Processing of emotional expression in subliminal and low-visibility images

Submitted by Hannah Lucy Filmer to the University of Exeter
as a thesis for the degree of
Doctor of Philosophy in Psychology
May 2012.

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other university.

Signature:…….

Abstract

This thesis investigated the processing of emotional stimuli by the visual system, and how the processing of emotions interacts with visual awareness. Emotions have been given 'special' status by some previous research, with evidence that the processing of emotions may be relatively independent of striate cortex, and less affected by disruption to awareness than processing of emotionally neutral images. Yet the extent to which emotions are 'special' remains questionable. This thesis focused on the processing of emotional stimuli when activity in V1 was disrupted using transcranial magnetic stimulation (TMS), and whether emotional properties of stimuli can be reliably discriminated, or affect subsequent responses, when visibility is low.

Two of the experiments reported in this thesis disrupted activity in V1 using TMS, Experiment 1 with single pulses in an online design, and Experiment 2 with theta burst stimulation in an offline design. Experiment 1 found that a single pulse of TMS 70-130 ms following a presentation of a body posture image disrupted processing of neutral but not emotional postures in an area of the visual field that corresponded to the disruption. Experiment 2 did not find any convincing evidence of disruption to processing of neutral or emotional faces. From Experiment 1 it would appear that emotional body posture images were relatively unaffected by TMS, and appeared to be robust to disruption to V1. Experiment 2 did not add to this as there was no evidence of disruption in any condition.

Experiments 3 and 4 used visual masking to disrupt awareness of emotional and neutral faces. Both experiments used a varying interval between the face and the mask stimuli to systematically vary the visibility of the faces. Overall, the shortest SOA produced the lowest level of visibility, and this level of visibility was arguably outside awareness. In Experiment 3, participants' ability to discriminate properties of emotional faces under low visibility conditions was greater than their ability to discriminate the orientation of the face. This was despite the orientation discrimination being much easier at higher levels of visibility. Experiment 4 used a gender discrimination task, with emotion providing a redundant cue to the decision (present half of the time). Despite showing a strong linear masking function for the neutral faces, there was no evidence of any emotion advantage. Overall, Experiment 3 gave some evidence of an emotion advantage

under low visibility conditions, but this effect was fairly small and not replicated in Experiment 4.

Finally, Experiments 5-8 used low visibility emotional faces to prime responses to subsequent emotional faces (Experiments 5 and 6) or words (Experiments 7 and 8). In Experiments 5, 7 and 8 there was some evidence of emotional priming effects, although these effects varied considerably across the different designs used. There was evidence for meaningful processing of the emotional prime faces, but this processing only led to small and variable effects on subsequent responses.

In summary, this thesis found some evidence that the processing of emotional stimuli was relatively robust to disruption in V1 with TMS. Attempts to find evidence for robust processing of emotional stimuli when disrupted with backwards masking was less successful, with at best mixed results from discrimination tasks and priming experiments. Whether emotional stimuli are processed by a separate route(s) in the brain is still very much open to debate, but the findings of this thesis offers small and inconsistent evidence for a brain network for processing emotions that is relatively independent of V1 and visual awareness. The network and nature of brain structures involved in the processing of subliminal and low visibility processing of emotions remains somewhat elusive.

Acknowledgments

During the last 4 years I have received support – academically and personally – from a number of different people. This support has been crucial, and without the help of my supervisors, peers and family this thesis would have been impossible.

Firstly, my PhD would not have happened without financial support I was given by the ESRC.

I'd like to thank my supervisors. Prof. Stephen Monsell has given expert and patient guidance for which I am very grateful. I also received valuable comments and feedback from Dr. Aureliu Lavric at several points in the last few years. Early on in my PhD, Prof. Vince Walsh provided advice on TMS experimental design that was a huge help at a time when there was no TMS expert at Exeter.

Many members of the psychology department also provided valuable feedback on my research throughout my time at Exeter.

The last few years have been made much easier, and considerably more fun, by a number of MSc and PhD students, past and present, in the department. My officemate Felice provided many lighter moments, along with Charlotte, Tobias, Nik, Dale, Bibiana, Heike, Jonathan, and David. My parents were also a fantastic source of support, and provided many hours proof reading assistance. Finally, my partner, Sam, has provided love, support, and many delicious meals that made the last few years particularly enjoyable.

Table of Contents

List of figures