Cognitive and emotional processing associated with borderline personality disorder

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Doctor of Philosophy
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Melbourne, Australia
2016
Abstract

The diagnostic criteria for borderline personality disorder (BPD) highlight difficulties with interpersonal relations. However, this interpersonal difficulty reports to exist largely with individuals that one is intimate with, in which relationship stress relate to the use of more instinctual, quicker acting, but poorer mentalisation processing for those with BPD. These quicker mentalisation processes could be argued to relate to expectations of others, as when someone with BPD sense fears of abandonment their ability to accurately depict the states of themselves and others seems to unravel.

Despite this mentalisation disadvantage that those with suffering from BPD have in attachment contexts, reports suggest that BPD sufferers still have some experiential differences to healthy controls in non-attachment contexts. Failing to realise the break of a social norm, and difficulties with faux pas stories are examples of this. Furthermore, those with BPD report to act more aggressively than healthy controls when provoked in a social monetary exchange task. On the other hand, another monetary exchange task indicated that those with BPD had an improved ability at reading the intentions of others, but only with the partners in the task that featured emotional cues that were pre-emptive signals telling participants what they should transfer.

This study therefore utilised EEG source localisation techniques to investigate the task where BPD sufferers reported to have a greater ability at reading the intentions of others. By using such methods, it may be possible to delineate whether those with BPD had improved behaviour modification mentalisation ability, or whether their performance was most related to an altered sensitivity and attention towards emotional faces due to facial encoding difference from/or autobiographical memory mechanism.

Study 1 investigated BPD-related symptoms during two mentalisation tasks using a sample of healthy controls, whereas study 2 investigated differences during the same two
mentalisation tasks in a healthy control versus clinical sample. Generally speaking, support was given towards ideas that those with BPD had an increased emotional memory or altered sensitivity to facial expression encoding, perhaps mediated by an autobiographical or even semantic memory mechanism. However, it is important to state that these interpretations should be viewed with reasonable caution, until further research is conducted.
Acknowledgments

There are numerous individuals that have helped immensely in relation to this project…

I would first like to thank the participants for their help and contribution – to those participants I tested at Spectrum, I wish you the best in your therapy and future.

I would like to express my appreciation and gratitude for my supervisory team, Associate Professor Joseph Ciorciari, Dr. Katherine Thompson, Professor Michael Kyrios, and Dr. Sathya Rao whom provided support and perspective at vital points throughout my candidature.

I would also like to express my appreciation and gratitude to additional staff at Spectrum whom provided me with the opportunities and aid when needed including Dr. Jillian Broadbear, Dr. Emma Nicholls, Anne Braham, the clinicians, Srilakshmi Ajjampura, Lalitha Ganapathy, and even Dr. Daniella Ventieri for her temporary role.

I would like to thank David Simpson for his efforts in designing, constructing and programming an EEG trigger box for my EEG acquisition.

I would like to thank Dr. Stefanie Lis and Dr. Daniela Mier for allowing me to modify their trust task.

I would like to thank Blush Hair Studios for their co-operation regarding booking participants after their EEG session at Spectrum, which at times were booked or cancelled at short notice.

I would like to thank Felicia Cooper for her proof reading of my thesis.

Finally, I would like to thank my family for their support during my Ph.D., which made an undeniably massive contribution to me.
Declaration

This thesis does not contain any material which has been accepted for the award of any other degree or diploma, nor to the best of my knowledge does it contain material previously published or written by another person except where due reference is made. All figures are original other than acknowledged adaptations.

Lee Matthew Lawrence
Table of contents

Prelude .................................................................................................................................................... 1

Chapter 1: Borderline Personality Disorder ............................................................................................ 4
1.1 Diagnostic criterion for BPD .......................................................................................................... 4
1.2 Prevalence of BPD, co-morbidity and society ............................................................................... 4
1.3 Course of symptoms ..................................................................................................................... 5
1.4 Risk factors to the pathogenesis of BPD ....................................................................................... 7
   1.4.1 Temperament and genetics ................................................................................................... 7
   1.4.2 Attachment ............................................................................................................................ 7
   1.4.3 Childhood abuse and neglect ............................................................................................... 11
1.5 BPD, emotion regulation and impulsivity ................................................................................... 13
   1.5.1 Influences of emotion dysregulation in BPD ........................................................................ 13
      1.5.1.1 Neurobiology of emotion dysregulation in BPD ........................................................... 21
   1.5.2 Dissociation and BPD ........................................................................................................... 23
1.6 Mentalisation .............................................................................................................................. 24
   1.6.1 Mentalisation in BPD............................................................................................................ 26

Chapter 2: Rationale for the study ........................................................................................................ 32
2.1 EEG methods ............................................................................................................................... 32
2.2 Neurobiology of the trust task .................................................................................................... 37
   2.2.1 Emotion recognition ............................................................................................................ 39
   2.2.2 Neurobiology of mentalisation ............................................................................................ 40
   2.2.3 Neurobiological indicators of Memory ................................................................................ 45
   2.2.4 Neurobiology of post-traumatic stress and childhood abuse .............................................. 47
   2.2.5 Neurobiology of brain-wired dissociation............................................................................ 50
2.3 Bio-psychosocial model for BPD with and without trauma reminders ...................................... 53

Chapter 3: Aims, hypotheses and methods of study 1 ......................................................................... 56
3.1 Aims............................................................................................................................................. 56
3.2 Hypotheses ................................................................................................................................. 56
   3.2.1 Psychosocial results ............................................................................................................. 56
   3.2.2 Emotional recognition task .................................................................................................. 56
   3.2.3 Trust task.............................................................................................................................. 57
3.3 Method ....................................................................................................................................... 58
   3.3.1 Participants .......................................................................................................................... 58
4.4.1 Data screening ................................................................................................................... 108
4.4.2 Judging the fairness of others ............................................................................................ 108
  4.4.2.1 Validity checks and comparisons by sex ................................................................. 108
  4.4.2.2 Comparisons by BPD traits ......................................................................................... 110
  4.4.2.3 Comparisons by emotion dysregulation ................................................................. 112
  4.4.2.4 Comparisons by positive views of others ................................................................. 114
  4.4.2.5 All other comparisons ................................................................................................. 115
4.4.2.5 Trust task: EEG source localisation results ................................................................ 116
  4.5.1 Data screening ................................................................................................................... 116
  4.5.2 Comparisons by sex ............................................................................................................ 118
  4.5.3 Validation of mentalisation regions ................................................................................... 120
    4.5.3.1 Partners without emotional cues ............................................................................... 121
    4.5.3.2 Partners with emotional cues ..................................................................................... 127
  4.5.4 Decisions for partners without emotional cues ................................................................. 134
    4.5.4.1 Comparisons by BPD traits .......................................................................................... 134
    4.5.4.2 Comparisons by emotion dysregulation ..................................................................... 137
    4.5.4.3 Comparisons by dissociative experiences .................................................................. 141
    4.5.4.4 Comparisons by negative views of self ....................................................................... 144
    4.5.4.5 Comparisons by Positive views of self ........................................................................ 147
    4.5.4.6 Comparisons by negative views of others ................................................................. 150
    4.5.4.7 Comparisons by positive views of others ................................................................. 153
  4.5.5 Decisions for partners with emotional cues ...................................................................... 156
    4.5.5.1 Comparisons by BPD traits .......................................................................................... 156
    4.5.5.2 Comparisons by emotion dysregulation ..................................................................... 159
    4.5.5.3 Comparisons by dissociative experiences .................................................................. 162
    4.5.5.4 Comparisons by negative views of self ....................................................................... 165
    4.5.5.5 Comparisons by positive views of self ........................................................................ 169
    4.5.5.6 Comparisons by negative views of others ................................................................. 172
    4.5.5.7 Comparisons by positive views of others ................................................................... 176
Chapter 5: Discussion of study 1 ......................................................................................................... 179
  5.1 Aims and support for the hypotheses ....................................................................................... 179
    5.1.1 Psychosocial ....................................................................................................................... 179
    5.1.2 Emotional recognition task ............................................................................................. 179
    5.1.3 Trust task ............................................................................................................................ 180
List of Figures

Figure 2.1. A diagrammatic representation explaining the mediating interaction between networks involved in mentalisation, emotion dysregulation, autobiographical memory and dissociation.

Figure 3.1. A pictorial replication of the investment, feedback, and evaluation phases of the trust task used by Franzen et al. (2011).

Figure 3.2. A pictorial representation of the reciprocation rates amongst fair and unfair partners with and without emotional cues.

Figure 3.3. Visual comparisons between the phases of the trust task used by Franzen et al. (2011; left) and the trust task used by this study (right) to allow for compatibility with EEG acquisition techniques.

Figure 3.4. A pictorial representation of the alterations made to Franzen et al.’s (2011) trust task to maximise its compatibility and user friendliness with EEG acquisition methods.

Figure 3.5. The experimental setup used in the study.

Figure 3.6. A visual representation of the step-wise analysis used to investigate both hostility and mentalisation differences in the trust task for the partners with emotional cues.

Figure 3.7. A visual representation displaying the allocation of congruency weights in accordance to partner fairness. Note: The horizontal line in the middle of the Figure represents partner transfers that would equate to participants finishing with the 90 dollars they started with.

Figure 3.8. A visual representation of the step-wise analysis used to investigate both hostility and mentalisation differences in the trust task for the partners without emotional cues.

Figure 4.1. Source localisation significances between sex by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and laterisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.
Figure 4.2. Source localisation significances between a high and low female BPD-trait group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Figure 4.3. Source localisation significances between a high and low male BPD-trait group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Figure 4.4. Source localisation significances between a high and low female emotion dysregulation group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Figure 4.5. Source localisation significances between a high and low male emotion dysregulation group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Figure: 4.6. Source localisation significances between a high and low male dissociation group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Figure 4.7. Source localisation significances between males and females by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.8. Source localisation significances between males and females by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.9. Source localisation significances for females between increased and decreased transfers overtime by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.10. Source localisation significances between high and low female scorers in the trust task by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left,
right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.11. Source localisation significances for males between increased and decreased transfers overtime by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.12. Source localisation significances between high and low male scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.13. Source localisation significances for females between increased and decreased transfers overtime by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.14. Source localisation significances between high and low female scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.15: Source localisation significances for males between increased and decreased transfers overtime by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.16. Source localisation significances between high and low male scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.17. Source localisation significances between a high and low female BPD-trait median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation
(left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.18. Source localisation significances between a high and low male BPD-trait median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.19. Source localisation significances between a high and low female emotion dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.20 Source localisation significances between a high and low male emotion dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.21. Source localisation significances between a high and low female dissociation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.22. Source localisation significances between a high and low male dissociation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.23. Source localisation significances between a high and low negative views of self median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.24. Source localisation significances between a high and low negative views of self median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and
lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.25. Source localisation significances between a high and low positive views of self median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.26. Source localisation significances between a high and low positive views of self median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.27. Source localisation significances between a high and low negative views of others median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.28. Source localisation significances between a high and low negative views of others median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.29 Source localisation significances between a high and low positive views of others median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.30. Source localisation significances between a high and low positive views of others median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 4.31. Source localisation significances between a high and low female BPD-trait median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation
(left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.32. Source localisation significances between a high and low male BPD-trait median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.33. Source localisation significances between a high and low female emotion dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.34. Source localisation significances between a high and low male emotion dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.35. Source localisation significances between a high and low female dissociation dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.36. Source localisation significances between a high and low male dissociation dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.37. Source localisation significances between a high and low negative views of self median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.38. Source localisation significances between a high and low negative views of self median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and
lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.39. Source localisation significances between a high and low positive views of self median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.40. Source localisation significances between a high and low positive views of self median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure: 4.41. Source localisation significances between a high and low negative views of others median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.42. Source localisation significances between a high and low negative views of others median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.43. Source localisation significances between a high and low positive views of others median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Figure 4.44. Source localisation significances between a high and low positive views of others median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.
Figure 7.1. Source localisation significances between a BPD and control group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Figure 7.2. Source localisation significances between a BPD and control sample by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Figure 7.3. Source localisation significances between a BPD and control sample by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.
List of Tables

Table 3.1. Demographic information of the participants in the study

Table 4.1. Descriptive statistics and psychometric properties of the psychosocial variables used in the study.

Table 4.2. Descriptive and comparative statistics in psychosocial variables for the participants in the study based on a high and low BPD-trait median split.

Table 4.3. Descriptive and comparative statistics in psychosocial variables for the participants in the study based on a high and low emotion dysregulation median split.

Table 4.4. Descriptive and comparative statistics in psychosocial variables for the participants in the study based on a high and low dissoication median split.

Table 4.5. Descriptive and psychometric statistics when making happy and angry decisions in judging emotional expressions (happy, neutral, angry) by sex.

Table 4.6. Descriptive and comparative statistics when making happy and angry decisions in judging emotional expressions (happy, neutral, angry) based on a high and low BPD-trait median split.

Table 4.7. Descriptive and comparative statistics when making happy and angry decisions in judging emotional expressions (happy, neutral, angry) based on a high and low emotion dysregulation median split.

Table 4.8. Descriptive and psychometric statistics when judging physical characteristics of emotional expressions (happy, neutral, angry) by sex.

Table 4.9. Descriptive and comparative statistics of judging physical characteristics of emotional expressions (happy, neutral, angry) based on a high and low BPD-trait median split.

Table 4.10. Trust task behavioural descriptive and comparative statistics in all participants in the study and between sex.
Table 4.11. Trust task behavioural descriptive and comparative statistics based on a high and low BPD-trait median split for males.

Table 4.12. Trust task behavioural descriptive and comparative statistics based on a high and low emotion dysregulation median split for females.

Table 4.13. Trust task behavioural descriptive and comparative statistics based on a high and low median split on positive views of others for males.

Table 6.1. Demographic information of the participants in the study
Table 6.2. Diagnoses and medications used by those with BPD (N = 11)
Table 7.1. Descriptive and comparative statistics between those with and without BPD for the psychosocial variables used in the study.

Table 7.2. Descriptive and comparative statistics between those with and without BPD when making happy and angry decisions in judging emotional expressions (happy, neutral, and angry).

Table 7.3. Descriptive and comparative statistics between those with and without BPD when making physical characteristic decisions in judging emotional expressions (happy, neutral, and angry).

Table 7.4. Trust task behavioural descriptive and comparative statistics between those with and without BPD.
# Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ACC</td>
<td>Anterior cingulate cortex</td>
</tr>
<tr>
<td>BPD</td>
<td>Borderline personality disorder</td>
</tr>
<tr>
<td>EEG</td>
<td>Electroencephalography</td>
</tr>
<tr>
<td>fMRI</td>
<td>functional Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>eLORETA</td>
<td>exact Low Resolution Electromagnetic Tomography</td>
</tr>
<tr>
<td>LORETA</td>
<td>Low Resolution Electromagnetic Tomography</td>
</tr>
<tr>
<td>MNI</td>
<td>Montreal Neurological Institute</td>
</tr>
<tr>
<td>OFC</td>
<td>Orbitofrontal cortex</td>
</tr>
<tr>
<td>PTSD</td>
<td>Post-traumatic stress disorder</td>
</tr>
<tr>
<td>sLORETA</td>
<td>standardised Low Resolution Electromagnetic Tomography</td>
</tr>
<tr>
<td>ToM</td>
<td>Theory of mind</td>
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Prelude

The present study intends to investigate the cognitive and emotional processes associated with borderline personality disorder (BPD). Focussing on mentalisation through social interactions, perceptions of self and others, emotion regulation, dissociation, and childhood abuse and neglect experiences, the researchers intend to investigate aspects of behaviour and brain activity (recorded using electroencephalography; EEG) during an emotional recognition task and a trust task.

