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# **Affect Recognition Training After Traumatic Brain Injury**

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## Abstract

Impairment in facial affect recognition is prevalent after moderate to severe traumatic brain injury (TBI), and may underlie some problems in social functioning. Tentative work indicates that emotion recognition can improve with training, but the effectiveness of these programmes remains unclear. Little is known about whether broader cognitive deficits underlie facial affect recognition impairment. Less is known about baseline cognitive variables that predict treatment response and the relationship between changes in cognitive functioning and improvement in facial affect recognition after treatment. The present research formed part of a multi-centre randomised controlled trial examining the efficacy of two affect recognition training programmes designed to improve emotion recognition in adults with moderate to severe TBI.

Study One reports outcome data from the main trial. Seventy people with TBI and facial affect recognition difficulties were randomly assigned to nine sessions of one of three treatments: *Faces*, focusing on facial affect recognition, *Stories*, determining emotions from social context, and a control group. Participants completed tests assessing cognition, emotion recognition, community integration, interpersonal behaviour and empathy, and informants completed interpersonal and social functioning measures. Participants were assessed five times: initial screening, pre- and post-treatment, and at three- and six-month follow-up. Significant improvement was seen in the *Faces* group on the primary facial affect recognition outcome measure (DANVA2-Adult Faces). These gains were sustained at six months. No significant differences between treatment groups and the control group were found on interpersonal and social functioning measures.

Study Two had 75 participants with facial affect recognition difficulties and investigated the relationship between facial affect recognition impairment and cognitive functioning. Greater facial affect recognition failures were related particularly to working memory, processing speed, and nonverbal memory. No relationship was found with executive functioning.

Study Three explored the relationship between baseline cognitive variables, changes in cognitive functioning, and long term treatment response. Only older age was predictive of a better long-term response to *Faces* treatment. Improvement of facial affect recognition was not mediated by changes in cognitive functioning.

This research provides further evidence that retraining is possible for affect recognition difficulties after traumatic brain injury.

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Finally, I wish to thank my family, especially my dear old mum. She has waited so patiently while I have been engaged on this doctoral journey; it has been a long haul, and I am looking forward to sharing more “laughing” moments together! A warm thank you also to my nieces and nephews, who love me purely for being ‘Auntie Jacki’!

## Preface

This thesis examines the effectiveness of two new interventions that each aimed to enhance emotion-recognition skills in people with traumatic brain injury (TBI). In addition, it addresses the issues regarding the cognitive processes involved in facial affect recognition. It is hoped that this research will stimulate further research in establishing useful evidence-based interventions for optimizing emotion-recognition skills remediation and outcome in individuals with TBI.

A growing number of studies suggest that impairments in facial affect recognition are prevalent in people with moderate to severe traumatic brain injury (D R Babbage et al., 2011; Bornhofen & McDonald, 2008a; McDonald, 2013; C. Williams & Wood, 2010) and that this deficit might well be an important determinant of poor social outcomes (Driscoll, Dal Monte, & Grafman, 2011). This research development has led to the implementation of trials and the evaluation of training programmes that specifically target facial affect-recognition deficits for this clinical group (Bornhofen & McDonald, 2008b, 2008c; Guercio, Podolska-Schroeder, & Rehfeldt, 2004; McDonald, Bornhofen, & Hunt, 2009b; Radice-Neumann, Zupan, Tomita, & Willer, 2009). However, the effectiveness of these programmes and their effects on social outcomes remain unclear. The present research formed part of a multi-centre randomised controlled trial, examining the efficacy of two affect recognition training programmes designed to improve different aspects of emotion recognition in adults with moderate to severe TBI. Study One reported an analysis of outcome data from the main trial. Through using targeted emotion recognition training intervention, retraining is possible for affect recognition difficulties after traumatic brain injury.

