Engstler-Schooler (1990) video and a still image from that video in a sequential lineup task. Alternatively, it might involve encoding multiple faces from single photographs (cf. Weston & Perfect, 2005) and presenting the identical photograph of the target.
during a subsequent sequential lineup. Only the results of experiments such as these will help to unravel the issue of whether it is an inappropriate processing shift or an inappropriate processing strategy due to a change in task demands that produces impaired recognition in overshadowing studies.

The second major finding from this thesis is the lack of evidence for a left-hemisphere right-hemisphere competition account of the processing shift. Obviously, this finding is only preliminary, but the results suggest that such a clear-cut differentiation between left and right hemisphere activation for the verbal description and control tasks is unlikely. Future investigations might circumvent the left hemisphere bias thought to be due to the inherently verbal nature of Navon stimuli by using a right hemisphere task that is not verbal, for example mental imagery tasks of cube-folding or object rotations (Shepard & Feng, 1972; Shepard & Metzler, 1971). However, even these tasks may fail to produce the differential hemispheric activation expected as the difficulty of the tasks might result in both hemispheres being engaged to a similar degree. Right hemisphere activity appears to produce physiological responses that are not as strong or easily identified as left hemisphere activity (e.g., Evert & Kmen, 2003; Martin, 1979a; Springer & Deutsch, 1993).

The third and final major finding of this thesis brought the RI hypothesis into question once again. Analysis of the quality of descriptions for participants who were not naïve and those who were naïve showed there was no difference in the number of correct, incorrect or subjective details across the two groups; yet, there was a definite effect of naïveté on identification. Non-naïve participants were 2.5 times more likely than naïve participants to correctly identify the target. If description content or misinformation affects recognition performance, then there should not have been any difference in recognition rates between the groups as description quality did not differ.

Eighteen years on, there is still much to be understood about the verbal overshadowing phenomenon. The parameters have been well-defined in terms of the type of stimuli vulnerable to the phenomenon, yet the two underlying theories are still challenged by the results of newer experiments. Recent findings by Brown and Lloyd-Jones (2005; 2006), that verbalisation can produce verbal facilitation, are not readily

29 Although Cherbuin and Brinkman's (2004) findings suggest a right hemisphere asymmetry may be evident.
accommodated by the TIPS hypothesis, yet the results of Experiment 4 (reversed-direction processing shift) and those of Macrae and Lewis (2002) and Perfect (2003) cannot be accommodated by the RI hypothesis. This thesis has provided strong support for the TIPS hypothesis by reversing the direction of the processing shift and showing that it produces a similar form of recognition impairment for faces to the standard processing shift. But, this is only a start. These findings need to be replicated, and further investigation is required to determine the effect of encoding media and duration on processing strategy. The investigations into the hemispheric activation associated with the tasks involved in overshadowing experiments are, again, only a beginning. Further research needs to identify whether hemispheric asymmetries can occur in conjunction with impaired recognition, and whether such asymmetry is necessary for recognition to be impaired. Finally, it is worth noting that the serendipitous findings of the final experiment have important implications for eyewitness identification. While we still do not know the cause of the verbal overshadowing phenomenon, we now have an indication that through educating eyewitnesses about the possibility of experiencing the phenomenon, and explaining the lineup and description procedures and their possible effects, we can help to immunise eyewitnesses to the phenomenon without limiting the quality of the description they can provide.
REFERENCES


232


Hunter, Z. R., & Brysbaert, M. (in press). Visual half-field experiments are a good measure of cerebral language dominance if used properly: Evidence from fMRI. *Neuropsychologia*.


APPENDIX A

A.1 Navon letter sheet

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  
9.  
10.  
11.  
12.  
13.  
14.  
15.  
16.  
17.  
18.  
19.  
20.  
21.  
22.  
23.  
24.  
25.  
26.  
27.  
28.  
29.  

30.  
31.  
32.  
33.  
34.  
35.  
36.  
37.  
38.  
39.  
40.  
41.  
42.  
43.  
44.  
45.  
46.  
47.  
48.  
49.  
50.  
51.  
52.  
53.  
54.  
55.  
56.  
57.  
58.  

242
A.2 Control Task Sample Photographs
## A.3 Control Task Photo Rating Sheet

Please look at each picture and rate how much you like, or don’t like, the picture (very sure, reasonably sure, somewhat sure).

<table>
<thead>
<tr>
<th>Picture</th>
<th>LIKE</th>
<th>DON’T LIKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture 1</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Picture 2</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Picture 3</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Picture 4</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Picture 5</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
</tbody>
</table>

Please put the pictures in order from the one you like the most to the one you like the least.

Like Most __________ __________ __________ __________ __________ Like Least
A.4 Lineup Sheet for Sequential Lineup

You are about to see six male faces. The original face you saw may be one of the six, or it may not. For each face in the lineup, your task is to rate how sure you are that the face is, or is not, the original face you saw. If you do not think the original face is in the lineup, please rate how sure you are the face is not in the lineup.

<table>
<thead>
<tr>
<th>Face 1</th>
<th>IS original face</th>
<th>is NOT original face</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Face 2</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Face 3</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Face 4</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Face 5</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
<tr>
<td>Face 6</td>
<td>Very sure</td>
<td>Reasonably sure</td>
</tr>
</tbody>
</table>

Not in the lineup

<table>
<thead>
<tr>
<th></th>
<th>Very sure</th>
<th>Reasonably sure</th>
<th>Somewhat sure</th>
</tr>
</thead>
</table>
Age: _______

Sex: M/F

Approximately how many years have you lived in Australia?: __________
A.6 Cognitive Styles Analysis Interpretation Sheet

Your Results

Enter your results from the final display screen.