Chapter 1 will help to define and conceptualise BPD, its symptoms, and provide perspectives into the risk factors associated with its development. BPD sufferers seem to experience negative emotions at a higher intensity than most people and have a drive to seek positive sensations. Additionally, BPD sufferers typically strive for a level of intimacy in relationships and have fears of abandonment, but also have difficulties expressing and labelling their emotions, which contributes to impulsive and/or aggressive acts. Childhood abuse is also another area that is discussed in detail, especially with reference to a specific coping style that has been associated with BPD, known as dissociation.

From a background understanding of BPD psychopathology, it is easier to understand the contributions that lead to perceptions of mistrust, increased stress and emotional dysregulation, as well as difficulties mentalising. Such realisations are important in understanding performance for those with BPD in a trust task, as reports suggest that emotions seem to be the vital contributor leading to the quicker but poorer mentalisation ability for those with BPD, especially from relationship stress and those one is intimate with. Indeed, further sections describe the intact mentalisation that BPD sufferers have in non-attachment settings. However, despite having an intact mentalisation ability outside attachment contexts, BPD sufferers do report to process and behave differently to some mentalisation-related stimuli to controls. For instance, evidence suggests that those with BPD seem to behave more aggressively on impulse to controls in a social context. Furthermore, those with BPD report to have more difficulties in detecting and assessing
social rule violations, seem to be vigilant to social cues of threat and rejection and therefore seem to be highly attune to detect non-verbal body language, such as the emotions of others. However, a negative bias seems to exist for those with BPD when recognising the emotions of others, especially with ambiguous faces.

Chapter 2 then focuses on supporting research that has not been necessarily directly implicated in BPD, in order to establish aims and hypotheses for the trust task used for this study. EEG source localisation techniques are discussed, as they become a core method necessary to investigate the process that those with BPD are using, when completing the trust task. For instance, mentalisation has been associated to relate to a core-driving area, known as the anterior cingulate cortex which only source localisation techniques can reliably measure when using EEG.

After explaining EEG techniques, by considering attachment insecurities, emotion regulation, mentalisation, dissociation and childhood abuse, an integrative approach is then taken when explaining an overarching bio-psychosocial model to explain the phenomena associated with BPD, and how that model could predict results for the trust task. The model further considers the role of behaviour correction and memory processes, which are important in the understanding of mentalisation and emotion recognition, as those with BPD are more sensitive and attentive to emotional expressions. Overall, it is argued that those with BPD have an improved ability at reading the intentions of others with emotional cues in the trust task this study replicates, due to differences in attention and encoding of emotional faces, perhaps from autobiographical processes.

Chapter 3 through 5 present the aims, hypotheses, methods, results and discussion of study 1, which performed median splits on variables from measures assessing aspects of BPD psychopathology and investigated their impact on mentalisation tasks in an exclusive non-clinical sample. Chapter 3 presents the aims, hypotheses, and methods, Chapter 4 presents the results, and Chapter 5 presents the discussion of study 1.
Chapter 6 through 8 presents the aims and hypotheses, methods, results and discussion of the second study, which performed direct comparisons between a healthy control and BPD affected sample and investigated their impact on psychosocial data and mentalisation tasks. Chapter 6 presents the aims, hypotheses, and methods, chapter 7 presents the results, and Chapter 8 presents the discussion.

Chapter 9 focuses on the general similarities between the two studies, has an emphasis on future research directions, and makes final conclusions from the studies.
Chapter 1: Borderline Personality Disorder

1.1 Diagnostic criterion for BPD

According to the American Psychiatric Association (APA; 2013), the short-hand diagnostic criteria for BPD is characterised by a pervasive pattern of instability of interpersonal relationships, self-image, affect, and marked impulsivity beginning by early adulthood that presents in a variety of contexts indicated by five (or more) of nine behaviours. Such behaviours can include frantic efforts to avoid real or imagined abandonment, a pattern of unstable and intense interpersonal relationships with extreme alternations between idealization and devaluation, markedly and persistently unstable self-image or sense of self, as well as an inappropriate and intense anger or difficulty controlling anger (e.g., frequent displays of temper, constant anger, recurrent physical fights). Other behaviours can include affective instability from a marked reactivity of mood (e.g., intense episodic dysphoria, irritability, or anxiety usually lasting a few hours, and, much more rarely, for more than a few days); chronic feelings of emptiness; and transient, stress-related paranoid ideation or severe dissociative symptoms. The final two behaviours involve impulsivity in at least two areas that are potentially self-damaging (e.g., spending, sex, substance abuse, reckless driving, binge eating), and recurrent suicidal behaviour, gestures, or threats, or self-mutilating behaviour (APA, 2013).

1.2 Prevalence of BPD, co-morbidity and society

According to the median population prevalence, BPD is reported to affect 1.6% of individuals within the society (APA, 2013; Lenzenweger, Lane, Loranger, & Kessler, 2007), whilst having a prevalence of 20% of all in-patients within the public mental health system (APA, 2013; Bahorik & Eack, 2010; Moran et al., 2010), 10% of all outpatients in clinics, and 6% in primary care settings (APA, 2013). However, prevalence could be as high as 5.9% in the general population (APA, 2013; Grant et al., 2008). Odds ratios using lifetime prevalence suggest that BPD is commonly co-morbid with alcohol and substance use, abuse and dependence, major depressive disorder, bipolar I and II disorder, panic disorder with and without agoraphobia, generalised anxiety disorder, social and specific phobias, as well
as post-traumatic stress disorder, cluster A (i.e., paranoid, schizoid, and schizotypal), B (i.e., borderline, antisocial, histrionic, and narcissistic) and C (i.e., avoidant, dependent, and obsessive compulsive) personality disorders (Grant et al., 2008).

Reports suggest that 75% of patients being treated for BPD are female (APA., 2013). However these sex differences may be due to an increased rate of females receiving treatment in a clinical setting because females are more likely to seek help for psychological problems. Better indications of prevalence rates may come from community settings (Skodol & Bender, 2003). More recent epidemiological studies do indicate similar prevalence in BPD psychopathology between males and females in community settings (Grant et al., 2008; Lenzenweger et al., 2007).

1.3 Course of symptoms

According to a review (Newton-Howes, Clark, & Chanen, 2015), personality disorders begin in childhood and adolescence, fluctuate over time, but establish at least until the age of 60. Personality features report to peak at 13-14 years, and reduce monotonically from 14 to 28 years - some of these decreases relating to changes in impulsivity, attention seeking, dependency, social competence and self-control. During 30 through 45 years, when development reports to slow, personality disorders typically present with stable traits and acute disturbances (e.g., suicidality or hyper-aggression). Certain symptoms seem to change based on age and experience. For instance, positive affectivity increases from birth to 20 years, then stabilising and dropping after 50 years; negative affectivity decreases after the age of 30; disinhibition and antagonism decreases over the lifespan; and detachment increasing after the age of 50, presumably due to lost attachment figures in later life (Newton-Howes et al., 2015). Therefore, although the symptoms associated with BPD, are defined as ‘an enduring, pervasive, and inflexible pattern of inner experience and behaviour’ (APA., 2013, pg. 645), evidence suggests that personality and some symptoms are less stable than others.

For instance, a 10 year follow-up studies report that quasi-psychotic thinking, some impulsive behaviour (sexual deviancy, self-harm, and substance use), and identity
disturbance tend to resolve within the first 4 years. Whereas relationship problems, affective instability, anger, non-delusional paranoia, anxiety, depression, emptiness, and general impulsivity tend to resolve after 4 to 10 years (Gunderson et al., 2011; Zanarini et al., 2007). With this said, it should be noted that self-harm, identity disturbance, abandonment fears, and emptiness are the behaviours that report to relate most to readmission (McGlashan et al., 2005). When considering the work of Eaton et al (2011), these therapeutic trends suggest that the externalising behaviour seen in BPD are more quickly resolved than the internalising behaviour witnessed in BPD (Eaton et al., 2011). General notions suggest that if individuals with BPD can achieve stable supports and avoid interpersonal stressors remission is likely (Gunderson et al., 2011).

When considering the course of symptoms regarding BPD, two approaches can be taken. The first relates to the extent to which diagnostic criteria is met and the second relates to how well individuals seem to be functioning or coping. A 16 year follow-up study looking at criterion-based remission rates over a 2 year period reported that BPD was slower to remit and recover than other personality disorders. At the end of the 16 year period, both BPD and other personality disorders reported similar levels of remission, but not similar levels of recovery. Therefore, remission in BPD is more common than recovery, when compared to other personality disorders (Zanarini, Frankenburg, Reich, & Fitzmaurice, 2012). When comparing diagnostic criterion based on remission and relapse rates for those with BPD to obsessive compulsive personality disorder and major depressive disorder over a 10 year course, evidence suggests that both rates are lower for BPD, but all seemed to improve overtime. Importantly, remission was defined as having two or less criterion for BPD over the last year interval. When using this two or less criteria symptom definition within a two month interval, remission and relapse rates for BPD report to be greater in the two month when compared to the year group. On the other hand, when looking at how well individuals are coping, those with BPD reported to have a lower level of global functioning and social adjustment when compared to those same conditions, but that level did not seem to change much over a 10 year period (Gunderson et al., 2011).
1.4 Risk factors to the pathogenesis of BPD

1.4.1 Temperament and genetics

Temperament refers to an individual’s emotional nature, their susceptibility to emotional stimulation, quality of prevailing mood, fluctuation and intensity of mood, and strength and speed of response (Widiger, 2005). Childhood temperament is generally viewed to provide the emotional substrate from which personality develops and is believed to have biological substrates. Someone’s anxiousness, angry hostility, depressiveness, self-consciousness, impulsiveness and vulnerability (i.e., neuroticism), is reported to be a big element contributing to the development of BPD. However, excitement seeking from the positive emotions (i.e., as found in extraversion), also relates to those with BPD (Widiger, 2005). Therefore, it could be said that those with BPD report to have a susceptibility from a young age experiencing and encountering more intense emotions than those without an emotional susceptibility, and have a heightened desire to seek excitement. If a susceptibility exists based on temperament, it may be expected that genetic differences may underlie it. Evidently, a review summarising results of mono and dizygotic twins has suggested that approximately 50% of personality traits are hereditary (Torgersen, 2005). More specifically, twin studies have revealed evidence that the development of cluster B personalities (i.e., Borderline, Antisocial, Histrionic, Narcissistic), seem to have both a genetic, but also an environmental influence. In particular, Borderline and Anti-Social Personality Disorder seemed to share the greatest level of genetic and environmental effects at 35% and 38%, respectively (Torgersen et al., 2008).

1.4.2 Attachment

Attachment behaviour has been defined as seeking and maintaining proximity to another individual. Such behaviours are believed to develop via associations that one makes in their early environment: they are particularly influenced by a child’s interactions with their first attachment figure - most commonly their mother (Bowlby, 1997). A mother forms a secure base from which the child can explore their environment whilst having a ‘safe place’ to return in moments of distress. Overtime, a child begins to form attachments to
other figures in their lives, but this is usually through interactions with those individuals whilst their mother is present. These other, subordinate attachment figures can be exemplified by other relatives and teachers. Even so, the subordinate attachment figures are only conditional, in that a child will want to return to their mother at a later time (Bowlby, 1997), especially in times of distress. Generally speaking, as a child grows older, they gain greater confidence, choosing to spend less time with their attachment figure and spend more time with peers and adults (Bowlby, 1997).

Early on, when a child sees their mother leave the room, or anticipates her leaving, a child will commonly protest by whimpering or crying, even attempting to follow her if the child is physically capable. Such behaviour reports to be extremely common between 8 months and lasting up until 3 years. However, although children exhibit attachment behaviour less urgently after their third birthday, attachment still substantially influences a person’s behaviour into later life (Bowlby, 1997). It is only in adolescence when a child projects equal or more priority on interacting with peers and potential sexual partners. At this time individual differences in attachment behaviour - which is already large to begin with - becomes increasingly more delineated with some individuals cutting themselves off from their parents, through to others who are unwilling to leave. However, for most individuals, the attachment to their parents continue into adulthood in many ways (Bowlby, 1997). Attachment is redirected and projected towards other relationships and are best able to do so when they know that a trusted person is standing behind them and is available in times of need. The more trustworthy the person, the greater the likelihood it is taken for granted. Consequently, a truly self-reliant person acts as a secure base for others, but is also glad to use others as a secure base in return (Bowlby, 1998d).

Attachment behaviour is particularly influential in every person’s life and is shaped by one’s early experiences which are used as a ‘template’ for how to behave with others in adulthood, particularly when someone is distressed. Regardless of the reason, if an individual has trouble in establishing secure attachments they are more likely to portray anxiety regarding attachment in future relationships: this anxiety is known as separation anxiety (Bowlby, 1997).
Maladaptive attachment: attachment anxiety

Separation anxiety is displayed through behaviour, such as with some children protesting when they see or expect their mother leaving the room. This protest is associated with continual whimpering, crying, and/or attempts to follow their mother until the child is assured that she is nearby or will not leave (Bowlby, 1997). In this event, a child can project anger towards their attachment figure for actually leaving or threatening to leave them, in the attempt to discourage that event occurring in the future and remove obstacles in the way preventing their reunion (Bowlby, 1998d). Sometimes anger can be in hope, other times it can be in despair. At times, a child’s hostility in wanting their attachment figure can manifest into levels of blame (Bowlby, 1998d). Although, anger and aggression is directed towards an attachment figure, it is also often directed to other people as well (Bowlby, 1998d). As mentioned, these behaviours intend to ensure and grow the bond between the attachment figure and the person. However, sometimes, the anger can be maladaptive, and discourage the bond between the child and attachment figure. In this situation, that person begins to alienate their attachment figure due to overly aggressive behaviour. Consequently, this appears as a double effect, whereby feelings of love decrease and resentment increases (Bowlby, 1998d). Seemingly then, the most symptoms seem to associate with children who experience multiple separations and feel abandoned (Bowlby, 1998d). The impact that attachment has on behaviour has lead Bowlby (1998a) to posit that the underpinnings of some anxiety and depressive problems could be explained by attachment issues from over or under-protective childhood experiences.

Maladaptive attachment: associated childhood backgrounds

Childhood experiences that Bowlby (1998a) believes relate to the development of depressive and anxiety conditions from childhood attachment patterns include: (1) a child who has failed to develop a secure attachment with their parents based on repeated and utmost attempts to follow their parents demands and fulfil their high expectations. This experience commonly relates to the development of, and strong bias to perceive any loss as yet another one of their personal failures to create or maintain an affectional relationship. (2) A child has been told repeatedly how unloved, inadequate, or incompetent they are.
Such situations commonly lead to the development of a personal model that they are unwanted and unloved, and a model of attachment figures are unavailable, rejecting, or punitive. When this child is faced with adversity, they expect others will be rejecting and hostile. (3) The child has, more than likely, experienced a death of an attachment figure in childhood and they were insensitive to change. Such an experience commonly confirms their belief that they are doomed to fail (Bowlby, 1998a).

According to a review (de Ruiter & van Ijzendoorn, 1993), Mary Ainsworth was the first to distinguish between 3 types of attachments which can be distinguished early in life: secure; anxious-avoidant; and anxious ambivalent. Follow up studies by Mary Main and Judith Solomon further found an additional attachment style: anxious-disorganised. Such attachments were found using the “Strange Situation” paradigm in which infants are left alone in a room by their parent, or left alone with a stranger. When left alone in a room as an infant, those with secure attachments become distressed when a parent leaves, but quickly resolve when they return back and continuing exploring when safe. On the other hand, those with attachment-avoidant patterns attach to a parent, but may turn their face or divert attention away from the caregiver towards other things, such as toys. This infant will explore, but less than an infant who is securely attached. Anxious-ambivalent attachments present with behaviour in which seek proximity, but resist and display anger towards them when they return. This attachment style is associated with a slower time to calm down, and begin exploration again. Such childhood attachment styles can influence adult attachments which can further be classified as secure, unresolved, preoccupied, and dismissing (de Ruiter & van Ijzendoorn, 1993).