The cognitive deficits in TBI are well-documented (Dikmen et al., 2009; Ruttan, Martin, Liu, Colella, & Green, 2008), yet little is known about whether these broader cognitive deficits partly underlie facial affect recognition impairments in this clinical group (Allerdings & Alfano, 2006; Spikman, Timmerman, Milders, Veenstra, & van der Naalt, 2012). Although tentative work has indicated that emotion recognition can improve with training programmes, the effects of cognitive functioning on treatment outcome and the trajectory of such functioning after facial affect treatment have yet to be fully determined. Studies Two and Three begin to address these gaps in the literature by directly exploring the relationship between facial affect recognition impairments and

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cognitive functioning, and by investigating the baseline cognitive variables, changes in cognitive functioning, and long term treatment response. The relationship between facial affect recognition and cognitive functioning in TBI is complex and multifactorial, and may be influenced by both internal and external factors. A better understanding of the linkage between the two domains and the individual factors that may predict treatment response could better inform research into the identification of more precise therapeutic targets to improve facial affect recognition. These skills are potentially significant in helping people with TBI to lead optimal social lives (Driscoll et al., 2011).



## **Structure of the Thesis**

This thesis is presented in three empirical investigations. Specifically, it investigates the effectiveness of two new training programmes designed to improve different aspects of emotion-recognition skills for people with TBI; examines the relationship between facial affect recognition impairments and cognitive functioning after TBI; explores the baseline cognitive variables and other demographic variables associated with long-term treatment response, and investigates whether improvement in facial affect recognition is related to changes in cognitive functioning. The present research focuses on adults with moderate to severe TBI.

This thesis consists of eleven chapters incorporating three studies, and is submitted with two chapters explicitly presented in publication format. Supporting chapters introduce the studies, and provide discussion of the findings set within them. Chapter One provides a brief introduction of traumatic brain injury and discusses its impact on people's social and interpersonal functioning. Chapter Two provides an overview of facial affect recognition and reviews empirical findings relating to the theoretical models and neural mechanisms behind this domain. Chapters Three and Four outline the empirical knowledge pertaining to facial affect-recognition impairments (including other emotion recognition deficits) after traumatic brain injury, and highlight the need for development of effective treatments to enhance emotion recognition for people with TBI. These first four chapters provide the rationale for this thesis and place it within the current frame of empirical knowledge and theoretical understanding. Chapter Five outlines the range of research questions addressed by the thesis. Chapter Six, Seven, and Eight present the first study, which was conducted to examine the effectiveness of two new affect recognition treatments and their effects on social functioning. Chapter Nine presents the second study, and investigates the relationship between facial affect recognition impairments and cognitive functioning. Chapter Ten presents the final study and explores the baseline cognitive variables and other demographic characteristics associated with long-term treatment response. It also examines whether changes in cognitive functioning mediate the effects of treatment outcomes. Finally, Chapter Eleven provides an overall summary and conclusion of the research findings of the thesis.

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## **Authorship and Contributions**

This research was part of a larger international study investigating the efficacy of two affect-recognition training interventions. While the main idea for this wider project was not mine, I was involved in the Ethics application to the Central Regional Health Disability, in the recruitment of participants, and in the provision of treatment to the New Zealand sample. Study one presents an analysis of the main outcome data from this trial, across the three sites. I carried out this analysis of the data (drawn from all three sites) relating to the effectiveness or otherwise of the two interventions independently of the wider research team, though with their full support. The analysis of these wider outcomes presented in this first study thus represents my own work, with only the usual doctoral supervisory input. Alongside this, I took sole responsibility for leading the investigations of the relationship between cognitive variables and the outcomes of the trial within the wider research team. The original aspects of the investigation underpinning the other two studies in this thesis related to this were thus entirely mine.

My supervisor, Dr Duncan Babbage, has trained me how to structure my arguments, has provided statistical advice, has provided critical review of my articles, and has discussed selection of appropriate journals for publication of material. For these reasons he will be named as co-author for the publications included in this thesis. Professor Barry Willer, the lead investigator for this project, along with Dr Dawn Neumann and Dr Barbra Zupan, the principal investigators at the Canadian and United States of America sites, will also be included as co-authors for the publications.

Presented after each chapter that is formatted as a paper for publication is a statement that outlines the contributions of each of the authors to the paper. In all cases for the papers included in this thesis, the input provided by other authors to the version of the paper included in the thesis was only the level of input normally provided by a doctoral supervisor for any thesis chapter.



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