COGNITIVE STYLE

Wholist-Analytic Ratio = 
Verbal-Imagery Ratio =

Cognitive Style Descriptions

An individual's cognitive style affects the manner in which information is processed during learning and thinking. It also influences the manner in which they respond to other people and social situations. Individuals vary in style from one extreme to the other.

A cognitive style is different from intelligence in that an individual at one end of the continuum will be good at some tasks and poor at others, while for a person at the other extreme the situation will be the reverse.

The two fundamental dimensions of cognitive style assessed are the Wholist-Analytic mode of processing information and the Verbal-Imagery style of the representation of information during thinking.

These two styles are independent of one another, that is the position of an individual on one dimension of cognitive style does not affect their position on the other. For instance a person may be a Wholist and an Imager, and another an Analytic and an Imager, or another may be a Wholist and a Verbaliser, while someone else may be Analytic and a Verbaliser.

WHOLIST-ANALYTIC COGNITIVE STYLE

Description

When they consider information, Wholists will have a balanced view of the whole, while Analytics will separate it out into its parts, or sections.

Effect on Learning Performance

<table>
<thead>
<tr>
<th>WHOLIST</th>
<th>ANALYTIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS ABLE TO SEE THE WHOLE</td>
<td>ANALYSES MATERIAL INTO ITS Parts</td>
</tr>
<tr>
<td>FINDS DIFFICULTY IN DISEMBEDDING</td>
<td>FINDS DIFFICULTY IN SEEING THE WHOLE</td>
</tr>
</tbody>
</table>

The positive strength of the Wholists is that they see the whole 'picture', the negative that they find difficulty in separating out parts. Socially they see a social group as a whole.

For Analytics, their positive ability is that they can analyse information into the parts, but may not be able to get a balanced view of the whole. Socially, they will tend to view a social group as a collection of individuals.

VERBAL-IMAGERY COGNITIVE STYLE

Description

Basically, when people who are Imagers read, listen to, or consider information they experience fluent, spontaneous and frequent mental pictures. By contrast, individuals who are Verbalisers read, listen to, or consider, information in words. The Verbal-Imagery mode of representation is a continuum with individuals placed along it. People in the middle tend to use either mode of representation.

Effect on Learning Performance

<table>
<thead>
<tr>
<th>VERBALISER</th>
<th>IMAGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARNS BEST FROM VERBAL PRESENTATION</td>
<td>LEARNS BEST FROM VISUAL DISPLAYS</td>
</tr>
<tr>
<td>FINDS SPEECH AND TEXT EASIER THAN DIAGRAMS</td>
<td>FINDS PICTURES EASIER THAN WORDS</td>
</tr>
</tbody>
</table>

It also has to do with the location of their representation - verbal has to do primarily with social communication since it is the basic medium of communicating with others, while imagery has to do with a world internal to the individual, which may be constructed with mental pictures. Consequently, it has important social implications as well as learning ones.
A.7 Encoding and Test Stimuli for Verbal Overshadowing Studies