Those with secure attachments can present a coherent memory of their past and present experiences with their attachments, and tend to value attachment experiences and relationships. The unresolved attachment style refers to an adult who has inconsistencies in discussions of past losses and/or trauma. Those with preoccupied attachments tend to report continuing preoccupation involvement with the past and present relationships with their parents. This preoccupation can be exemplified by anger and/or passively trying please attachments. Individuals with dismissing adult attachments tend idealise their past attachment figures but claim difficulties remembering much from their childhood. Those
with dismissing adult attachments have tended to have parents who were rejecting and unloving (de Ruiter & van Ijzendoorn, 1993).

With specific reference to BPD, a review of the literature focussing on attachment measures (Agrawal, Gunderson, Holmes, & Lyons-Ruth, 2004) suggests that those with BPD present with an attachment style that are unresolved (50% to 80% of cases) or fearful, both having a secondary attachment style of preoccupied. This means that individuals with BPD have a failure to resolve mourning over the loss of a significant attachment figure, or other trauma, such as childhood abuse (unresolved type), or have a negative self-image combined with a scepticism that a significant other will be available, trusting and loving (fearful type); both having motivations to seek close, intimate relationships but are very reactive to their perceived dependency or undervaluation (Agrawal et al., 2004). Another study found a similar 90% of participants with BPD were classified as having fearful or preoccupied attachments, but a cluster analysis suggested that 29% of those with BPD can be classified as avoidant, 26% pre-occupied, and 45% fearful around attachment figures, which is important when considering results indicating the preoccupied types are more concerned about abandonment, fearful types have higher ratings of identity disturbance and whereas the avoidant types report greater inappropriate anger (Levy, Meehan, Weber, Reynoso, & Clarkin, 2005).

1.4.3 Childhood abuse and neglect

BPD is commonly associated with neglect, verbal, emotional, physical, and sexually abusive childhoods (Barnow et al., 2010), and has particularly been linked with physical and sexual childhood abuse experiences (Herman, Perry, & Van Der Kolk, 1989; Zanarini et al., 1997). The relevance of childhood abuse becomes salient when discussing symptoms that tend to develop from such experiences. For instance, childhood abuse experiences have been suggested to intrinsically relate to the development of psychotic symptoms, as opposed to suffering abuse as an adult (Barnow et al., 2010). Childhood neglect and emotional abuse has been associated with schizotypal symptoms, whereby physical assault has particularly been associated with positive symptoms, and sexual assault has been strongly associated with hallucinations. With that said, all types of trauma were associated
with visual hallucinations, whereas rape and molestation were specifically linked with auditory hallucinations, and physical and sexual abuse were linked with tactile hallucinations (Barnow et al., 2010). These hallucinations show similarities to symptoms that feature in psychotic disorders, such as schizophrenia (APA., 2013), and the quasi-psychotic thinking in BPD around fear of abandonment can be misinterpreted as psychotic delusions (APA., 2013). There are also suggestions and early evidence that indicate a dissociative pathway could underlie the hallucinations from childhood abuse (Perona-Garcelán et al., 2012; Pilton, Varese, Berry, & Bucci, 2015).

Childhood abuse has also been associated with various mood and anxiety conditions. Odds ratios suggest that the incidence of major depression, dysthymia, bipolar disorder, post-traumatic stress disorder, agoraphobia, generalised and social phobias, as well as substance disorders are increased for those with childhood abuse experiences (Afifi, Boman, Fleisher, & Sareen, 2009; Molnar, Buka, & Kessler, 2001). Additionally, most personality disorders have also been associated with childhood abuse (Johnson, Cohen, Brown, Smailes, & Bernstein, 1999; Lobbestael, Arntz, & Bernstein, 2010). Consequently then, experiences of childhood abuse appear to manifest into various personality, mood, and anxiety disorders.

According to the Australian Childhood Foundation, childhood abuse in Australia was recorded at 0.76% according to reported cases in 2007. However, this value fails to take unreported cases into consideration. Therefore, by basing results on the Personal Safety Survey (Australian Bureau of Statistics, 2005; Australian Childhood Foundation, 2008), estimates suggest that 3.7% of children are maltreated annually. Yet, based on estimates from the United States, as high as 13.8% of children could be maltreated annually in Australia (Australian Childhood Foundation, 2008). Childhood abuse is associated with developmental delay and impairment, cognitive and neurological impairment, low academic achievement, and impaired social functioning. In line with this, homelessness, teen pregnancy, delinquency and adult criminal behaviour, subsequent victimisation of one’s own children are also related to childhood abuse. Furthermore, substance misuse, depression, anxiety and PTSD also link with childhood abuse. And, this fails to consider head trauma, fractures, and premature death (Australian Childhood Foundation, 2008). Follow-up studies on individuals who were sexually (Clark, Caldwell, Power, & Stansfeld, 2010; Cutajar et al., 2010) and physically abused (and those experienced parental divorce before the age
of 16) as children, indicate that sufferers can still report detrimental effects around their 45th birthday (Clark et al., 2010). However, the psychological response from abuse seem to be related to various major and minor factors.

Age of abuse onset (Schoedl et al., 2010) and the duration of abuse seem to be important contributors to symptom development (Briere & Jordan, 2004; Follette, Polusny, Bechtle, & Naugle, 1996), but psychological responses are also influenced on the levels of post-traumatic response (Briere & Jordan, 2004; Spidel, Lecomte, Greaves, Sahlstrom, & Yuille, 2010), social support, and even more specific situational factors (Briere & Jordan, 2004). Further to this, there are some symptoms that undoubtedly relate to the events (e.g., flashbacks of the event/s, avoidance of stimuli that remind someone of the event/s). However, there are some symptoms that both relate to propagate after trauma, as well as being a pre-curser to making someone more susceptible to being traumatised, such as psychosis (Briere & Jordan, 2004; Spidel et al., 2010) and drug taking (Briere & Jordan, 2004). Another example are reports that attachment difficulties from childhood abuse acts as a mediator to develop post-traumatic symptoms after experiencing trauma later in life (Nishith, Mechanic, & Resick, 2000). Interestingly, this last example highlights the importance of a childhood adversity on the symptoms associated with a later trauma, thereby maintaining the view that childhood experiences can have substantial effects on later life.

1.5 BPD, emotion regulation and impulsivity

1.5.1 Influences of emotion dysregulation in BPD

Starting from Linehan’s original work (Linehan, 1993), which has recently been extended (Crowell, Beauchaine, & Linehan, 2009), emotion regulation is the ability to flexibly respond to, and manage emotions. Therefore, inversely, emotional dysregulation refers to the inability to respond to and manage emotions (Carpenter & Trull, 2013). Linehan suggests that invalidating childhood backgrounds influence the development of emotional dysregulation through the lack of teaching of labelling and responding to emotions, how to tolerate emotional distress, and when to trust one’s own emotional responses in context. Therefore, because the problems of an emotional child are not
recognised, little effort goes into solving them. As adults, those with BPD invalidate their own emotional experiences, look towards others for accurate reflections to validate reality, and oversimplify solving life problems. Oversimplification leads to unrealistic goals, and inability to use reward instead of punishment in small steps to fulfil goals, and self-hate when failing to achieve those goals. Furthermore, life problems are not known how to be solved yet the distress cannot be tolerated, and large displays are often necessary to provoke a helpful response in the environment, which can include suicidal behaviour (Linehan, 1993).

Generally speaking, Linehan (1993) implicated two facets related to emotion dysregulation: emotional vulnerability and emotional modulation. Emotional vulnerability refers to ideas that those with BPD experience intense emotions and reactions from are typically extreme. This means that those with BPD narrow their attention to their emotions, which are slow to return back to baseline. Therefore, those with BPD label and misattribute new and old events based on a negative emotional state. Emotional modulation refers to ideas that those with BPD inhibit negative emotions, meaning that those with BPD will avoid engaging with negative emotions (Linehan, 1993); using dissociation is one example (Crowell et al., 2009). More recent research suggests that those with BPD also have a susceptibility to intense emotions and impulsive symptoms, which can be argued to add further urgency for those with BPD to deal with negative emotions (Crowell et al., 2009).

The interaction of the two factors of emotion dysregulation, setup an emotional lability, which can lead to those with BPD behaving inconsistently, and therefore relationships, behaviour and thought processes can be chaotic, so those with BPD have difficulties with having a stable sense of self (Linehan, 1993). Negative cognitive consequences include experiencing low self-esteem, self-hatred, hopelessness, disorganisation, or dissociation. Whereas, behaviourally, one may withdrawal from others, avoid certain situations, or perform frequent impulsive behaviours, inclusive of self-injury. Emotionally, one may experience a generalised emotional variability, sadness, shame, or anger. On the other hand, socially, one may experience social isolation, have problematic peer relationships, and have difficulties establishing individuation from a care-giver (Crowell et al., 2009). All these processes can lead to further emotional lability and therefore creating
a cycle between emotion dysregulation and invalidating environments (Crowell et al., 2009; Linehan, 1993). Today, at least 3 factors can be argued to relate to the emotion dysregulation process in BPD: emotional sensitivity, negative emotions, and emotion regulation strategies (Carpenter & Trull, 2013) which are also influenced by impulsivity (Carpenter & Trull, 2013; Crowell et al., 2009), and each of these are discussed hereafter.

**Emotional sensitivity**

Numerous methodologies have been used to provide evidence of an emotional sensitivity in BPD. One study (Berenson, Downey, Rafaeli, Coifman, & Leventhal Paquin, 2011) investigated the differences in rejection sensitivity that existed in BPD and the relationship between rejection sensitivity and anger. Those with BPD reported to have a greater sensitivity to rejection in self report measures, and were also quicker at reading words that were associated with rage when primed with words that have rejection connotations. Within this study, participants were also instructed to take a diary home and, when prompted with a situation that had connotations of rejection, were instructed to rate their levels of perceived rejection and anger at the time. Results indicated that those with BPD reported a much greater level of anger in situations that featured rejection, which was also higher for those with BPD when compared to controls (Berenson et al., 2011).

Another study found that those with and without BPD were presented neutral and unpleasant words, and these words were accompanied with a loud sound burst to provoke a startle response. When compared to control participants, results suggested that those with BPD had a greater startle response when being presented the unpleasant words only. Therefore, this suggests that those with BPD seem to have an increased sensitivity to emotional stimuli (Hazlett et al., 2007). These results are similar to trends in another study where greater emotional responses were found when a pain stimuli was given after neutral images, but not for the negative images (Niedtfeld et al., 2012). Another study found those with BPD to be sensitive to negative emotions (e.g., sadness, anger, fear), as compared to positive emotions. For instance, studies using the emotional Stroop task have been used to help identify this sensitivity (Carpenter & Trull, 2013). The emotion Stroop task presents various emotionally laden words in varying colours. Participants are required to suppress what the word says, and report on the colour of the word. Therefore, better abilities at
suppressing content and emotions of a word relate to faster reaction times (Compton et al., 2003). Evidence suggests that those with BPD were slower at responding to emotionally ladled words in some studies, but others have not. Interestingly though, one study that did not find any emotion biased, behavioural results, also investigated neurobiological results in their study (Carpenter & Trull, 2013). These neurobiology results indicated differences in brain activity on the presentation of negative words. In particular, a strong response was found when presented with a word that related to a recent stressful experience the participants encountered. In comparison, those with BPD did not report differences in brain activity, indicating an attention bias towards processing negative-valanced words (Wingenfeld et al., 2009), perhaps as a protective function. In addition to this, there is other evidence that exists indicating an emotional sensitivity in BPD.

One study used dynamically changing faces where the participants were asked to stop the morph when they were able to identify the emotion. Results indicated that those with BPD tended to stop the motion more quickly than controls, and this did not lead to any increase or decrease in errors. This was interpreted as those with BPD being more sensitive in learning about the specific emotional characteristics of the individual faces displayed (Domes et al., 2008). When compared to controls, those with BPD have been reported increased amygdala activity when viewing negatively valanced images (Hazlett et al., 2012; Herpertz et al., 2001), words (Silbersweig et al., 2007), as well as happy, sad, fearful and even neutrally valanced facial expressions (Donegan et al., 2003). The importance of the amygdala activity in these studies is represented in its key contribution to aggressive behaviour, as well as fear conditioning, the formation and recollection of emotional memory, and triggering fight-or-flight responses (Teicher et al., 2003).

Those with BPD report to experience adverse emotions when in social contexts, especially when social cues of threat or rejection are present. Interestingly, however, studies have indicated that those with BPD have difficulties in recognising a wide array of dynamic emotional expressions when compared to controls. This difficulty appears to be enhanced when someone is stressed from daily life events. Generally speaking, it has been suggested that those with BPD are more prone to incorrectly identify ambiguous facial expressions and tend to over-report emotions based on a negative bias: angry faces are
over-reported; anger and sadness are blended, as well as anger and happiness (Domes, Schulze, & Herpertz, 2009). Other research studies investigating static faces have indicated that negative faces (anger, fear, sadness, disgust) were more poorly recognised by those with BPD. However, there was a trend in the results whereby those with BPD confused disgust with anger, fear with surprise, and sadness with fear. Controls on the other hand, seemed to have most difficulties with confusing surprise with fear. Furthermore, errors indicated that those with BPD over-attributed surprise and disgust, under-attributed fear and sadness, and attributed happiness and anger equally (Unoka, Fogd, Füzy, & Csukly, 2011). Other studies on static faces have found that those with BPD and controls were able to identify anger and happiness equally (Franzen et al., 2011).

**Negative emotions**

Those with BPD report to experience high levels of negative emotions (e.g., sadness, shame, anger) that appear to be a direct consequence of an emotional sensitivity (Crowell et al., 2009). Although some studies have indicated that those with BPD experience more negative emotions than controls, some studies have indicated that these differences may not be the case, or may not be so large. For instance, differential methods from performing cross-sectional comparisons between levels of emotions between those with and without BPD are to use ecological momentary assessment methods. That is, asking participants to fill in a diary during their everyday lives, whereby participants are prompted to report on their current emotional state at regular intervals (e.g., every 10-20 minutes, hour, etc.) and over a given timeframe (e.g., over a day, month, etc.; Carpenter & Trull, 2013). Momentary Assessment methods suggest that an emotional instability in negative emotions appears to be more iconic of BPD compared to the durations of experiencing negative emotions. For instance, negative emotions in BPD fluctuate and can intensify rapidly compared to controls (Ebner-Priemer & Sawitzki, 2007), and this remained the case even when controlling against clinical depression (Trull et al., 2008). These experiences of fluctuating, negative emotions could be explained by the combination of emotion sensitivity and perhaps amygdala activity.

For instance, the amygdaloid nuclei are one of the most sensitive brain structures, as demonstrated with kindling. Kindling refers to the phenomena where repeated stimulation produces greater and greater alterations in excitability, in worst cases leading to
spontaneous discharges of electrical activity (i.e., seizures). Overall then, this suggests that long-term stimulation of the amygdala, could result in difficulties in controlling behaviour (Teicher et al., 2003), and therefore emotion dysregulated behaviour. Overall, these negative emotions seem to maintain itself continually because of a failure in having appropriate emotion regulation strategies.

