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MECHANISMS OF COMPENSATION IN AGENESIS OF THE CORPUS CALLOSUM

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A thesis submitted in partial fulfilment of the requirements for
the degree of Doctor of Philosophy in Psychology
University of Auckland, 2003
ABSTRACT

This thesis examines the compensatory mechanisms that allow information to be available to both cerebral hemispheres in individuals with agenesis of the corpus callosum.

The first set of experiments, detailed in Chapter Three, were designed to determine what types of visual information can be integrated interhemispherically in these subjects. Two acallosals, J.P. and M.M., and ten control subjects were tested. Results showed that M.M., whose anterior commissure was within normal limits, was much worse at matching colours and letters between visual fields than within visual fields, while J.P., whose anterior commissure was greatly enlarged, showed no evidence of interhemispheric disconnection on these tasks. This suggests that in some cases of callosal agenesis an enlarged anterior commissure may compensate for the lack of a corpus callosum. Neither acallosal subject showed disconnection on tasks requiring integration of location and orientation, however, suggesting that the anterior commissure plays no role in such tasks, although both subjects performed poorly relative to controls. These tasks may depend on subcortical commissures, such as the intertectal commissure.

The two experiments in Chapter Four tested J.P. and M.M. tested on a simple reaction-time (RT) task, with visual stimuli presented either singly to one or the other visual field or in bilaterally presented pairs. Stimuli were either white against a black background, or grey against an equiluminant yellow background. RTs to bilateral pairs were decreased beyond predictions based on a simple race between independent unilateral processes, implying interhemispheric neural summation. This effect was enhanced under equiluminance in M.M., but not J.P., suggesting that the anterior commissure may act, relative to its size, to affect cortical activation to bilateral pairs, which then acts to decrease subcortical neural summation.

In Chapter Five, J.P., M.M. and A.L.M. (the daughter of M.M.), and twelve control subjects were tested on a simple RT task, with visual evoked potentials collected using a high-density 128-channel system. Independent-components analyses were performed to isolate the visual components of interest.
Contrary to previous research with acallosals, evidence of ipsilateral activation was present in all three acallosal subjects. While ipsilateral visual components were present in all four unilateral conditions in M.M. and A.L.M., in J.P. these were present only in the crossed visual field/hand conditions and not in the uncrossed conditions. It is suggested that individual differences and methodological limitations in the previous studies due to the small number of electrodes used are the most likely explanation for the difference in findings.

Finally, due to the clear individual differences in aetiology, neurophysiology and compensatory mechanisms utilized by the three acallosal subjects tested here, a case study approach was taken with each subject discussed separately.
ACKNOWLEDGMENTS

I would firstly like to thank my supervisor, Professor Michael Corballis, for his unwavering support and mentorship. Mike’s wealth of knowledge, constructive advice and sense of humour has made this experience a pleasant as well as productive one. I would also like to thank Dr. Jeff Hamm and Dr. Ian Kirk for their guidance and support.

A huge thank you also to John and the rest of my family for all their encouragement and support throughout my time at university. I also want to mention all those in the Cognitive Lab and on the "3rd floor". The friendship and great sense of fun that we have shared has made my time there very enjoyable.

Finally I want to thank J.P., M.M. and A.L.M. for their participation in this study.

This research was supported by grants from the Marsden Fund of the Royal Society of New Zealand and the Human Frontiers Science Program.
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