<table>
<thead>
<tr>
<th>Authors</th>
<th>Different at Study and Test?</th>
<th>Material at Study</th>
<th>Material at Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandimonte, Schooler &amp; Gabbino (1997)</td>
<td>Exp 1 - Y</td>
<td>2 sets of pictures (hard-to-name and easy-to-name stimuli) used in Brandimonte, Hitch, &amp; Bishop 1992</td>
<td>Same</td>
</tr>
<tr>
<td></td>
<td>Exp 2 - Y</td>
<td>1 set of pictures (hard-to-name stimuli)</td>
<td>Same</td>
</tr>
<tr>
<td></td>
<td>Exp 3 - Y</td>
<td>1 set of pictures (easy-to-name stimuli)</td>
<td>Same</td>
</tr>
<tr>
<td></td>
<td>Exp 4 - Y</td>
<td>1 set of pictures (easy-to-name stimuli)</td>
<td>Same</td>
</tr>
<tr>
<td></td>
<td>Exp 5 - Y</td>
<td>1 set of pictures (easy-to-name stimuli)</td>
<td>Same</td>
</tr>
<tr>
<td></td>
<td>Exp 2 - Y</td>
<td>Photos of cars</td>
<td>Different photo of cars (taken by experimenter and from magazines)</td>
</tr>
<tr>
<td></td>
<td>Exp 3 - Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exp 4 - Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown &amp; Lloyd-Jones (2005)</td>
<td>Exp 1 - Y</td>
<td>Full frontal of face</td>
<td>¾ view (left) of face</td>
</tr>
<tr>
<td></td>
<td>Exp 2 - Y</td>
<td>Full front of face</td>
<td>¾ view (left) of face</td>
</tr>
<tr>
<td></td>
<td>Exp 3 - Y</td>
<td>As for exp 2</td>
<td>As for exp 2</td>
</tr>
<tr>
<td>Authors</td>
<td>Different at Study and Test?</td>
<td>Material at Study</td>
<td>Material at Test</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Brown &amp; Lloyd-Jones (2006)</td>
<td>Exp 4 – Y</td>
<td>As for exp 1</td>
<td>As for exp 1</td>
</tr>
<tr>
<td>Lloyd-Jones, Brown and Clarke (2006)</td>
<td>Exp 1 – Y</td>
<td>Full frontal of face</td>
<td>¾ view (left) of face</td>
</tr>
<tr>
<td>Clare &amp; Lewandowsky (2004)</td>
<td>Exp 1 – Y</td>
<td>One face</td>
<td>A different face to the encoding face</td>
</tr>
<tr>
<td>DeShon, Chan &amp; Weissbein (1995)</td>
<td>Exp 1 – Y</td>
<td>Person who entered the lecture theatre 45 degree left-profile head and shoulders colour picture</td>
<td>Frontal head and shoulders photos</td>
</tr>
<tr>
<td></td>
<td>Exp 2 – Y</td>
<td>45 degree left-profile head and shoulders colour picture</td>
<td>Frontal head and shoulders colour photo</td>
</tr>
<tr>
<td></td>
<td>Exp 3 – Y</td>
<td>45 degree left-profile head and shoulders colour picture</td>
<td>Frontal head and shoulders colour photo</td>
</tr>
<tr>
<td>Dodson, Johnson &amp; Schooler (1997)</td>
<td>Exp 1 – Y</td>
<td>Raven’s Progressive Matrices on computer and pencil and paper – 2 condition, one solved without verbalisation, one with verbalisation</td>
<td>No recognition condition</td>
</tr>
<tr>
<td></td>
<td>Exp 2 – Y</td>
<td>Schooler &amp; Engstler-Schooler video</td>
<td>Schooler &amp; Engstler-Schooler photos</td>
</tr>
<tr>
<td></td>
<td>Exp 3 – Y</td>
<td>Candid photos from college yearbook</td>
<td>Posed, formal photos from college yearbook</td>
</tr>
<tr>
<td>Authors</td>
<td>Different at Study and Test?</td>
<td>Material at Study</td>
<td>Material at Test</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Exp 2 – N/A</td>
<td>No study photos – used verbal descriptions</td>
<td>Same as exp 2</td>
</tr>
<tr>
<td></td>
<td>Exp 3 – Y</td>
<td>Same as exp 1</td>
<td>Same as exp 1</td>
</tr>
<tr>
<td>Finger (2002)</td>
<td>Exp 1 – Y</td>
<td>Face at 45 degree angle</td>
<td>Full-frontal face</td>
</tr>
<tr>
<td></td>
<td>Exp 2 – Y</td>
<td>As for exp 1</td>
<td>As for exp 1</td>
</tr>
<tr>
<td>Finger &amp; Pezdek (1999)</td>
<td>Exp 1 – Y</td>
<td>Face at 45 degree angle</td>
<td>Full-frontal face</td>
</tr>
<tr>
<td></td>
<td>Exp 2 – Y</td>
<td>As for exp 1</td>
<td>As for exp 1</td>
</tr>
<tr>
<td>Fiore &amp; Schooler (2002)</td>
<td>Exp 1 – Y</td>
<td>Map of a small town with 16 landmarks on it</td>
<td>Blank map on which to put the 16 landmarks</td>
</tr>
<tr>
<td>Hunt &amp; Carroll (in press)</td>
<td>Exp 1 – Y</td>
<td>One photo of the target</td>
<td>A different photo of the target</td>
</tr>
<tr>
<td>Lane &amp; Schooler (2004)</td>
<td>Exp 1 – Y</td>
<td>16 stories</td>
<td>Different stories that either matched appeared</td>
</tr>
<tr>
<td></td>
<td>Exp 2 – Y</td>
<td>As for exp 1</td>
<td>(shared surface similarity) or was an analogy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(shared deep structure)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>As for exp 1</td>
</tr>
<tr>
<td>Lyle &amp; Johnson (2004)</td>
<td>Exp 1 – Y</td>
<td>Frontal face (same as Dodson, Johnson &amp;</td>
<td>Frontal face but in a different setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schooler)</td>
<td></td>
</tr>
<tr>
<td>Authors</td>
<td>Different at Study and Test?</td>
<td>Material at Study</td>
<td>Material at Test</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------</td>
<td>--------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Maclin (2002)</td>
<td>Exp 2 – Y for all</td>
<td>Frontal face (from Stirling database)</td>
<td>¾ profile of face</td>
</tr>
<tr>
<td>Meissner (2002)</td>
<td>Exp 1 – Y</td>
<td>¾ head and shoulder view</td>
<td>Full-frontal head and shoulder view, different clothes</td>
</tr>
</tbody>
</table>
Exp 2 – Y       | Finger & Pezdek’s stimuli - Face at 45 degrees  
As for exp 1  
As for exp 1       | Finger & Pezdek’s stimuli - Full-frontal face  
As for exp 1  
As for exp 1       |
| Melcher & Schooler (1996)      | Exp 1 – Y                    | One serve of red wine                      | Another serve of red wine             |
Exp 2 – Y       | Photo of mushroom  
As for exp 1       | Different photo of mushroom  
As for exp 1       |
| Pelizzon, Brandimonte &        | Exp 1 – Y  
Exp 2 – Y       | Brandimonte, Schooler & Gabbino’s stimuli  
As per exp 1       | Brandimonte, Schooler & Gabbino’s stimuli  
As per exp 1       |
<table>
<thead>
<tr>
<th>Authors</th>
<th>Different at Study and Test?</th>
<th>Material at Study</th>
<th>Material at Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luccio (2002)</td>
<td>Exp 3 – Y</td>
<td>As per exp 1</td>
<td>As per exp 1</td>
</tr>
<tr>
<td>Perfect, Hunt &amp; Harris (2003)</td>
<td>Exp 1 - Y</td>
<td>Voice recording</td>
<td>Different recording but same phrase</td>
</tr>
<tr>
<td>Schooler &amp; Engstler-Schooler (1990)</td>
<td>Exp 1 – Y, Exp 2 – Y, Exp 3 – Y, Exp 4 – Y, Exp 5 – Y, Exp 6 – Y</td>
<td>Video, As for exp 1, Mounted paint chip, As for exp 1, As for exp 1, Photos from yearbook - candid</td>
<td>Photo, As for exp 1, Identical colour but different paint chip mounted, As for exp 1, As for exp 1, Photos from yearbook - posed</td>
</tr>
<tr>
<td>Schooler, Ohlsson &amp; Brooks (1993)</td>
<td>Exp 1 – N/A, Exp 2 – N/A, Exp 3 – N/A, Exp 4 – N/A</td>
<td>Problems – one group had interruption, one did not, As for exp 1, As for exp 1, As for exp 1</td>
<td>None, None, None</td>
</tr>
<tr>
<td>Schooler, Ryan and Reder (1996)</td>
<td>Exp 1 – Y</td>
<td>One view – re-presentation was of original encoding photo</td>
<td>A different view</td>
</tr>
<tr>
<td>Authors</td>
<td>Different at Study and Test?</td>
<td>Material at Study</td>
<td>Material at Test</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
</tbody>
</table>
Exp 2 – Y | One recording of the voice
Telephone recording of the voice | A physically different recording
A physically different telephone recording and a different phrase |
| Westerman & Larsen (1997)   | Exp 1 – Y
Exp 2 – Y | Video (Schooler & Engstler-Schooler video?)
Video                      | Photo of face
Photo of faces and cars     |
| Weston & Perfect (2005)     | Exp 1 – Y | 4 faces                                  | 2 aligned composite faces. 1 had one old half and one new half, the other was 2 new halves |
| Wickham & Swift (2006)      | Exp 1 – Y | Stirling head-and-shoulders photo        | Lineup of 10 visually similar faces – target was different photo |
A.8 Control Reading Aloud Task