**Emotion regulation strategies**

Appropriate emotion regulation strategies begin with having an awareness of, and distinguishing amongst emotional states (Carpenter & Trull, 2013), which those with BPD have trouble doing (Linehan, 1993). Adaptive emotion-regulation strategies emphasise the importance of accepting and valuing emotional responses, and responding to them in a flexible manner, applying various coping strategies in a variety of different situations. Furthermore, instead of changing the emotion experienced, adaptive regulation strategies involve altering the intensity or duration of an emotional experience. In doing so, one is able to control their behaviour when experiencing adverse emotions, refraining themself from using inappropriate or impulsive behaviours, and behave in accordance to desired goals (Gratz & Roemer, 2004).

Maladaptive regulation strategies relate to the use of more simple or immediately acting techniques to manage one’s emotions, as opposed to the more difficult or slower acting adaptive regulation strategies. However, these more simple strategies are problematic because of negative consequences, or because they are not effective long-term (Carpenter & Trull, 2013). Because adaptive regulation strategies were difficult for those with BPD to learn, they tend to use maladaptive emotional regulation strategies that include self-harm (e.g., cutting, burning, scratching) and impulsive behaviour (e.g., spending, sex, substance abuse, reckless driving, binge eating) (APA., 2013; Carpenter & Trull, 2013). Rumination and thought suppression tend to increase negative emotions, and is also another maladaptive regulation strategies used by those with BPD. Whereas failures to deal with a situation through avoidance (Carpenter & Trull, 2013; Linehan, 1993) and violence towards others (APA., 2013; Gratz & Roemer, 2004) are further maladaptive emotion regulation strategies used by those with BPD. Using a questionnaire designed to measure emotional dysregulation thought processes and behaviour (Gratz & Roemer, 2004), BPD-
congruent traits related to impaired adaptive regulation strategies in a number of studies using non-clinical samples (Carpenter & Trull, 2013).

### Impulsivity

Generally speaking, impulsivity has been defined as an inability to stop a behaviour that has negative consequences; preference for immediate over delayed rewards; risk-taking; increased novelty-seeking behaviour; behaving without considering consequences; impatience when waiting; having a short attention span; and failing to avoid perseveration at a particular activity. Therefore, impulsivity can be thought of as a multifaceted construct (Perry & Carroll, 2008). With this in mind, the Barrett Impulsivity Scale is a highly used scale measuring impulsivity along uni and multi-dimensional ways (Stanford et al., 2009). Using this scale, increased levels of impulsivity has been reported for those who have been diagnosed with BPD, when compared to controls (Berlin & Rolls, 2004; Coffey, Schumacher, Baschnagel, Hawk, & Holloman, 2011; Links, Heslegrave, & Van Reekum, 1999). However, there are also particular tasks in the literature that measure levels of impulsivity that have also reported differences in impulsivity between those with BPD and control participants. For instance, delayed discounting tasks (Lawrence, Allen, & Chanen, 2010), risk taking or gambling-based tasks (Coffey et al., 2011; Dougherty, Bjork, Huckabee, Moeller, & Swann, 1999; Haaland & Landrø, 2007; Hochhausen, Lorenz, & Newman, 2002), and response inhibition tasks (Coffey et al., 2011; Rentrop et al., 2007; Silbersweig et al., 2007) all reported that those with BPD tended to have greater levels of impulsivity compared to controls. Considering most of these aforementioned tasks are quite robust given their standardised natures, collectively these results suggests that those with BPD have tendencies towards immediate gratification, risk taking behaviour, and difficulties in suppressing one’s behaviour when attempting to achieve a goal in experimental conditions. Overall then, impulsivity appears to be an important element in BPD, as various methodologies have reported impulsive elements in BPD.

Biosocial models regarding BPD suggest that impulsivity interacts with emotional processing and behaviour, in which impulsive tendencies contribute to the experience of emotions themselves, creating a greater sense of urge for relief and use of maladaptive...
emotion regulation strategies (Crowell et al., 2009). This interaction can be exemplified by discussing the literature around aggression, which is one aspect that associates with BPD (APA., 2013). Notably, a number of studies investigating impulsivity have used samples that also report to have high levels of aggressive tendencies (Stanford et al., 2009).

According to a commonly used definition, aggression can be defined along behavioural, cognitive, and emotional constructs. Behaviourally, physical and verbal aggression both pertain to hurting or harming others through behaviours such as hitting and breaking things, as well as being argumentative and threatening towards others, respectively. However, on a cognitive level, hostility refers to feelings of ill will and injustice, presenting with thoughts that one has been treated unfairly, as well as having a suspiciousness of others’ behaviour. Emotionally, anger refers to a physiological arousal and preparation for aggressive thoughts or behaviour (Buss & Perry, 1992). Notably then, aggression appears to involve a self-control element which is manifested by an anger component in a premeditated or impulsive nature (Buss & Perry, 1992; Stanford, Houston, Mathias, et al., 2003).

Aggression has generally be defined as either (1) impulsive, unintentional, affective, or reactive, or (2) planned, controlled, premeditated, intentional, predatory, or proactive (Stanford, Houston, Mathias, et al., 2003). Therefore, impulsive aggression has been defined as an emotional charged aggressive response manifesting from a lack of behavioural control (Stanford, Houston, Villemarette-Pittman, & Greve, 2003). Impulsive aggression appears to present in a spontaneous nature as an emotional reaction that is either out of proportion to a provocation or unprovoked. Nevertheless, such spontaneous acts are also associated with guilt after an aggressive act, hence adding validity to its impulsive nature (Barratt, Stanford, Dowdy, Liebman, & Kent, 1999). On the other hand, premeditated aggression is defined as a purposeful, controlled aggressive display that has an instrumental nature (Stanford, Houston, Villemarette-Pittman, et al., 2003). Therefore, premeditated aggression does not usually have a large emotional response, but are more intentional (Barratt et al., 1999).
The importance of conceptualising aspects associated with aggression, provides essential insight into the role that impulsivity has on influencing emotions. Although aggression has been associated with impulsive and premeditated motives (Stanford, Houston, Mathias, et al., 2003), only impulse-aggression relates and likens to the general definitions of impulsivity (Barratt et al., 1999), and therefore impulsive aggression is a particularly good way to explain the anger and physical fight diagnostic criterion in BPD (APA., 2013). The interaction between impulsivity and emotions could also provide some insight into the fluctuation of emotions, experienced by those with BPD (Ebner-Priemer & Sawitzki, 2007; Trull et al., 2008).

1.5.1.1 Neurobiology of emotion dysregulation in BPD

In keeping true of intentions to control one’s behaviour in response to emotional experiences, neurobiological indicators have been suggested that could represent this difficulty for those with BPD. For instance, it has been suggested that those with BPD have a disrupted fronto-amygdala connectivity compared to controls, and this disruption underlies the difficulties that those with BPD have in controlling their emotions. Such suggestions come from studies that investigated the frontal cortices down regulatory role on the amygdala in response to aversive stimuli, such as that experienced when taking meta-chlorophenylpiperazine (New et al., 2007). Meta-chlorophenylpiperazine is a serotonin agonist, that when taken induces increased body temperature, heart rate, blood pressure, and anxiety (Kahn & Weltzer, 1991). With this in mind, when comparing between the placebo and meta-chlorophenylpiperazine conditions, control participants reported to have decreased activity between the right dorsal amygdala and regions consistent with the pre-motor cortex and middle frontal gyrus (Brodmann areas 6 and 8), whereas those with BPD reported no interaction between these areas. Furthermore, those with BPD reported to have a decreased activity between the rostral pre-frontal cortex (Brodmann area 10) and the right ventral amygdala, whereas control participants reported an increased activity. Those with BPD were reported to have a decreased activity between subgenual cingulate regions and the right dorsal amygdala, when compared to the control participant’s increase in activity. These same differences were also reported between those with BPD and controls
between right dorsal regions of the amygdala and regions consistent with the orbitofrontal cortex (OFC; Brodmann areas 11 and 47; New et al., 2007).

Another study investigated differences between the responses of revenge were investigated between those with BPD (albeit also having co-morbid intermittent explosive disorder) and controls were compared in a social monetary exchange task (New et al., 2009). Participants were told that they should aim to get as much money for themselves, but that their partner is also aiming to get as much for themselves too. Participants were informed that this partner was sitting in a different room. However, this partner was actually only virtual in nature. Unbeknownst to the participants, the actions of the partner were pre-programmed to act in a provocative and non-provocative way, based on the options in the task. For instance, during the task, participants were able to press one of three buttons where they could ignore provocations, retaliate, or protect themselves. Pressing the first button 100 times earned the participants a point; pressing the second 10 times took a point away from their partner; and pressing the third once gave the participant protection from their partner taking points off of them for a period of time. Consequently, the participant’s partner could also take these three options. Results indicated that both participants with BPD and control participants reported an increased level of retaliation between provocation and non-provocation conditions. However, those with BPD responded more aggressively than control participants in both the non-provoked and provoked conditions. Therefore, it was concluded that participants that suffered from BPD behaved more aggressively than control participants (New et al., 2009).

When provoked, those with BPD reported to have greater amygdala response to control participants when comparing the change in response between the provocation and non-provocation conditions. In addition to this amygdala hypersensitivity, those with BPD had a greater OFC response change in the provocation condition when compared to the non-provocation condition, whereas controls reported a decreased OFC response change between those two conditions. When coupled with the behavioural results, in which those with BPD were more aggressive in both the provoked and non-provoked conditions, this suggests that those with BPD have tendencies to react in accordance to amygdala responses and this could be initiated by OFC activity differences. That is, higher OFC output may fail in
“putting the brakes” on amygdala responses for which those with BPD have difficulties doing (New et al., 2009).

1.5.2 Dissociation and BPD

As originally coined and investigated by Pierre Janet near the turn of the 20th century (van der Hart & Horst, 1989), dissociation can be defined as “a disruption of/or discontinuity in the normal integration of consciousness, memory, identity, perception, body representation, motor control, and behaviour” (APA., 2013). Consequently, good examples of dissociative phenomenon include cognitive failures, such as failures in attention; daydreaming; flashbacks (Giesbrecht, Lynn, Lilienfeld, & Merckelbach, 2008); feelings that one is detached from, or that one is an outside observer of one’s mental processes or body (such as in depersonalisation disorder; Sierra & Berrios, 1998); as well as the identity or ‘personality’ switches witnessed in a condition known as dissociative identity disorder (APA., 2013). These such examples of dissociation bring reference to notions that dissociation can be described and investigated as a one dimensional concept, but also multidimensionally, as many authors believe that experiences of derealisation, depersonalisation, and psychogenic amnesia are characteristic of dissociative processes (Giesbrecht et al., 2008).

High rates of dissociation are reported in the aftermath from living through traumatic experiences, such as sexual assault, physical assault, and the death of a family member (Kihlstrom, 2005). It is widely believed that dissociation develops from trauma (Bremner, 2010; Giesbrecht et al., 2008; Kihlstrom, 2005; Merckelbach & Muris, 2001), but clinical cases of dissociation have been found without a history of trauma (Kihlstrom, 2005) and dissociation has been shown to occur in the general population (Ross, Joshi, & Currie, 1990, 1991; van der Hart & Horst, 1989). Therefore, current views suggest that trauma does not necessarily directly cause maladaptive levels of dissociation, but is propagated from the development of dissociation congruent thought processes that alter subsequent behaviour (Giesbrecht et al., 2008; Kihlstrom, 2005; Merckelbach & Muris, 2001), which can be mediated by trauma (Giesbrecht et al., 2008). Consequently, this view can explain why there are different levels of dissociation found in the general population, because dissociation has been suggested to be a coping mechanism that could be used by anyone in society (Ross et
that is commonly associated with trauma scenarios (Kennedy et al., 2004; Pica, 1999; van der Hart & Horst, 1989).

Based on Pierre Janet’s studies with patients with hysteria, dissociation was associated with a compartmentalisation of consciousness and attention. Whereby an individual always has a consciousness, but two or more systems of consciousness can become active separately from each other at different times. Therefore, dissociation was referred to as a ‘splitting off’ or isolation of psychological regulating systems. Where, the ‘splitting off’ of consciousness came from using distraction (i.e., suppressing personal consciousness; van der Hart & Horst, 1989) or repression (Kihlstrom, 2005) as a defence mechanism against overwhelming trauma. Subsequently, this loss of personal consciousness results in amnesia (van der Hart & Horst, 1989). Dissociative symptoms are thought to propagate through automatic freezing, analgesia, and emotional numbing. Where, once invoked the first time, individuals start to use dissociation as a habitual coping mechanism, even from the presence of a minor stressor (Giesbrecht et al., 2008).

The link that BPD has with dissociation is blatantly detailed in diagnostic criteria, which makes reference to depersonalisation symptoms (APA., 2013). With regard to BPD behaviour, studies have reflected strong associations with dissociation using self-report measures and diagnostic interviews (Johnston, Dorahy, Courtney, Bayles, & O’Kane, 2009; Korzekwa, Dell, Links, Thabane, & Fougere, 2009), and this could be mediated by high rates of experiencing childhood physical and sexual abuse (Herman et al., 1989; Zanarini et al., 1997).

1.6 Mentalisation

According to a review, mentalisation refers to a form of social cognition that helps individuals interpret human behaviour as a function of intentional mental states (e.g., their needs, desires, feelings, beliefs, goals, etc.; Fonagy & Luyten, 2009). Hence, this indicates that we understand that other people have different thoughts and emotions to our own, and that they are in control of their own behaviour. Understanding what someone else is thinking requires reading the environment for clues (such as reading body language - which
is also influenced by our own perspective), all of which are compared together to produce the final outcome of our interpretation of what another person’s thoughts and feelings are (Gallagher & Frith, 2003). Mentalisation is the more expanded name given to the contemporary Theory of Mind (ToM) processing which were argued to be too narrow. For instance, ToM has traditionally focussed on false-belief tasks to reflect these thought processes (Allen & Fonagy, 2006). That is, if we both know the location of an object and understand that someone else thinks that object is somewhere else, we would expect that person would go to the location that they think the object is, not the location that we know it is (Gallagher & Frith, 2003).

Mentalisation has been suggested to consist of four different elements. For instance, mentalisation relates to the interpretation of the self and of others, such as being able to identify between one’s own thoughts and feelings and those of others. Additionally, mentalisation can refer to internal and external elements, whereby one can focus on internal thoughts, feelings, and experiences, or on physical and visible features, or actions of oneself or others. It can refer to cognitive and emotional mechanisms. For instance, the cognitive mechanism refers to the ToM, agent-attitude-proposition, such as “mother believes johnny took the cookies”. Whereas the emotional mechanism refers to an empathising system that uses self-reflective state-propositions, such as “I am sorry you feel hurt by what I said”. Whereas the final element of mentalisation relates to a controlled or automatic process, whereby the former seems to be a slower process, and the latter seems to be quicker (Fonagy & Luyten, 2009). Overall then, the ideal mentaliser is someone who not only passes mentalisation tasks (i.e., false-belief tasks) but is also someone who can see connections between thoughts, emotions, and desires of themself and others (Allen & Fonagy, 2006; Fonagy & Luyten, 2009). Yet, these behaviours have to be learnt because humans are immature at birth (Brüne & Brüne-Cohrs, 2006).

