Declaration

I, Nicolas Cherbuin, hereby declare that, except where acknowledged, that this work is my own and has not been submitted for a higher degree at any other university or institution.

Nicolas Cherbuin
Acknowledgements

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The study of individuals with dyslexia presented in Chapter 6 has been conducted in collaboration with Judy Buchholz. Judy is a qualified clinical psychologist and I am grateful that she performed the neuropsychological assessment of participants as well as part of the experimental tests for this study.

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Publications arising from the thesis

Experiments 3, 5, 6, and 7 have been published in the following articles:


Abstract

The performance of most tasks requires some interaction between the cerebral hemispheres. Despite this fact, research has focused on demonstrating that each hemisphere is specialised for certain processes and has largely neglected this interaction.

Recent research has recognised the need for a better understanding of how resources are shared between the cerebral hemispheres. While these studies have shed light on factors external to the participants being tested, such as the type of task and stimuli used, presentation times, and different measurement methods, they have neglected variables that differ between individuals. The studies reported here focused on factors internal to the participants. They include sex, age, handedness, functional lateralisation, practice, attention, and hemispheric activation, which vary between individuals or within individuals across time, and have been shown to influence the structure and morphology of the corpus callosum which is the main pathway for hemispheric interactions.

This thesis examines the relationship of these variables to the efficiency of hemispheric interactions.

A literature review of the factors affecting hemispheric interactions and interhemispheric transfer is presented in Chapter 1, and methodological issues relating to the measurement of these variables in Chapter 2. Based upon this research, two tasks, the Poffenberger paradigm and a letter-matching task, were selected to assess interhemispheric transfer time and hemispheric interactions, respectively, and to investigate the relationship between these two variables.

Chapters 3 and 4 present the findings of the principal study, using a large sample of participants and regression analysis, which demonstrate that both faster interhemispheric transfer and more extreme left-handedness are associated with greater efficiency of hemispheric interaction. Surprisingly, other factors which were expected to influence hemispheric interactions (age, sex, functional lateralisation, and attention) did not have a significant effect on this variable.

A strong practice effect found in the task used in Chapters 3 and 4 is analysed in Chapter 5. Contrary to previous findings, this practice effect seems not to be due to a shift from sequential, rule-based processing to memory-retrieval, but rather, is a more general practice effect consistent with progressively more efficient use of neural resources.

Chapter 6 shows that individuals with dyslexia not only demonstrate an abnormally fast interhemispheric transfer, but also attentional deficits, due probably to decreased efficiency in hemispheric interactions. Because some clinical populations, such as individuals with dyslexia, have been shown to have hemispheric interaction deficits, the study of such clinical samples can provide valuable information about the relationship between hemispheric interactions and other individual variables.

In Chapter 7 it is demonstrated that both latent and induced patterns of lateralised hemispheric activation affect hemispheric interactions. This suggests that
assessment of hemispheric activation is important not only in this field, but probably also more generally in neuropsychological research. These findings highlight the need for a simple, inexpensive measure of hemispheric activation that can be applied routinely in cognitive experiments.

Chapter 8 presents a new technique to measure lateralised brain activation in typical psychological experiments using functional tympanic membrane thermometry (fTMT). This measure relies on the measurement of ear membrane temperature as an index of hemispheric activation. The technique is simple and inexpensive, and is shown to be suitable for the assessment of hemispheric activation patterns during typical experiments.

In conclusion, individual characteristics such as the efficiency of interhemispheric transfer, handedness, functional lateralisation, attention, and hemispheric activation are important factors to consider when researching hemispheric interactions in both normal and clinical populations. Furthermore, future research will benefit from this newly developed measure, fTMT, by allowing the systematic study of the effects of hemispheric activation in brain processes.
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