14

**Adelaide Gazette**

13 March 1956

**Menzies Stays Put**

The first time Townsend noticed her was on a flight up to Sydney. He was reading the *Gazette*: the lead story should have been relegated to page three and the headline was weak. The *Gazette* now had a monopoly in Adelaide, but the paper was becoming increasingly slack. He should have removed Frank Bailey from the editor’s chair after the merger, but he had to satisfy himself with getting rid of Sir Colin first. He frowned.

‘Would you like your coffee topped up, Mr Townsend?’ she asked. Townsend glanced up at the slim girl who was holding a coffee pot, and smiled. She must have been about twenty-five, with curly fair hair and blue eyes which made you go on staring at them.

‘Yes,’ he replied, despite not wanting any more. She returned his smile – an air hostess’s smile, a smile that didn’t vary for the fat or the thin, the rich or the poor.

Townsend put the *Gazette* to one side and tried to concentrate on the meeting that was about to take place. He had recently purchased, at a cost of half a million pounds, a small print group which specialised in giveaway papers distributed in the western suburbs of Sydney. The deal had done no more than give him a foothold in Australia’s largest city.
Townsend put the Gazette to one side and tried to concentrate on the meeting that was about to take place. He had recently purchased, at a cost of half a million pounds, a small print group which specialised in giveaway papers distributed in the western suburbs of Sydney. The deal had done no more than give him a foothold in Australia’s largest city.

It had been at the Newspapers and Publishers Annual Dinner at the Cook Hotel that a man of about twenty-seven or twenty-eight, five foot eight, square-jawed with bright red hair and the shoulders of a prop forward, came up to his table after the speeches were over and whispered in his ear, ‘I’ll see you in the men’s room.’ Townsend wasn’t sure whether to laugh or just to ignore the man. But curiosity got the better of him, and a few minutes later he rose from his place and made his way through the tables to the men’s room. The man with the red hair was washing his hands in the corner basin. Townsend walked across, stood at the basin next to him and turned on the tap.

‘What hotel are you staying at?’ he asked.

‘The Town House,’ Keith replied.

‘And what’s your room number?’

‘I have no idea.’

‘I’ll find out. I’ll come to your room around midnight. That is, if you’re interested in getting your hands on the Sydney Chronicle.’ The red-headed man turned off the tap, dried his hands and left.

Townsend learned in the early hours of the morning that the man who had accosted him at the dinner was Bruce Kelly, the Chronicle’s deputy editor. He wasted no time in telling Townsend that Sir Somerset Kenwright was considering selling the paper, as he felt it no longer fitted in with the rest of his group.

‘Was there something wrong with your coffee?’ she asked.

Townsend looked up at her, and then down at his untouched coffee. ‘No, it was fine, thank you,’ he said. ‘I’m just a little preoccupied at the moment.’ She gave him
that smile again, before removing the cup and continuing on to the row behind. Once again he tried to concentrate.

When he had first discussed the idea with his mother, she had told him that it had been his father’s lifelong ambition to own the Chronicle, though her own feelings were ambivalent. The reason he was travelling to Sydney for the third time in as many weeks was for another meeting with Sir Somerset’s top management team, so he could go over the terms of a possible deal. And one of them still owed him a favour.