According to a review (Brüne & Brüne-Cohrs, 2006), it is upon the accomplishment of particular stages of development where someone begins to understand differences within and between the mental processing states of themselves and others (emotions and cognitions). Metaphorically, this can be viewed similarly to a child who cannot jump before they walk, and walk before they crawl. Around the age of 14-18 months, a child begins to
understand the mental states of desire, intention, and the relationship between a person’s emotions and goals. However, it is only by the age of 3-4 years, when a child can distinguish between his or her own and others’ beliefs and knowledge of the world. Children between 5 and 6 years can hold the belief that others can have a belief about another person’s beliefs. However, there remains to be some instability in understanding false-beliefs at this age. Those below the ages of 6 to 7 have difficulties in their ability to go beyond the literal meaning of a sentence, such as distinguishing between lies from jokes, and when irony and sarcasm are used (Brüne & Brüne-Cohrs, 2006).

By the ages of 9 to 11, more advanced processing of other’s mental states start to reliably establish themselves. These more advanced processes include phenomena known as a ‘faux pas’, which is exemplified when, in a group of three people, one detects that another person does not realise that they said something they should not have said. This latter ability is more complex because it involves the processing of two mental states: the mental state of the person who committed the ‘faux pas’, and the mental state representing the person that may have been hurt by what was said (Brüne & Brüne-Cohrs, 2006).

The development of mentalisation can also be demonstrated via the formation of “scripts”. That is, through repeated experiences of an event, we establish expectations of how one should behave and how others should behave in that specific situation. For example, when we go to a restaurant, we expect to wait to be seated, read the menu, order food... pay for the meal at the end of the night (Gallagher & Frith, 2003). This expectation is referred here as a script, and this seems to liken to concepts of a schema (Eysenck & Keane, 2010). Overall, the gradual development of mentalisation and schema development provide some interesting ramifications for behaviours that are associated with BPD, particular when childhood attachment difficulties are considered.

1.6.1 Mentalisation in BPD

When referring back to the core components that make up mentalising (Fonagy & Luyten, 2009), recent theories suggest that when those with BPD have difficulties mentalising because of a greater utilisation of using automatic, exterior, emotional, and self
mechanisms. Therefore, those with BPD discount internal indications to understand mental states, and are reliant on reading physical and visible signs, gestures, or actions to understand other mental states, which those with BPD are hypersensitive to. Similarly, those with BPD tend to have difficulties differentiating themselves and others, but rely on emotional decision making, which relate to the utilisation of quicker, more instinctual, but poorer mentalisations (Fonagy, Luyten, & Bateman, 2015).

A more integrated model suggests that the attachment system has a low threshold, is hyper-sensitised, and is triggered too frequently, leading to the consequential deactivation of the attachment system (Fonagy & Bateman, 2006). By doing such, individuals with BPD are naturally more prone to strive for a rapid progression of intimacy, far faster than one might expect. Hyperactivity of the attachment system removes a normal emotional boundary between self and others, generating an entangled and preoccupied relationship, whilst also removing the need to assess a partner’s social validity. Therefore, the excessively positive view of another partner in the initial stages may reflect the suppression of negative relationship-specific emotions and the inability to integrate cognitions and emotions. The emotion instability featured in BPD, may be a consequence of a rebound effect of the hypersensitive attachment system, accounting for violent anger outbursts and interpersonal suspiciousness. Such difficulties are believed to surmount from a dysfunctional development of the attachment system, but also working in combination with later traumatic events in an attachment context. Therefore, the capacity to mentalise in the attachment setting generates substantial anxiety for those with insecure attachment or traumatisation experiences. This creates a cycle between heightened attachment, increased decoupling of mentalisation, and increased vulnerability to further interpersonal trauma (Fonagy & Bateman, 2006). In association with attachment insecurities, difficulties in mentalising for those with BPD are influenced by emotions themselves too, which impact on their sense of self.

With regard to emotions, it is believed that internal mentalisations develop in infanthood by associating external signs of emotion and processed according to reflection or mirroring from a caregiver. For instance, for an infant to associate their experience of happiness with a smile, the caregiver would smile back at the child in an exaggerated way.
When this is not consistently done, an infant is not able to ‘label’ their own internal state. If someone fails to label their internal emotional states via mirroring in the first 6 months of life, that person will be more inclined to experience substantial confusion of their emotional state of mind and sense of self (Fonagy & Luyten, 2009). As previously reported, difficulties in understanding between one’s emotional states have been reported in BPD (Carpenter & Trull, 2013).

On a cognitive level, traditionally, toddlers believe that things that they know or have just been taught are shared cultural knowledge available to every other person. Toddlers will therefore believe that there is nothing unique about their own thoughts and feelings. Whilst keeping in mind the difficulties in developing mentalisation elements for those with BPD, those with BPD also describe an expectation that others will perceive a shared event or situation in the same way that they do. Therefore, others are expected to know what they are thinking and feeling (Fonagy & Luyten, 2009), and when self-other associations are placed in jeopardy (Fonagy & Luyten, 2009), it can lead to a sense of identity confusion, and means that those with BPD cannot see that they are contributors to their own actions (Fonagy & Bateman, 2007).

Further to this, those with BPD report to struggle to maintain a self-identity because of difficulties establishing a sense of selfhood when growing up (Fonagy & Luyten, 2009). Instead, someone with BPD are more prone to internalise a care-giver or abuser as part of themselves, whereby someone with BPD can see themselves as rotten to the core or permanently damaged (Fonagy & Bateman, 2007; Young, Klosko, & Weishaar, 2003). Therefore, a number of influences are reported in BPD that could relate to subsequent difficulties in shaping identity and mentalisation. Of which, these mentalisation difficulties report to create substantial complications for those with BPD in relationships, as stress appears to relate to the utilisation of quicker, instinctual mentalisation processes.

With this said, those with BPD report to perform as well as control participants in mentalising tasks under low stress, but they cannot explain their experiences when under high stress within attachment contexts, showing confusion when under reflex. Hence, when under relationship stress it appears that a higher order mentalisation is decoupled, and taken over by instinctual, fight-flight-freeze mentalisation processes (Fonagy & Luyten,
In other words, those with BPD report to have an impaired mentalising ability, but seemingly only in the context of intimate relationships, in which an individual’s depiction of mental states accurately appears to unravel (Fonagy & Bateman, 2006; Fonagy & Luyten, 2009). It is this reflexive, identity confused mentalisation that can explain the triggering of intense emotional reactions experienced by those with BPD when signs of abandonment are read with an intimate person, as it is expressed through an automatic and not controlled form (Fonagy & Luyten, 2009). Despite suggestions indicating an intact mentalisation ability exists for those with BPD outside of relationship and intense daily stress, there is some evidence suggesting that more lower mentalising components could be impaired in those with BPD.

With regard to cognitions, inappropriate reflection from caregivers (Crowell et al., 2009; Fonagy & Luyten, 2009) could also lead someone into failing to realise their behaviour have violated social norms, as suggested for those with BPD experimentally. For instance, one study investigated co-operation between those with and without BPD, by using a task that involved a series of monetary exchanges between the participant and the partner in the task (King-Casas et al., 2008). The idea was that participants were required to get as much money for themselves, yet maintain a level of co-operation with their partner as that would mean participants could get more money in the long run. In order to maintain co-operation, the participant was required to utilise ‘coaxing’, whereby participants could encourage co-operation by handing over more to their partner than themselves from time-to-time. Therefore, transfers of little money to the partner could be described as a break in co-operation. Results from this study indicate that those with and without BPD transferred the same amount at the start of the task, but those with BPD ended up transferring little in the second half of the task and this differed from controls who maintained co-operation. Therefore this indicates that those with BPD were more inclined to break co-operation. Further to this, when comparing between high and low participant repayment, results suggested that those with BPD did not realise they broke a social norm, as those with BPD reported insula cortex inactivity when compared to controls. The insula cortex has been associated with pain perception, uncertainty of decision outcomes, and violation of social norms. Hence, because evidence suggests that those with BPD are reinforced by monetary rewards, it was deduced that those with BPD did not realise their social norm violation.
because uncertainty of decision outcomes was deemed uninfluential (King-Casas et al., 2008).

Another study compared those with BPD to controls on cognitive and emotional elements using empathy in ‘faux pas’ stories of strangers. Results suggested that those with BPD were less able to detect the cognitive elements that made up the stories (Harari, Shamay-Tsoory, Ravid, & Levkovitz, 2010). Another study implicated differences in cognitive perceptions regarding interpreting emotions from images of eyes. When presented with only pictures of people’s eyes, those with BPD reported as accurate as control participants, however those with BPD reported to have a much greater confidence in their ability to detect someone’s emotions in the pictures (Schilling et al., 2012). Despite not necessarily being a difficulty per se, this latter study highlights differences in thought processes outside intimate relationships.

Overall then, although mentalisation reports to only be problematic in intimate relationships, there is evidence and suggestions that potential detriments can also exist outside the attachment context (Harari et al., 2010; King-Casas et al., 2008). Perhaps then, this suggests that those with BPD have an impaired ability in self-reflective state-propositions, according to both an empathy and cognitive agent-attitude-proposition system. These perspectives line up with previous notions that those with BPD have difficulties in forming, explaining and managing emotions (Carpenter & Trull, 2013; Crowell et al., 2009) and expecting that others know what they are thinking and feeling (Fonagy & Luyten, 2009). Together this suggests that those with BPD would have difficulties with interacting with others. However, there is a study which has suggested those with BPD have an improved ability at reading the intentions of others.

One study (Franzen et al., 2011) investigating the ability at reading the intentions of others used an experimental design whereby the participants started with all of the money, and were asked to transfer an amount to four partners that were presented to them, one at a time. Considering each partner was presented 9 times each, the participants were able to identify, overtime, which ones were trustworthy and which ones were untrustworthy. Trustworthiness for each of the partners, in this task, was determined by the overall amount of reciprocation from each of the partners. Therefore, partners transferring money adding up to less than what the participant originally started with was considered as an indication
of untrustworthy behaviour. Synonymously, when a partner transferred more to what the participant started with could be considered as trustworthy behaviour. Overall, two of the partners in the task were pre-programmed to transfer less, on average, than what the participant had started with, and therefore were deemed to be untrustworthy. The other two partners were pre-programmed to transfer more than what the participant started with, on average, and therefore was deemed to be trustworthy. However, the task also added in additional manipulation in both one of the fair and one of the unfair partners: the inclusion of emotional cues. The idea was to see if any behavioural differences occurred between those with and without BPD in detecting that the greater the extent of the smile meant that the partner would transfer enough money so the participant would end up with more money than what they started with. On the other hand, the inverse was true for frowning faces: the greater the frown the less the participant would get back. In other words, the differences in performance and ability between those with and without BPD in identifying the partner’s intentions from emotional cues were investigated using this task.

Results indicated that both those with and without BPD transferred less to the untrustworthy and more for trustworthy partners without emotional cues. However, only those with BPD transferred more to the smiling faces and less to frowning faces. Therefore this suggested that those with BPD had a better ability reading the emotional cues of the partners than control participants, and therefore had a greater ‘mentalisation’ ability (Franzen et al., 2011). Overall then, because those with BPD reported to be able to recognise the trustworthy and untrustworthy partners of the non-emotional partners, this suggests that those with BPD have an intact cognitive ability in reading others’ intentions, comparable to control participants. However, this task suggests that those with BPD report to interpret emotions differently, and this will need to be discussed given that reading emotional and facial cues is a core component in being able to mentalise (Gallagher & Frith, 2003), which those with BPD report to be sensitive to (Domes et al., 2008). In addition to suggesting that emotional expressions are an important contributor to reading others, such results indicate that differences in attention and, arguably, long-term memory exist between those with and without BPD - further exploration is needed.
Chapter 2: Rationale for the study

2.1 EEG methods

Brain activity, measured via the EEG, records the complex summation of excitatory and inhibitory synaptic electrical potentials from large groups of neurons connected to each other through recurrent networks. The EEG compares the summated electrical activity between an electrode at a point of interest, and at a common “reference” point, whereby the difference in potential allows a comparison of the EEG oscillations within a time frame, or polarity at a time point. The EEG reports to be able to record quick changes in brain activity (in milliseconds), but it is less able to detect the spatial location of that activity. This spatial representation is based on both how closely the electrodes are placed to each other on the surface of the scalp, and the ‘smearing’ of the electrical activity through the numerous layers between the brain and scalp. For instance, if a 20 microvolt difference is detected at a shared time between two electrodes placed 2 centimetres apart, it can said that the smearing effect was roughly 10 microvolts per centimetre. Nevertheless, the ‘smearing’ of electrical potential is something that is difficult to overcome in scalp recorded EEG’s (Nunez & Srinivasan, 2006). On the other hand, functional Magnetic Resonance Imaging (fMRI) provides a correlation between small changes of regional cerebral blood flow and neural activity. Increases in regional cerebral blood flow coincide with blood oxygen level dependence, which means that greater levels of blood-carried oxygen is required by the brain areas that are more active. This blood oxygen level dependence, in turn, provides a difference in the recorded signal between different experimental conditions or stimuli. In comparison to the EEG, fMRI tends to record brain activity quite slowly (the slow, blood oxygen level dependence response only seems to peak at about 5 seconds after stimulus onset). However, fMRI reports to be able to precisely detect where the brain activity is coming from (in the very low millimetre range). In addition to these resolution differences, fMRI technology has the advantage of recording direct brain activity in subcortical regions (Huettel, Song, & McCarthy, 2009), compared to the EEG’s scalp recordings (Nunez & Srinivasan, 2006). However, because subcortical regions can present on the surface of the cortex (Nunez & Srinivasan, 2006), activity from subcortical regions can be measured with EEG technology.
Source localisation

A technique known as Low Resolution Electromagnetic Tomography (LORETA) can provide an indication of the sub-cortical spatial activity of the brain using EEG data (Pascual-Marqui, 2002, 2007; Pascual-Marqui, Michel, & Lehmann, 1994). Generally speaking, LORETA uses a series of mathematical calculations to trace EEG waves, recorded at multiple surface electrode sites, to provide a three dimensional distribution of regional cortical and subcortical brain electrical activity (KEY Institute, 2014; Pascual-Marqui, 2002, 2007; Pascual-Marqui, Esslen, Kochi, & Lehmann, 2002a; Pascual-Marqui et al., 1994). This three-dimensional space is calculated using standardised electrode placements (Jurcak, Tsuzuki, & Dan, 2007) and neuroanatomical Montreal Neurological Institute (MNI) co-ordinates, which are corrected to Talairach space and subsequent Brodmann areas (Brett, Johnsrude, & Owen, 2002). Over time, the original LORETA analysis (Pascual-Marqui et al., 1994) was developed into more comprehensive forms: a standardised (sLORETA; Pascual-Marqui, 2002) and then an exact (eLORETA; Pascual-Marqui, 2007) version.

LORETA was different from its source localisation predecessors due to its ability to produce true three-dimensional, brain electrical potential tomography. LORETA was able to establish this because of its head-wide, ‘smoothing’ algorithms that do not require predetermined knowledge of source regions (i.e., a dipole). The smoothing algorithms are based on the demonstrations in which neighbouring neurons are most likely to activate in synchrony and simultaneously (Pascual-Marqui et al., 1999; Pascual-Marqui et al., 1994).

sLORETA improved on the methods of LORETA by adding in further mathematical equations to account for the independence of actual source activity and measurement noise (Pascual-Marqui, 2002). Finally, eLORETA was improved further onto sLORETA because it implemented more optimal weightings to calculations that represented deeper sources more accurately (Pascual-Marqui, 2007). Further to this, both sLORETA and eLORETA use the boundary element method (a series of mathematical equations) with the intentions to achieve a balance between the simplified spherical models of sourcing electrical potentials, and the complex models that require detailed information on real tissue (Fuchs, Kastner, Wagner, Hawes, & Ebersole, 2002) from a structural template (i.e., Mazziotta et al., 2001). The later versions of LORETA claim to have zero error, which differs from its original version.
which has been validated, even in the presence of noise (Pascual-Marqui et al., 2002a; Pascual-Marqui, Esslen, Kochi, & Lehmann, 2002d).

Independent publications have supported the use of LORETA techniques by revealing predictable brain activity during various tasks (Pascual-Marqui et al., 2002a), with further evidence indicating activation of complimentary brain region activity to that of fMRI activity (Mobascher et al., 2009; Mulert et al., 2004; Olbrich et al., 2009). Furthermore, LORETA techniques have been used to predict seizures from the border of brain lesions (Rullmann et al., 2009), and isolate brain-stem auditory evoked potentials (Fontanarosa, Lasky, Lee, & Van Drongelen, 2004). Therefore, LORETA techniques can be viewed as a reliable means of recording brain activity from deep structures such as from mesial temporal (Zumsteg, Friedman, Wieser, & Wennberg, 2006) and anterior cingulate (ACC) regions (Pizzagalli et al., 2001).

Overall, using different methods, LORETA techniques can produce similar results to that of fMRI. In line with this, it has been suggested that the blood oxygen level dependence signal is essentially a slow time version of electrical neuron activity (Pascual-Marqui et al., 2002a). However, LORETA techniques can analyse both time-point polarity differences and oscillations of brain activity within a time frame (KEY Institute, 2014). These oscillations in brain activity will now be discussed in further depth.

Spectral analysis

Sampled EEG oscillations are typically represented as frequency ranges based on averages made using the frequency spectrum (e.g., gamma, beta, alpha, theta, and delta; Andreassi, 2007; Hanlon, Thatcher, & Cline, 1999; Nunez & Srinivasan, 2006; Thatcher, Walker, & Giudice, 1987). However, although seemingly minor, researchers have used different values to represent these frequencies (cf. Andreassi, 2007; Budzynski, Budzynski, Evans, & Abarbanel, 2009; Niedermeyer & Lopes Da Silva, 1999; Nunez & Srinivasan, 2006; Pascual-Marqui et al., 1999; Sanei & Chambers, 2007; Thatcher et al., 1987). For instance, some report delta EEG oscillations are those between 1.5 to 6.5 cycles per second or Hertz (Pascual-Marqui et al., 1999), whereas others only report delta going up to 4 Hertz.
Furthermore, these frequencies can be further divided into different sub-components, such as alpha being divided into alpha 1 and alpha 2 (Budzynski et al., 2009; Pascual-Marqui et al., 1999). However, some frequencies are divided more than others. For instance, some have divided beta into 2 sub-components (Budzynski et al., 2009), whereas others have used 3 (Pascual-Marqui et al., 1999). These quantification differences will therefore be reported followed by a short discussion of what the most commonly used frequencies have been reported to investigate, outside of the sleep literature.

Theta has been suggested to be quantified according to frequencies within the 4 to 7.5-8 Hertz range (Andreassi, 2007; Budzynski et al., 2009; Niedermeyer & Lopes Da Silva, 1999; Sanei & Chambers, 2007), though some have pushed up the lower bound to 6.5 Hertz (Pascual-Marqui et al., 1999). Hence, popular quantifications of theta frequency reports to be between 4 to 7.5-8 Hertz. Theta is most present when an individual enters into a drowsy state, whereby the prevalence of theta increases. Therefore, theta has been suggested to relate to attention difficulties and when someone is not engaged but rather dissociated. Inversely however, theta is associated with a creative and spontaneous state (Budzynski et al., 2009), including working memory and executive processes (Sauseng, Klimesch, Schabus, & Doppelmayr, 2005).

Alpha has consistently been reported between 8 and 13 Hertz (Andreassi, 2007; Budzynski et al., 2009; Niedermeyer & Lopes Da Silva, 1999; Pascual-Marqui et al., 1999; Sanei & Chambers, 2007). Within which, alpha 1 has been reported to be 8 and 10 Hertz (Budzynski et al., 2009) and 8.5 to 10 Hertz (Pascual-Marqui et al., 1999), and alpha 2 has been reported to be between 10 to 12-13 Hertz (Budzynski et al., 2009), and 10.5 to 12 Hertz (Pascual-Marqui et al., 1999). Therefore, despite subtle differences, alpha 1 and 2 share some general consensus of its frequency quantification. Generally speaking, alpha relates to attention processing (Budzynski et al., 2009; Ray & Cole, 1985), particularly with reference to pain modulation. For instance, decreased amplitudes of alpha have been found in those with anxiety, whereby an elevated central alpha has been associated with emotion regulation problems. Alpha 1 is associated with relaxation and awareness of surroundings, such as the disparity between an eyes-closed and eyes-open condition. On the other hand, alpha 2 is associated with a more generalised attention and awareness, whereby someone is
aware of their surroundings, but holds no focus on a specific thought or stimuli (Budzynski et al., 2009). Further to this, alpha 2 also relates to working memory and executive processes (Sauseng et al., 2005). However, it should also be noted that some evidence suggests that individual differences in these frequencies are also reported, whereby one individual may have a maximum output of alpha activity that is at a higher or lower frequency than another (Goljahani et al., 2012). In comparison to alpha, beta frequencies do not seem to have such a cohesive agreement in their quantification.

Generally speaking, beta reports to be between 13 to 30 Hertz (Andreassi, 2007; Pascual-Marqui et al., 1999), though others have indicated a higher bound of 26 Hertz for beta, in which the next frequency quantification (i.e., gamma) begins at 30 Hertz (Sanei & Chambers, 2007). On the other hand, some have indicated that beta has no higher bound (Budzynski et al., 2009; Niedermeyer & Lopes Da Silva, 1999). Previously mentioned was that beta activity has been segregated into 2 and 3 different components. These segregations could be employed from the distribution and characteristics of such frequencies. For instance, beta 1 reports to be more present in occipital regions than beta 2 and 3, which are reported to be more present in frontal regions. Beta 2 and 3 were segregated based on their physical characteristics: beta 2 appearing with larger amplitudes when compared to beta 3 (Niedermeyer & Lopes Da Silva, 1999).

Some researchers have quantified beta 1, 2, and 3 according to 12.5 to 18, 18.5 to 21, and 21.5 to 30 Hertz intervals, respectively (Pascual-Marqui et al., 1999). Yet, it is also possible to quantify beta as 14 to 19, 20 to 25, and 25 to 30 Hertz, respectively (Niedermeyer & Lopes Da Silva, 1999). Additionally, lower beta has been quantified to occur between 13 to 21 Hertz, whereas higher beta has been quantified between 22 to 35 Hertz (Budzynski et al., 2009). Based on the information presented above, it appears that the best consensus is that beta 1 activity would begin at about 13 Hertz and cease at about 19 Hertz. However, frontal beta between 18 to 22 Hertz has been implication in anxiety states (Niedermeyer & Lopes Da Silva, 1999), and therefore this suggests that a general consensus indicates that beta 1 is quantified between about 13 to 18 Hertz, whereas beta 2 is quantified between roughly 18 to 21 Hertz. Presumably then, this leaves beta 3 being between 22 and 30 Hertz. Generally speaking, increased beta is associated with increased
cognitive effort, irritability, agitation (Budzynski et al., 2009); and therefore emotions (Ray & Cole, 1985).

Overall then, as implicated in the preceding sections, the combination of utilising EEG oscillations and segregated it by particular frequencies allow researchers to investigate general indicators of particular brain processes and developmental differences. As BPD psychopathology indicates developmental differences exist for those with BPD (New et al., 2007; New et al., 2009) and with childhood abuse experiences (Teicher et al., 2003), such techniques will be most helpful to discover these differences. The difficulty lies in being able to control for the impact that medications and drugs have on these select frequencies (Banoczi, 2005; Niedermeyer & Lopes Da Silva, 1999; Sanei & Chambers, 2007).

2.2 Neurobiology of the trust task

Mentioned in earlier sections was that those with BPD tend to be able to mentalise as well as controls when not under a high level of emotion (high daily and especially relationship stress; Fonagy & Luyten, 2009), despite having minor issues in some mentalisation processes (Harari et al., 2010; King-Casas et al., 2008). However, one study found that those with BPD were better than controls at reading the intentions of others, specifically with emotional facial expressions (Franzen et al., 2011). Having a greater vigilance to social cues of threat and social rejection (Domes et al., 2009), long term memory processes could be occurring for those with BPD in the trust task based on expectation (Gallagher & Frith, 2003). For instance, previous sections have described the motivation (Agrawal et al., 2004; Young et al., 2003) that those with BPD have in establishing an intimate, partner relationship (Fonagy & Bateman, 2006) from unresolved childhood needs. This in turn leads someone towards thinking that others will leave and abandon them, just like what was experienced in childhood (Agrawal et al., 2004). Because such mentalisation processes have been suggested to be driven by activation of the attachment system (Fonagy & Bateman, 2006), the thought processes in BPD (Agrawal et al., 2004; Young et al., 2003) likens to a ToM script (Gallagher & Frith, 2003). In other words, these experiences are so strongly internalised for someone with BPD that they evolve into self-defining, autobiographical memories, as has been implicated to be more greatly accessed (Jørgensen
et al., 2012; Schnell, Dietrich, Schnitker, Daumann, & Herpertz, 2007), and accessed more quickly (Baer, Peters, Eisenlohr-Moul, Geiger, & Sauer, 2012) by those with BPD. When this attachment script is activated, someone with BPD is more at risk of losing their mentalisation ability, but only in the attachment setting (Fonagy & Bateman, 2006).

However, because reading non-verbal cues is an important aspect in mentalisation (Gallagher & Frith, 2003), someone with BPD may become more vigilant to social cues of threat and rejection (Domes et al., 2009) because of caregiver interactions (Crowell et al., 2009; Fonagy & Luyten, 2009; Linehan, 1993). In particular, evidence of this existing outside the attachment setting may have been reported by reports that those with BPD are more sensitivity in learning to pick out the emotional cues compared to controls (Domes et al., 2008). Arguably, this also occurred in the trust task by Franzen et al (2011), perhaps as a more global representation of the mentalisation-attachment system (Fonagy & Luyten, 2009). In keeping true of this script perspective, being more vigilant to social cues of threat and rejection (Domes et al., 2009) could underlie the responses to the angry faces in the trust task. After all, the angry face does represent a hostile cue (Franzen et al., 2011). Similar expectations could be occurring for the smiling faces in the trust task. However, unlike with a threat cue, perhaps those with BPD are more salient to ‘positive cues’ from histories of being compelled or dependent to follow others and suppress their own thought processes (Linehan, 1993; Young et al., 2003), and therefore notice and transfer more to the smiling faces in the trust task (Franzen et al., 2011). Perhaps these processes could be viewed even more so, if someone collects information on the trustworthiness of others (Young et al., 2003) and if someone with BPD internalises a care-giver or abuser as part of themselves (Fonagy & Bateman, 2007; Young et al., 2003). If these aforementioned processes commonly occur in BPD, it suggests that those with and without BPD would likely allocate different processes in attention and memory to interpret and retain untrustworthy behaviour, during mentalisation.

The ideas stipulated above suggest that numerous processes can be occurring for those with and without BPD in the trust task (Franzen et al., 2011). Even though the trust task involves an investment, feedback, and evaluation phases, every phase of the trust task, for each partner, involves the utilisation of a participant to use their knowledge and
memory (or lack of knowledge and memory) of previous presentations to decide if they are trustworthy or not. Therefore, each phase of the trust task would associate with memory encoding and retrieval processes. With specific reference to the trust task, this trustworthiness would be based on the previous (or lack of previous) interactions with each emotion cue (smiling, frowning, or none at all) and identity (partner 1 through 4). During the feedback phase participants have a chance to associate the amount they gave, their partner reciprocated, what partner it was, and if they had an emotion cue. For example, during the feedback phases, participants have a chance to associate that a smiling face relates to more money for them. Through this association, ideal performance in the trust task would relate to learning that they should transfer more money for a smiling face next time. The evaluation phase would then act to facilitate this learning, association, and behaviour correcting process. Hence, at each of these time-frames a participant has the opportunity to link and associate the partner reciprocity with the characteristics of the image (i.e., emotional cue or not and partner identity), and this has a memory retrieval and encoding element overtime. For this reason, neurobiological measures may be useful in narrowing down what is occurring in the trust task for participants.

2.2.1 Emotion recognition

As discussed by a review (Domes et al., 2009), interpreting the facial cues of others is important in understanding the thought processes of another and in social interactions. This is because sufficient abilities in interpreting facial cues are deemed vital in social situations, as they promote trust, empathy, and pro-social behaviour (Domes et al., 2009). Neuroscience literature purports that brain areas involved in face perception include the extra-striate cortex, fusiform gyrus, superior temporal sulcus, and then areas that modulate the core system. Modulating areas include those important for attention, memory, and emotion, such as the ACC, the hippocampus, the insula, and the amygdala. Consequently, these modulating areas suggest that emotional processing can disturb cognitions: attention, working memory, and inhibition (Domes et al., 2009). Although non-clinical studies have failed to consistently reflect amygdala activity in emotional recognition paradigms (Esslen, Pascual-Marqui, Hell, Kochi, & Lehmann, 2004), those with BPD have reported increased amygdala activity in reaction to static images of other people’s faces, regardless of whether
they were emotional or completely neutral (Donegan et al., 2003). These results occurred in both the right and left amygdala, but activation appears to be greater in the left amygdala (Donegan et al., 2003). However, this lateralisaton may have been influenced by developmental differences in emotional processing, whereby females report greater left amygdala response and males report a greater right amygdala response (Cahill, Uncapher, Kilpatrick, Alkire, & Turner, 2004; Gasbarri et al., 2007). However, more information can be useful in identifying regions of interest in accordance to specific emotions.

Using source localisation techniques, happy faces (in a happy – neutral comparison) were associated with activity in left and right frontal regions between 138 - 205 milliseconds. Whereas the 244-290 millisecond time point was associated with activation in the left and right vmPFC and temporal areas, as well as right parietal regions. Then, between 361 – 467 milliseconds, activation was recorded in the ACC and in right frontal areas. Angry faces (in an angry – neutral comparison) were associated with activation in the right inferior frontal lobe (lateral OFC), and a trend of activity in the medial superior frontal gyrus between 349 – 431 milliseconds. Right pre-frontal cortex activity (Brodmann area 10) was also found on the presentation of angry faces between 452 – 467 milliseconds (Esslen et al., 2004).

2.2.2 Neurobiology of mentalisation

Generally speaking, core ToM ability has been suggested to be representative of activity in the anterior-paracingulate cortex (Gallagher & Frith, 2003), which has also been implicated in self-referential processing of the state of oneself (Fonagy & Luyten, 2009; Murray, Debbané, Fox, Bzdok, & Eickhoff, 2015), but also others’ states (Fonagy & Luyten, 2009). This said, some researchers have proposed that the intra-parietal lobule/temporal-parietal junction/angular area is also involved in processing of the states of oneself too (Abu-Akel, 2003) though others have suggested that this area relates to the processing of both self and other states (Fonagy & Luyten, 2009). Processing the states of others, on the other hand has been reported to relate to processing in the posterior cingulate cortex (Murray et al., 2015) and the superior temporal sulcus (Abu-Akel, 2003). Other areas are reported to aid this ToM ability by processing object and face recognition and memory, such
as the temporal lobes (Fonagy & Luyten, 2009; Gallagher & Frith, 2003) and the medial prefrontal cortex (Fonagy & Luyten, 2009), possibly for decision making (Fellows & Farah, 2007; Volz, Schubotz, & Von Cramon, 2005).