Over the past few months Townsend’s lawyers had been working in tandem with Sir Somerset’s, and both sides now felt they were at last coming close to an agreement. ‘The old man thinks you’re the lesser of two evils,’ Kelly had warned him. ‘He’s face the fact that his son isn’t up to the job, but he doesn’t want the paper to fall into the hands of Wally Hacker, who he’s never liked, and certainly doesn’t trust. He’s not sure about you, although he has fond memories of your father.’ Since Kelly had given him that piece of invaluable information, Townsend had mentioned his father whenever he and Sir Somerset met.

When the plane taxied to a halt at Kingsford-Smith airport, Townsend unfastened his seatbelt, picked up his briefcase and began to walk towards the forward exit. ‘Have a good day, Mr Townsend,’ she said. ‘I do hope you’ll be flying Austair again.’

‘I will,’ he promised. ‘In fact I’m coming back tonight.’ Only an impatient line of passengers who were pressing forward stopped him from asking if she would be on that flight.

When his taxi came to a halt in Pitt Street, Townsend checked his watch and found he still had a few minutes to spare. He paid the fare and darted through the traffic to the other side of the road. When he had reached the far pavement, he turned round and stared up at the building which housed the biggest-selling newspaper in Australia. He only wished his father was still alive to witness him closing the deal.

He walked back across the road, entered the building and paced around the reception area until a well-dressed middle-aged woman appeared out of one of the lifts, walked over to him and said, ‘Sir Somerset is expecting you, Mr Townsend.’
When Townsend walked into the vast office overlooking the harbour, he was greeted by a man he had regarded with awe and admiration since his childhood. Sir Somerset shook him warmly by the hand. ‘Keith. Good to see you. I think you were at school with my chief executive, Duncan Alexander.’ The two men shook hands but said nothing. ‘But I don’t believe you’ve met the Chronicle’s editor, Nick Watson.’

‘No, I haven’t had that pleasure,’ said Townsend, shaking Watson by the hand. ‘But of course I know of your reputation.’

Sir Somerset waved them to seats around a large boardroom table, taking his place at the top. ‘You know, Keith,’ began the old man, ‘I’m damn proud of this paper. Even Beaverbrook tried to buy it from me.’

‘Understandably,’ said Townsend.

‘We’ve set a standard of journalism in this building that I like to think even your father would have been proud of.’

‘He always spoke of your papers with the greatest respect. Indeed, when it came to the Chronicle, I think the word ‘envy’ would be more appropriate.’

Sir Somerset smiled. ‘It’s kind of you to say so, my boy.’ He paused. ‘Well, it seems that during the past few weeks our teams have been able to agree most of the details. So, as long as you can match Wally Hacker’s offer of £1.9 million and - just as important to me - you agree to retain Nick as editor and Duncan as chief executive, I think we might have ourselves a deal.’

‘It would be foolish of me not to rely on their vast knowledge and expertise,’ said Townsend. ‘They are two highly respected professionals, and I shall naturally be delighted to work with them. Though I feel I should let you know that it’s not my policy to interfere in the internal working of my papers, especially when it comes to the editorial content. That’s just not my style.’

‘I see that you’ve learned a great deal from your father,’ said Sir Somerset. ‘Like him, and like you, I don’t involve myself in the day-to-day running of the paper. It always ends in tears.’

Townsend nodded his agreement.
‘Well, I don’t think there’s much more for us to discuss at this stage, so I suggest we adjourn to the dining room and have some lunch.’ The old man put his arm round Townsend’s shoulder and said, ‘I only wish your father were here to join us.’

The smile never left Townsend’s face on the journey back to the airport. If she were on the return flight, that would be a bonus. His smile became even wider as he fastened his seatbelt and began to rehearse what he would say to her.

‘I hope you had a worthwhile trip to Sydney, Mr Townsend,’ she said as she offered him an evening paper.

‘It couldn’t have turned out better,’ he replied. ‘Perhaps you’d like to join me for dinner tonight and help me celebrate?’

‘That’s very kind of you, sir,’ she said, emphasising the word ‘sir’, ‘but I’m afraid it’s against company policy.’

‘Is it against company policy to know your name?’

‘No, sir,’ she said. ‘It’s Susan.’ She gave him that same smile and moved on to the next row.
A.9 Lineup Sheet

Task 3: Line up Identification

You are about to see six male faces. The original face you saw may be one of the six, or it may not.

We want you to tell us which face you think was the original face by circling either “Face 1”, or “Face 2”, or “Face 3”, or “Face 4”, or “Face 5” or “Face 6” below. But please, circle only one number.

If you think that the original face is not in this lineup, then circle “not in the lineup” instead of a face number.

Face 1  Face 2  Face 3  
Face 4  Face 5  Face 6  
Not in the lineup

How sure are you the face you chose just now was the face you saw at the beginning of the experiment (or if you chose “not in the lineup” how sure are you that the original face was not in the lineup)? Please circle one of the following.

somewhat sure / reasonably sure / very sure
A.10 Remaining Faces Confidence Sheet

**Task 4: Finally....**

For the remaining faces, the ones you did *not* choose as the face seen at the beginning of the experiment, how sure are you that they are not the original face?

For each face (except the one you chose on the previous page), circle somewhat sure, reasonably sure or very sure to indicate how certain you are that that face is not the target face.

<table>
<thead>
<tr>
<th>Face 1</th>
<th>Face 2</th>
<th>Face 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>somewhat sure</td>
<td>somewhat sure</td>
<td>somewhat sure</td>
</tr>
<tr>
<td>reasonably sure</td>
<td>reasonably sure</td>
<td>reasonably sure</td>
</tr>
<tr>
<td>very sure</td>
<td>very sure</td>
<td>very sure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Face 4</th>
<th>Face 5</th>
<th>Face 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>somewhat sure</td>
<td>somewhat sure</td>
<td>somewhat sure</td>
</tr>
<tr>
<td>reasonably sure</td>
<td>reasonably sure</td>
<td>reasonably sure</td>
</tr>
<tr>
<td>very sure</td>
<td>very sure</td>
<td>very sure</td>
</tr>
</tbody>
</table>
APPENDIX B

B.1 Edinburgh Handedness Inventory

1. With which hand do you write?
2. In which hand do you prefer to use a spoon when eating?
3. With which hand do you throw a ball?
4. In which hand do you prefer to hold the toothbrush when you are cleaning your teeth?
5. In which hand do you hold the box when striking a match?
6. When cutting paper, in which hand do you hold the scissors?
7. With which hand would you prefer to use a knife to sharpen a pencil?
8. When pouring tea, in which hand do you prefer to hold the pot?
9. In which hand do you prefer to hold a jar when unscrewing the lid?
10. Which hand do you use to draw?
The data for this participant was collected during Experiment 6. The participant was female, 19 years of age, extremely right-handed (+1 on the Edinburgh Handedness Inventory), and in the local Navon condition. During the debriefing session with this participant, she asked about the TMT recordings which were on the screen in front of the experimenter. The experimenter explained that the readings from her session were somewhat unusual as halfway through the experiment her left TMT had started to rise and had continued to rise until the end of the local Navon task. The participant then commented that about halfway through the Navon task she had started to actively plan what she was going to have for dinner, what she would cook and what she would need to buy on the way home. While it is true that adopting a near future perspective, for example dinner that evening as opposed to a night out with friends next year, promotes more concrete and detailed (proximal) thinking (Förster, Friedman, & Liberman, 2004), it is also possible to that this participant was contemplating dinner in a more abstract form that would allow it to be construed as distal. Rather than thinking in terms of a specific recipe and ingredient requirements, she may have planned dinner in terms of more abstract thoughts such as whether she felt like meat or fish, and what condiments might go well with such meals. This interpretation would be more consistent with the disengagement of the left hemisphere displayed in the fTMT data (see Figure 6.4). The participant performed well on the local Navon task and stated that she could continue to do the task quite easily while planning her evening meal. This participant correctly identified the target face.

30 The participant could not see the screen during the experiment, but the experimenter often showed participants the TMT readings during the debriefing.
Figure 6.4. Experiment 6: fTMT data for a single participant who was distracted.
### APPENDIX C

#### C.1 Verbal Overshadowing Procedures

<table>
<thead>
<tr>
<th>Authors</th>
<th>Exp</th>
<th>Encoding</th>
<th>Post-Encoding Filler Task</th>
<th>Control task</th>
<th>Lineup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dodson, Johnson &amp; Schooler</td>
<td>Exp 1</td>
<td>30 sec video</td>
<td>20 min reading/comprehension task</td>
<td>5 min reading/comprehension task</td>
<td>Simultaneous, 8 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td></td>
<td>Exp 3</td>
<td>5 sec photo</td>
<td>5 min category generation (US states)</td>
<td>5 min category generation (US states)</td>
<td>Simultaneous, 6 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td>Fallshore &amp; Schooler (1995)</td>
<td>Exp 1</td>
<td>5 sec photo</td>
<td>5 min crossword puzzle</td>
<td>5 min category generation (names of US states)</td>
<td>Simultaneous, 6 faces, untimed</td>
</tr>
<tr>
<td>Finger (2002)</td>
<td>Exp 1</td>
<td>30 sec photo</td>
<td>5 min questions about school</td>
<td>5 min category generation</td>
<td>Simultaneous, 6 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td></td>
<td>Exp 2</td>
<td>30 sec photo</td>
<td>5 min questions about school</td>
<td>5 min category generation</td>
<td>Simultaneous, 6 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td>Kitagami, Sato &amp; Yoshikawa</td>
<td>Exp 1</td>
<td>10 sec photo</td>
<td>5 min crossword puzzle</td>
<td>5 min verbal listing task</td>
<td>Simultaneous, 8 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td>(2002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maclin (2002)</td>
<td>Exp 1</td>
<td>3 min video</td>
<td>5 min digit search puzzle</td>
<td>5 min category generation (US states)</td>
<td>Simultaneous, 6 faces, untimed</td>
</tr>
</tbody>
</table>