Another area of delineating the neurobiology of mentalisation is based on automatic and controlled mentalisation (Fonagy & Luyten, 2009). Controlled mentalisation reports to be represented by lateral and medial pre-frontal and parietal regions, medial temporal lobe, and rostral ACC activity. Such areas have a greater role in processing linguistic and symbolic information. On the other hand, automatic mentalisation is reported to reflect processing in amygdala, basal-ganglia, ventro-medial pre-frontal cortex, lateral temporal cortex, and dorsal ACC. Hence, such areas rely more heavily on sensory information. Automatic mentalisation is implicated in BPD as those with BPD when under high levels of stress, especially relationship stress (Fonagy & Luyten, 2009).

In people with BPD, previous notions suggest that orbitofrontal influence is low and amygdala influence is high in BPD when under distress and provocation (New et al., 2007; New et al., 2009). Considering the key role of the ACC in mentalisation (Gallagher & Frith, 2003) and also the role of the OFC in ‘putting the brakes’ on emotions (New et al., 2009), it is beneficial to discuss the role of such areas.

**Role of the ventro-medial pre-frontal cortex**

According to a review (Rolls & Grabenhorst, 2008), it is possible to think of the OFC as an area involved in the reception of information from each modality-specific “what” cortical pathway. For instance, visual information is routed to the OFC from the inferior temporal cortex and superior temporal sulcus. The inferior temporal cortex is involved in processing object and facial identity, whereas the superior temporal sulcus is involved in processing face expression and gestures. The caudal OFC receives input from the amygdala, amongst other areas. The OFC projects back to temporal lobe regions, to the ACC (Rolls & Grabenhorst, 2008), prefrontal regions for decision making (Fellows & Farah, 2007; Rolls & Grabenhorst, 2008), and entorhinal and perirhinal cortex to send reward information to the hippocampus (Rolls & Grabenhorst, 2008). Therefore this area is highly interconnected.
More importantly, the OFC features error neurons and is involved in reward expectation and processing (Rolls & Grabenhorst, 2008). For instance, in tasks involving reward, neurons in the OFC stimulate in response to rewarding stimuli and decrease activity in response to stimuli that do not reward. Similarly, in aversive tasks, error neurons in the OFC report to stimulate in response to detecting error. For this reason, the OFC responds to a wide array of stimuli, including facial expressions important to social reinforcement, however real faces elicit better responses to substitutes (Rolls & Grabenhorst, 2008).

The ACC is thought to have similar reward-error responses to the OFC, but the ACC has a greater role when rewards are obtained (or when rewards are lowered) or errors are made, and therefore a greater role in helping the action system correct itself and change someone’s expectations and behaviour (Rolls & Grabenhorst, 2008). The differences between the OFC and ACC is vital in understanding mentalisation ability, particularly regarding controlled and automatic mentalisation stated earlier (Fonagy & Luyten, 2009). In particular, a meta-analysis looking at decision making in cognitive and emotional tasks suggests that the ACC can be split in half based on a ventral emotion and dorsal cognitive processing division (Bush, Luu, & Posner, 2000). Regarding the trust task, it may therefore be possible to establish whether participants are using cognitive or emotional decisions.

Depending on the modality (cognitive or emotional), ACC activity would therefore represent mentalisation processing (Gallagher & Frith, 2003) as an indication of the action system correcting itself via establishing expectation via trial and error methods during a trust task. Hence, a learning process at these time points would hypothetically relate to a variation in activation of the ACC within the first and second half of the trust task, reflecting someone that is correcting behaviour, or those that are having difficulties doing so. For instance, once a partner’s fairness has been identified decreases in ACC activity in the second half of the task may be expected (Rolls & Grabenhorst, 2008). Therefore, activity in the ACC when mentalising may be helpful in gauging whether those with BPD had an improved ACC driven mentalisation ability in the trust task (Franzen et al., 2011).
One study looking at grey matter density in BPD reported that those with BPD had a lower density in the cognitive regions of the ACC when compared to healthy controls (Hazlett et al., 2005). However those with BPD had significantly higher levels of white matter to medial frontal regions (Brodmann area 9; Hazlett et al., 2005). However, these differences may not as strong earlier in the condition when compared to controls, because only right OFC grey matter differences were found during the late teenage years where participants first presented with BPD symptoms (Chanen et al., 2008). Nevertheless, Chanen et al still presented evidence that the OFC-ACC network is and could be compromised in BPD. It could also be possible that functional as opposed to structural differences could be occurring, which the error-related-negativity may be helpful with.

The error-related-negativity is a negative potential that peaks 100 milliseconds after the detection of error in a response (i.e., button press). This negativity then turns positive and lasts a further 300 milliseconds. Overall, this potential is typically epoched 200 milliseconds prior to a participant response through to 600 milliseconds post response (Bush et al., 2000). However, a study that investigated the theta oscillations associated with the error-related-negativity epoched at between 500 milliseconds before and after the stimulus (Trujillo & Allen, 2007). Importantly, error-related negativity has been suggested to be a direct representation of the ACC’s role in processing errors (Bush et al., 2000). Even though, some have suggested that the error-related negativity relates to conflict monitoring and comparison (Botvinick, Cohen, & Carter, 2004; Bush et al., 2000; Falkenstein, Hoormann, Christ, & Hohnsbein, 2000), this has been challenged back to errors (Burle, Roger, Allain, Vidal, & Hasbroucq, 2008). Importantly, reports indicate that those with BPD have a less efficient error-related negativity response when compared to healthy controls (Ruchsow et al., 2006).

Overall, the anatomical and processing issues with the ACC that are reported to exist for those with BPD (Hazlett et al., 2005; Ruchsow et al., 2006) compared to controls provide support to the claims that the results for those with BPD in the trust task may be more due to a script-based, long term memory process rather than a core ACC-driven mentalization. However, it is important to note that the error-related negativity cannot be directly implicated in a trust task, whereby a participant does not know beforehand which partners
are trustworthy. Instead, the error-related negativity is able to provide an indication into when participants reflect on the validity of the responses they make, and therefore provide a window of time to investigate these reactions upon learning of a partner’s trustworthiness. The time when a participant decides how much to transfer to each partner could be interesting at investigating mentalisation and error mismatch processes. Additionally, because the trust task relies on using a +/- 90 as an indicator of winning and losing in the feedback phase, this time point could also be a moment of interest to investigate error mismatch.

Eluded above, are suggestions that a split-half (i.e., looking at the first half and second half of the trust task) analysis is ideal for the trust task, which could be expected to yield an ACC correction response because of learning overtime. However, it is important to note that this method creates a relatively small amount of EEG epochs for analysis; especially if happy and angry faces are analysed separately, which would be ideal because of differences in emotion recognition. For this reason, it may be unlikely to expect reliable results from these comparisons because of a small amount of EEG epochs and EEG epoch length. For these reasons, this study is reliant on time-frequency analysis methods (Event-Related-Oscillations) that do not rely on as large amount of epochs compared to Event-Related-Potential methods (Herrmann, Rach, Vosskuhl, & Strüber, 2013).

Time-frequency methods have been used to measure brain development changes using 16 seconds of resting state EEG data (Hanlon et al., 1999; Thatcher et al., 1987). In fact, 10 seconds of EEG data has been able to distinguish differences between groups with time-frequency analysis methods (Hopper et al., 2002). If this 10 second point is used as an indication of the minimum of EEG data required for EEG analysis, then epoch length and analysis methods are restricted to allow for reliable interpretation. Given one second epoch lengths has been used in the past for time frequency analysis of the error related negativity (Trujillo & Allen, 2007), it may be unlikely to see substantial differences between the split half EEG comparisons. Nevertheless, there is another way to analyse the results.
An alternative, more statistically powerful analysis includes utilising the error and reward salient moments of the trust task in a logical way, forcing an error-related-negativity-like response. For instance, an error-related-negativity-like response is forced if the transfer decision phase are compared and independently subtracted from the feedback and evaluation phases of the trust task. After all, the feedback and evaluation phases is a moment when the participant realises that their partner transferred less or more than the 90 they started with, and so they are forced to retrospectively decipher whether their last transferred amount was a correct or incorrect assessment of the partners fairness - future decisions are thereafter guided by this. Hence, instead of breaking the task in symmetric halves for analysis, select phases can be chosen and compared to investigate specific phenomena from the task. These comparisons could provide indications of general behaviour corrections or partner evaluations for the participants. By doing this comparison, ACC activity could be investigated between and within the emotional and non-emotional face cues, therefore showing if any differences in mentalisation processes exist between participant groups and phenomena. However, if the improved reading ability that those with BPD had compared to controls in the trust task (Franzen et al., 2011) was due to a long term memory process, the neurobiology of memory is necessary to discuss.

2.2.3 Neurobiological indicators of Memory

Declarative memory refers to the explicit, conscious recollection of events and facts, whereas non-declarative memory refers to a system that is implicit, i.e., changing behaviour without one’s knowledge. Declarative memory can further be divided into episodic and semantic processes. Episodic memory pertains to the storage and recollection of specific events or episodes that link to a given place and time, whereas semantic memory relates to general knowledge of objects, words, facts, and people in the absence of a specific time. In other words, they differ according to the personal nature of the memory. Autobiographical memory is memory for one’s own life which differs from episodic memory’s personal experiences or events that happened at a given time in a specific place. Therefore, autobiographical memory has been suggested to define identity, link personal history to public history, support a network of personal goals and projects across the lifespan, and ground the self in experience (Eysenck & Keane, 2010). Different brain regions are activated.
according to autobiographical, episodic and semantic memory, and these affects encoding and retrieval processes.

Autobiographical memory has been linked to numerous brain regions, whereby a specific model has been developed based on evidence (Cabeza & St Jacques, 2007). The ventro-medial prefrontal cortex has been suggested to relate to feelings of rightness and the medial prefrontal cortex has been suggested to relate to self-referential processes. Furthermore, the left lateral prefrontal cortex has been suggested to relate to memory search processes; the hippocampus and retrosplenial cortex involved in recollection, in association with the amygdala; and the occipital and parietal regions involved in visual imagery (Cabeza & St Jacques, 2007). This such model was developed from comparisons between memory specific tasks.

For example, studies have investigating the differences between episodic and autobiographical memory reflect distinct differences between the brain activity associated with autobiographical and episodic memory whereby medial prefrontal (Brodmann areas 10) and OFC were associated with autobiographical memory, which was not the case for episodic memory (Gilboa, 2004). This reports to be different to previous conceptions whereby the role of the medial prefrontal cortex used to be considered to be involved in episodic memory (Cabeza & Nyberg, 2000).

Episodic and semantic encoding are viewed as opposites of the same coin, because individuals try to elaborate meaning of episodic memories from their knowledge. For this reason, it has been suggested that episodic and semantic retrieval processes have a shared activation in the prefrontal cortex (Cabeza & Nyberg, 2000). In addition to this, semantic retrieval is associated with left temporal lobe activity in categorisation tasks (particularly Brodmann area 21). However, unlike for semantic memory retrieval, episodic memory retrieval utilises the dorsal ACC (Brodmann area 32), but also the dorsal posterior cingulate cortex (Brodmann area 31) at a much greater level than semantic memory, as well as activity in parietal regions (particularly Brodmann area 7; Cabeza & Nyberg, 2000). Episodic memory retrieval was associated with decreased ventral parietal activity, related to bottom-up attentional aspects in which memories can be both recalled in less detail and have
difficulties encoding after brain atrophy. In line with this, the parietal cortex has been suggested to mediate the bottom-up processing associated with many cognitive functions, including encoding episodic memory, such as those within ToM tasks (Cabeza, 2008; Cabeza, Ciaramelli, & Moscovitch, 2012a, 2012d). In which, the anterior or mid regions of the posterior cingulate cortex (Brodmann areas 23, 31) have been implicated to be involved in processing pain. Whereas retrosplenial regions, or the most caudal regions of the posterior cingulate cortex, has been implicated in processing emotions (Nielsen, Balslev, & Hansen, 2005).

Having presented memory processes in general, it is interesting that there appears to be a reasonable amount of overlap between areas utilised for memory and mentalisation. Notably, these include temporal regions for semantic, categorisational, long term memory in temporal regions (Fonagy & Luyten, 2009; Gallagher & Frith, 2003), anterior and posterior cingulate regions for episodic memory (Cabeza & Nyberg, 2000; Fonagy & Luyten, 2009), and the middle frontal region for autobiographical memory (Cabeza & St Jacques, 2007; Fonagy & Luyten, 2009). These realisations provide some support, along with the previous reports of impaired error detection, that the performance of those with BPD in the trust task could be related to long-term memory processing, as opposed to an ACC-driven mentalisation. For the moment, it is difficult to ascertain whether a temporal categorical long term memory (inclusive of facial encoding) may best represent the performance of those with BPD in the trust task, or whether a middle frontal, autobiographical memory process could underlie it. For this reason, it is worth exploring the literature on dissociation and childhood abuse, to get an idea of how identity can be affected by life changing (and arguably defining) events and whether they can affect brain development.

2.2.4 Neurobiology of post-traumatic stress and childhood abuse

A person’s brain naturally matures overtime from periods of postnatal overproduction of axonal and dendritic arborisation, synapses and receptors, which is followed by elimination and pruning post puberty (Casey, Tottenham, Liston, & Durston, 2005; Gogtay et al., 2004; Teicher et al., 2003). Studies have indicated that development occurs in cyclic fashion throughout childhood: some areas developing at greater rates and
frequencies than others (Hanlon et al., 1999; Thatcher, 1992; Thatcher et al., 1987), and are different between males and females (Hanlon et al., 1999). If we also consider that abuse can steer normal development onto a different trajectory, it could be viewed that differences in brain development would inevitably occur depending on the time of the onset of abuse, and be different for each sex. For instance, the frontal lobe reports to have substantial developmental periods between the ages of 4 to 6, and, but seemingly less so, at 8 and 12 to 15 (Hanlon et al., 1999). Speculatively, perhaps adverse events occurring before or during these periods could integrate within, or disturb the developmental process, resulting in more severe, maladaptive thinking styles and behaviour, congruent with psychopathology. For instance, earlier adversities are associated with greater levels of current and lifetime psychiatric prevalence (Kessler et al., 2010).

PTSD (Miller, Chen, & Zhou, 2007), as well as emotional dysregulation (Crowell et al., 2009), the loss of capacity to mentalise (Fonagy & Luyten, 2009), as well as aspects of dissociation (Simeon et al., 2007) all can be argued to relate to stress chemicals. According to Teicher et al. (2003) periods of postnatal development are substantially altered from stressful childhoods, via the action of stress hormones which suppress glial cell division important for myelination and therefore have devastating implications on normal developmental trajectories. In general, control participants who did not report experiences of abuse produced evidence that they had a greater development of their left hemisphere compared to those who experienced abuse. A similar trend also reported for the right hemisphere for those with and without a history of abuse. This indicates that those who reported to be abused exhibited substantial lags in development in their left hemisphere (Teicher, Tomoda, & Andersen, 2006). However, some brain regions are more sensitive to stress chemicals than others, in which the hippocampus, amygdala, cerebellar vermis, and the corpus callosum are particularly susceptible to the effects of high level stress (Teicher et al., 2003).

The hippocampus reports to have altering synaptic connectivity with age, inclusive of having specific growth spurts and pruning periods in childhood. The hippocampus is known to play a critical role in encoding and retrieval of episodic information, and has been indicated to relate to dissociative states. The hippocampus has been suggested to play a role
in anxiety, from noradrenergic projections from the locus coeruleus (Teicher et al., 2003). And, the hippocampus also features serotonergic projections from the raphe nucleus affecting behavioural inhibition. Therefore, overall, the hippocampus may relate to the levels of amnesia, dissociation, anxiogenic, and inhibitory dysfunctions in PTSD (Teicher et al., 2003) and also analogously for BPD. Whereas the amygdala, as has been previously noted to be involved in BPD pathology in earlier sections, is a key contributor to aggression, and impulsive behaviour, and can be sensitised from childhood abuse experiences, potentially producing unstable emotions and difficulties regulating them (i.e., seizures from kindling; Teicher et al., 2003).