---

*The (modified) forced choice option gave participants the option of saying the target face was not in the lineup.*
<table>
<thead>
<tr>
<th>Authors</th>
<th>Exp</th>
<th>Encoding</th>
<th>Post-Encoding Filler Task</th>
<th>Control task</th>
<th>Lineup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meissner (2002)</td>
<td>Exp 1</td>
<td>5 sec photo</td>
<td>15 min digit search puzzle</td>
<td>5 min category generation</td>
<td>(modified) forced choice</td>
</tr>
<tr>
<td></td>
<td>Exp 1</td>
<td>10 sec photo</td>
<td>5 min digit search puzzle</td>
<td>5 min category generation</td>
<td>Either Sequential, 8 faces, 15 sec per face, yes/no response</td>
</tr>
<tr>
<td></td>
<td>Exp 2</td>
<td>10 sec photo</td>
<td>5 min digit search puzzle</td>
<td>5 min category generation</td>
<td>Or Simultaneous, 8 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td>Meissner, Brigham &amp; Kelley (2001)</td>
<td>Exp 1</td>
<td>10 sec photo</td>
<td>5 min digit search puzzle</td>
<td>5 min category generation</td>
<td>Simultaneous, 6 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td></td>
<td>Exp 2</td>
<td>10 sec photo</td>
<td>5 min digit search puzzle</td>
<td>5 min category generation</td>
<td>Simultaneous, 6 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td>Ryan &amp; Schooler (1998)</td>
<td>Exp 1</td>
<td>5 sec photo</td>
<td>2 min crossword puzzle</td>
<td>4 min category generation</td>
<td>Simultaneous, 6 faces, untimed, forced choice</td>
</tr>
<tr>
<td>Schooler &amp; Engstler-Schooler (1990)</td>
<td>Exp 1</td>
<td>30 sec video</td>
<td>20 min reading/comprehension</td>
<td>5 min unrelated activity</td>
<td>Simultaneous, 8 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td></td>
<td>Exp 2</td>
<td>30 sec video</td>
<td>20 min unrelated activity</td>
<td>5 min unrelated activity</td>
<td>Simultaneous, 8 faces, untimed, (modified) forced choice</td>
</tr>
<tr>
<td></td>
<td>Exp 6</td>
<td>5 sec photo</td>
<td>5 min unrelated activity</td>
<td>5 min continued unrelated activity</td>
<td>Simultaneous, 6 faces, untimed</td>
</tr>
<tr>
<td>Westerman &amp; Larsen (1997)</td>
<td>Exp 2</td>
<td>60 sec video</td>
<td>20 min unrelated activity</td>
<td>4 min writing feelings about the crime seen on the video</td>
<td>Sequential, 8 faces, 8 secs per face, (modified) forced choice, lineup shown twice</td>
</tr>
</tbody>
</table>

32 One condition in this experiment was a timed lineup, however as it also included an untimed lineup, this experiment has been included.
We would like you to spend the next 5 minutes doing the following crossword puzzle. It doesn’t matter if you don’t finish the puzzle. If you do finish the puzzle, please just sit quietly until you are asked to move onto the next task.

<table>
<thead>
<tr>
<th>ACROSS</th>
<th>DOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. a season</td>
<td>1. coral reef</td>
</tr>
<tr>
<td>2. average group</td>
<td>2. average group</td>
</tr>
<tr>
<td>3. religious</td>
<td>3. religious</td>
</tr>
<tr>
<td>5. fashionable</td>
<td>4. frozen water</td>
</tr>
<tr>
<td>6. not even</td>
<td>7. boring</td>
</tr>
<tr>
<td>8. protective covering for building</td>
<td>9. to leave out</td>
</tr>
<tr>
<td>10. a colour</td>
<td>11. in words</td>
</tr>
<tr>
<td>12. measured by a clock</td>
<td>13. uncontrolled gathering</td>
</tr>
<tr>
<td>14. to have fun</td>
<td>14. make happy</td>
</tr>
<tr>
<td>15. faster than walking</td>
<td>16. not the beginning</td>
</tr>
<tr>
<td>17. wax, often fragrant</td>
<td>18. desire for</td>
</tr>
<tr>
<td>19. fun, light-heartedness</td>
<td>19. fun, light-heartedness</td>
</tr>
<tr>
<td>20. hens lay them</td>
<td>21. to agree, to say ---</td>
</tr>
</tbody>
</table>
C.3 Verbalisation Task

Task 2: Describing the Face

We would like you to spend the next 5 minutes describing the face you saw at the beginning of the experiment. In the space below, please describe each facial feature in as much detail as possible. Try not to leave out any details about the face even if you think they are not important. The more details you provide, the more helpful it will be.

As describing a face is often a difficult task, it is important that you concentrate and stay focused for the next few minutes.

Again, please provide as much detail as possible on each feature of the face, and continue writing for the full 5 minutes. You will be told when to stop.
C.4 Category Generation Control Task

Task 2: Animals

We would like you to spend the next 5 minutes writing down the names of as many types of animals as you can think of (e.g., dog, cat, cow). If you run out of animals to write down, please just sit quietly until you are asked to move onto the next task.

1. ___________________  21. ___________________
2. ___________________  22. ___________________
3. ___________________  23. ___________________
4. ___________________  24. ___________________
5. ___________________  25. ___________________
6. ___________________  26. ___________________
7. ___________________  27. ___________________
8. ___________________  28. ___________________
9. ___________________  29. ___________________
10. ___________________ 30. ___________________
11. ___________________ 31. ___________________
12. ___________________ 32. ___________________
13. ___________________ 33. ___________________
14. ___________________ 34. ___________________
15. ___________________ 35. ___________________
16. ___________________ 36. ___________________
17. ___________________ 37. ___________________
18. ___________________ 38. ___________________
19. ___________________ 39. ___________________
20. ___________________ 40. ___________________
APPENDIX D

D.1 Description Rating Sheet

Each bullet point below translates to one score (i.e. one mark on the score card). So, for eyebrows, dark gets a correct mark, thick and/or bushy gets a single (additional) mark, and symmetrical gets an (additional) mark. Any one of these three mentioned would each get one mark, the sequence does not matter. Although the lists of “correct” characteristics is complete in terms of the assessments, the list of “incorrect” and “subjective” items are not comprehensive but provide guidance in case of doubt.

A subject’s comparison with a feature being “normal” or “average” does not of itself make to comment subjective (i.e. unless something else does, like a reference to colour).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Subjective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>20-25 or anything covering any part of this range</td>
<td></td>
<td>young</td>
</tr>
<tr>
<td>Race</td>
<td>Caucasian, white man, Anglo-Saxon</td>
<td></td>
<td>other colour</td>
</tr>
<tr>
<td>Eyebrows</td>
<td>dark, thick, bushy symmetrical did not meet in the middle, no monobrow</td>
<td>big, long</td>
<td>any colour length</td>
</tr>
<tr>
<td>Eyelashes</td>
<td>cannot tell, so any reference to eyelashes is incorrect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyes</td>
<td>dark, wide-set, far apart large oval wide-open</td>
<td>black, round, deep set</td>
<td>any colour other than black</td>
</tr>
<tr>
<td>Nose</td>
<td>wide bridge broad, wide at end, larger size right nostril smaller than left straight</td>
<td>rounded, any reference to length</td>
<td>colour</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Correct</td>
<td>Incorrect</td>
<td>Subjective</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Mouth</td>
<td>- unsmiling</td>
<td>-</td>
<td>- colour</td>
</tr>
<tr>
<td></td>
<td>- straight</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- slanted down (to his left)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- closed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- large, wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lips</td>
<td>- full, broad, big, thick</td>
<td>-</td>
<td>- colour</td>
</tr>
<tr>
<td></td>
<td>- symmetrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheeks</td>
<td>- cheek bones not prominent, rounded cheeks</td>
<td>-</td>
<td>- any</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>comment</td>
</tr>
<tr>
<td>Chin</td>
<td>- rounded, soft</td>
<td>- small</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- dimple</td>
<td>- large</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- average size</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- broad, wide jaw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face shape</td>
<td>- oval, longish</td>
<td>- round</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- soft</td>
<td>- long</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- elongated</td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td>- clear, smooth</td>
<td>- any colour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- pale, fair, white</td>
<td>reference is</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>incorrect (but</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>see &quot;Race&quot; above)</td>
<td></td>
</tr>
<tr>
<td>Hair</td>
<td>- no facial hair</td>
<td>- head hair</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- incorrect (is</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>hidden)</td>
<td></td>
</tr>
<tr>
<td>Ears</td>
<td></td>
<td>- incorrect</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- hidden</td>
<td></td>
</tr>
<tr>
<td>Distinguishing</td>
<td>- neutral, serious expression</td>
<td>- frown, smiling</td>
<td></td>
</tr>
<tr>
<td>features</td>
<td>- thick, wide neck</td>
<td></td>
<td>happy, etc</td>
</tr>
<tr>
<td></td>
<td>- no distinguishing features, tattoos, piercing, etc;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- unremarkable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>- average size</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
While verbal overshadowing is an example of when language can impede memory, typically language has been shown to enhance memory. Please name two techniques in which language enhances memory. (1 mark)

Verbal rehearsal, elaboration, or verbal discussion.

Verbal overshadowing has been observed when people attempt to generate descriptions of faces. Please name 4 other stimuli with which verbal overshadowing has been observed. (1 mark)

Colours, abstract figures, wine tasting, decision making, insight problem solving, voice recognition, mental models of spatial maps, music, taste, visual forms.

Why did Melcher and Schooler's (1996) study of verbal overshadowing focus on the task of wine tasting? (1 mark)

Because wine tasting varies with respect to non-verbal and verbal expertise and therefore is vulnerable to verbal overshadowing. OR It is a perceptual event that is not easily decomposed into its constituent features but this can be learnt so therefore it is vulnerable to verbal overshadowing.

Verbal overshadowing occurs when there is a discrepancy between perceptual and verbal expertise. Please describe the nature of this discrepancy. (1 mark)

VO occurs when perceptual expertise is superior to verbal expertise.
What were the hypotheses of Melcher and Schooler’s (1996) study for each experimental group? (1 mark)

Novice and expertise groups – no effect of verbalisation on memory

Intermediate group – negative effect of verbalisation on memory (i.e. VO)

What were the results of Melcher and Schooler’s (1996) study for each experimental group? (1 mark)

Novices – no effect/slight positive effect of verbalisation on memory

Intermediate group - negative effect of verbalisation on memory (i.e. verbal overshadowing)

Experts – no effect of verbalisation on memory

Please explain the trial effect evident in Melcher and Schooler’s (1996) study. (1 mark)

The negative effects of verbalisation were only evident in the first trial for the intermediate group.

Please describe one reason given for the trial effect observed in Melcher and Schooler’s (1996) study (1 mark)

Intermediates may have a) altered the strategy used to complete the task after initial difficulty i.e. realigned encoding and recognition strategies so they were commensurate with each other, or b) acquired experience in shifting back and forth
between verbal and perceptual representations. (NB. It is incorrect to say that intermediates improved quality of their descriptions of wine).

For the novice group, verbalisation appeared to enhance memory in Melcher and Schooler’s (1996) study. What is the reason given for this effect? (1 mark)

Novices, lacking the perceptual and/or verbal expertise necessary to perceive and to describe the full complexity of their perceptual experience, may focus on one or two salient, most easily verbalised features. If a novice’s discrimination for one or two features among the test sample was accurate, having focused narrowly may increase the probability of correct recognition.
And finally, for my dad

Dr Stephen Meggitt

MA *Oxon.*, MSc *Natal*, Ph.D *ANU*

Because I know how much this means to you.