The corpus callosum is one of the sensitive areas implicated to be affected from childhood abuse. The corpus callosum forms the bridge between the two cerebral hemispheres of the brain, and therefore it is crucial in transmitting contralateral brain signals. Generally speaking, the left hemisphere is involved in perception and the expression of language and logical thought, whereas the right hemisphere is involved in the expression of emotion. The left hemisphere is usually more complex in its development and appears to be involved in a greater array of tasks. However, communication between both the right and left hemispheres reports to be paramount, and therefore the weak corpus callosum integrity can be particularly devastating to neural communication. In line with this, high levels of stress appear to suppress glial cell division and therefore affect the number and growth of myelinated axons in the corpus callosum. Such deficits have been investigated by studies utilising probe auditory evoked potentials, which has been used as a measure of hemispheric lateralisation. In short, these studies report lateralisation by revealing attenuated amplitudes when the participants actively engaged in a hemisphere-specific task. For instance, marked decreases in amplitudes in the left hemisphere was found for those with a history of trauma for neutral memories, and this was similar for evoked potentials in the right hemisphere for emotionally disturbing memories. Consistent with the view that abuse can disrupt hemispheric connectivity, control participants reported bilateral activation when recalling both neutral and emotional memories (Teicher et al., 2003).

Overall, studies have reported that abuse leaves a severe imprint on the development of the brain when comparing between those who experienced trauma in childhood versus adulthood, in which childhood trauma leaves a more severe imprint (Cook,
Ciorciari, Varker, & Devilly, 2009). Empirically, however, studies have typically compared between individuals that have and have not experienced childhood abuse, revealing the severe imprint that abuse has on development (De Bellis et al., 1999; Teicher et al., 2003; Teicher et al., 1997).

2.2.5 Neurobiology of brain-wired dissociation

Previously mentioned was that BPD is particularly associated with depersonalisation symptoms (APA., 2013). The link that BPD has with depersonalisation is essential because aspects of dissociation may not share similar aetiological links, as some seem to have greater biological links than others (Giesbrecht et al., 2008). For instance, some forms of dissociation has been suggested to relate to biological mechanisms of fight, flight or freeze stress response systems (Simeon et al., 2007), whereas depersonalisation is viewed as a brain-wired process (Sierra & Berrios, 1998). Knowing that BPD is associated with depersonalisation encourage the view that dissociation in BPD could be manifested by brain development (Sierra & Berrios, 1998).

Importantly, there is evidence that depersonalisation and extreme levels of dissociation have a brain-derived biological base (Reinders, 2008; Reinders et al., 2003; Reinders et al., 2006; Sierra & Berrios, 1998; Simeon et al., 2000). A simplified model suggests that depersonalisation symptoms could manifest from an inhibitory component from the left prefrontal cortex on the amygdala which thereafter inhibits the ACC. Alternatively, an inhibitory role from the right prefrontal cortex is believed to relate to depersonalisation symptoms too. However, this right inhibition is manifested from an excitatory role from the amygdala, through ascending arousal systems, which in turn project to the right prefrontal cortex. Hence, projections to and from the amygdala and the prefrontal cortex could be involved in generating a state of arousal leading to mind emptiness and indifference to pain (Sierra & Berrios, 1998). Indeed, the ACC has a role involved in the attention of, and processing pleasant and unpleasant stimuli (Rolls & Grabenhorst, 2008). If dissociation was used as a continual coping mechanism (Giesbrecht et al., 2008) to the point that it was brain based, like that in depersonalisation symptoms (Sierra & Berrios, 1998), ACC activation may be expected to be reduced in those with
greater levels of dissociation. Nevertheless, other evidence would add interesting insight into the underlying neurobiology associated with dissociative symptoms.

Results from a verbal learning task performed by individuals diagnosed with [the former DSM-IV] depersonalisation disorder (APA., 2000) indicate that the left occipital association areas, superior temporal and fusiform gyrus, as well as the posterior cingulate and somatosensory regions reported to activate differently to controls (Simeon et al., 2000). However, given this study investigated cognition in a verbal learning task, it may not be as relevant as those that pertain to in-the-moment dissociation. Unfortunately, most evidence from in-the-moment, extreme levels of dissociation come from studies investigating DID due to the lack of neurobiological evidence in BPD.

Using a provocation design, patients with DID were presented with traumatic scripts of their own, and other people’s traumatic experiences. The idea was that only personalised scripts would yield the self-defensive mechanism where someone with DID would implement different dissociative states. From this study it was found that brain areas activated differently. Such areas include the right medial prefrontal cortex, bilateral middle frontal gyrus, visual association areas, and bilateral parietal regions. Posterior regions were suggested to activate differently from the personalised trauma script as a representation of the visual and somatosensory processing involved in visualising and feeling discomfort from reliving the trauma. Frontal regions were suggested to reflect the retrieval and processing of the self-concept: episodic and autobiographical information. In addition to this, the insula did not activate in the personalised trauma scripts, perhaps as an indication of the behavioural and emotion dissociation (Reinders et al., 2003; Reinders et al., 2006). Interestingly then, studies on DID (Reinders et al., 2003; Reinders et al., 2006) indicate that right prefrontal connections, perhaps elicited from arousal pathways, are involved in mediating dissociative symptoms (Sierra & Berrios, 1998). Whereby, this right prefrontal activation could result from a personal, autobiographical memory-like, coping-style (Reinders et al., 2003; Reinders et al., 2006). Interestingly, however, differences in activation within the ACC did not reveal (Reinders et al., 2003; Reinders et al., 2006; Sierra & Berrios, 1998), but this can be explained by a cancelling out of emotional processing in those regions between the trauma scripts, in which only autobiographical processing would present.
Regarding dissociation in BPD, the best studies come from studies investigating pain tolerance. A particular study investigated induced temperate pain in those with BPD and controls after being presented with neutral and negative valanced images. Results from this study suggested that a middle frontal-amygdala disconnection for those with BPD could be dependent on a state-based, enhanced emotional sensitivity. This is because the communication break for those with BPD only seemed to occur preceding the negative images (Niedtfeld et al., 2012). This prior, speculated dissociative response can also explain why an increase in communication was found for those with BPD with the pain stimulus when neutral images were presented first (Niedtfeld et al., 2012), as an emotional sensitivity begins to be able to explain the response for the neutral images (Donegan et al., 2003; Herpertz et al., 2001; Teicher et al., 2003). Along with the opposite brain activity trends hinting at a dissociative response, another is hinted at regarding the role of the middle frontal gyrus which has an involvement in attention shifting when experiencing pain and discomfort, using distraction techniques (Niedtfeld et al., 2012) such as when mentally escaping in dissociation (Reinders et al., 2003; Reinders et al., 2006). Additional evidence of a dissociative response in BPD comes from another study where those with BPD reported no activity in the ACC when being presented with emotional ladelled words, in accompaniment with daily stress, which did not occur for controls (Wingenfeld et al., 2009).

When bringing the results presented above back to the original model on depersonalisation (Sierra & Berrios, 1998), it appears that there is some evidence supporting the involvement of the right prefrontal cortex in dissociative symptoms, however its role on the ACC is difficult to ascertain based on the information presented on DID. When paired with the results that those with BPD report to have a break in communication between the frontal cortex and amygdala, one might suspect that an inhibitory role of the right frontal cortex would therefore become more essential in eliciting depersonalisation symptoms (Reinders et al., 2003; Reinders et al., 2006; Sierra & Berrios, 1998). Furthermore, as hinted to from the studies investigating DID (Reinders et al., 2003; Reinders et al., 2006) based on the information from autobiographical processing (Cabeza, 2008; Cabeza et al., 2012a, 2012d; Cabeza & St Jacques, 2007; Gilboa, 2004), it can be argued that these ascending arousal pathways for depersonalisation symptoms (Sierra & Berrios, 1998) would
include the lateral parietal cortex and occipital areas, in particular. This is because these areas are involved in visual imagery, recalling vivid details of an autobiographical memory (Cabeza, 2008; Cabeza et al., 2012a, 2012d; Cabeza & St Jacques, 2007).

2.3 Bio-psychosocial model for BPD with and without trauma reminders

Mentalisation, emotional regulation (including dissociation), autobiographical memory, and childhood abuse, all share common pathways and symptoms regarding self-identity and behaviour control. Therefore, using these, a single model might be able to help explain the phenomena associated with BPD, adapted from Cabeza and St Jacques (2007). As represented in Figure 2.1 below, those with BPD have difficulties controlling their behaviour and emotions because of abnormalities in OFC/ACC activity in reducing adverse emotions from an over-activation of the amygdala (New et al., 2007; New et al., 2009), especially when experiencing high levels of stress (Crowell et al., 2009). Such inabilities could be due to ineffective error and reward processing (Hazlett et al., 2005; Rolls & Grabenhorst, 2008; Ruchsow et al., 2006) developed from difficulties establishing enough nurturance, support and an adaptive level of independence from attachment figures (Crowell et al., 2009; Fonagy & Luyten, 2009; Young et al., 2003), adequate emotion regulation strategies and socialisation learning from role models and/or difficulties dealing intense emotions (Crowell et al., 2009). Because the OFC/ACC is associated with feelings of rightness (Cabeza & St Jacques, 2007) memories and emotional ‘gut’ feelings is established via a lower order emotional reaction (Cabeza & St Jacques, 2007). Such processing would relate to those with BPD having differential attention to, encoding of, and associated retrieval of memories of facial stimuli, as represented by a sensitivity in noticing emotional cues (Domes et al., 2008), negative bias towards them, and even difficulties in reading them (Domes et al., 2009; Unoka et al., 2011).

When specifically considering the social context, the ACC is associated with emotional attention and behaviour correction, both have been implicated to be impaired in those with BPD (Ruchsow et al., 2006; Wingenfeld et al., 2009), which is also implicated in automatic mentalisation processes (Fonagy & Luyten, 2009). Such automatic reactions from OFC/ACC responses influences someone with BPD to act out or internalise in general, but
especially in attachment settings (Fonagy & Luyten, 2009) because of their numerous, negative, ingrained self-defining memories (i.e., schematic scripts) that evolved to become who they are as a person (or rather a confused, disjointed sense of who they are) from internalised views of themselves and others from their experiences, their coping styles (Young et al., 2003); ineffective error reward processes (Hazlett et al., 2005; Ruchsow et al., 2006) and dealing with stress (Crowell et al., 2009; Fonagy & Luyten, 2009; Miller et al., 2007; Simeon et al., 2007) exacerbate these issues.

Self-referential processing is indicated to be associated with activity in the pre-genual anterior cingulate region (Murray et al., 2015) and/or activation of the right prefrontal cortex (Cabeza & St Jacques, 2007; Reinders et al., 2003; Reinders et al., 2006; Sierra & Berrios, 1998), and left prefrontal cortex for relevant semantic information (Cabeza & Nyberg, 2000). Further to this, social situations elicit memory searches initiated by the left DLPFC from the OFC/ACC or right prefrontal cortex, to which hippocampal and retrosplenial regions are involved in processing the recollection of memory detail. This recollection can induce both amygdala activation (and therefore emotions) and the recall of vivid visualisations of those personal memories in parietal and occipital regions (Cabeza & St Jacques, 2007). With the above in mind, when amygdala-driven emotions reach that point, a switch occurs from controlled to automatic mentalisation further leading to the acting out of impulsive or aggressive behaviour and disoriented views of the self (Fonagy & Luyten, 2009); the latter from pre-genual anterior cingulate and/or right prefrontal processing. However, when reaching an overwhelmingly critical point of memory vividness and emotions, such as when provoked by memories of childhood abuse or neglect (Reinders et al., 2003; Reinders et al., 2006), autobiographical coping styles mediated by the right prefrontal cortex initiates a dissociative reaction via altering, switching off or down (depending on the characteristics and severity of the dissociative response) ACC activity (Sierra & Berrios, 1998; Wingenfeld et al., 2009) and visual searches, thereby stopping adverse amygdala output and vivid recollections of events.
Figure 2.1. A diagrammatic representation explaining the mediating interaction between networks involved in mentalisation, emotion dysregulation, autobiographical memory and dissociation.
Chapter 3: Aims, hypotheses and methods of study 1

3.1 Aims

This study intends to investigate the cognitive and emotional processes associated with BPD in a healthy sample of males and females. Specifically, measures on BPD, dissociation, emotion dysregulation, and perceptions of self and others will allow the researchers to investigate their impact on behaviour and underlying brain activity in an emotional recognition and Franzen et al.’s (2011) trust task.

3.2 Hypotheses

3.2.1 Psychosocial data

Hypothesis 1: By comparing between those high and low in BPD traits, it was expected that those with greater BPD traits would have higher levels of negative states of themselves and others, emotion dysregulation, and dissociation.

3.2.2 Emotional recognition task

Hypothesis 2: By comparing between those that present with high and low BPD traits, it was expected that those with greater BPD traits would have more negative perceptions of ambiguous facial stimuli as expressed through difficulties reading ambiguous stimuli and negative bias. Therefore, it is expected that those with greater BPD traits would rate an angry face as more angry, a neutral face as more angry, and happy face as less happy when compared to those with less BPD traits.

Research question 1: Whether those with BPD interpret the facial expressions to be physically different will be explored.

Hypothesis 3: It is anticipated that those with greater BPD traits would have different brain activity processing, reflected in brain regions involved in attention to and memory retrieval associated with facial recognition. Therefore, ACC, hippocampus, extra-striate cortex, fusiform gyrus, and the superior temporal gyrus are expected to be different between high and low BPD traits.
Hypothesis 4: Brain regions involved with emotion recognition are also expected to show differences for those with emotional regulation issues (including dissociation), but also with the OFC and sensory regions (i.e., parietal regions).

3.2.3 Trust task

Hypothesis 5: It is expected that those with high BPD traits (and those with high levels of negative views of the self/others) will perform better at the trust task by identifying that emotional cues relate to high and low monetary responses, compared to those with low BPD traits. Therefore, overtime, those individuals with higher BPD traits and higher negative perceptions (self and other) will transfer more money over to a partner that is smiling, and transfer less to the frowning faces when compared to controls and those with positive perceptions of themselves.

Hypothesis 6: Those with high and low levels of BPD traits, negative views of self and others are expected to reveal no differences between partners that do not have emotional cues.

Hypothesis 7: During and between the transfer and evaluation phases, it was expected to witness neurobiological processes specifically involved in mentalisation and episodic memory processing, such as ACC, posterior cingulate, temporal, and angular regions.

Hypothesis 8: It was expected that those with higher levels of BPD, and higher scores on negative perceptions of self and others, will have differences in activity in these mentalisation regions when compared to lower symptomatic counterparts.

Hypothesis 9: Episodic memory processes between high and low BPD, negative views of self and others comparisons are expected to be represented by posterior cingulate cortex, retrosplenial region difference when compared to lower score profiles.

Hypothesis 10: Autobiographical memory processes between high and low BPD, negative views of self and others comparisons are expected to be represented in right
prefrontal regions when compared to lower score profiles, particularly with partners with emotion cues.

Hypothesis 11: Increased activity in the OFC and parietal regions were anticipated to present between those with greater BPD traits, negative perceptions of self and others, as well as emotion regulation and dissociation as a results of a greater emotional sensitivity.

Hypothesis 12: Those that present with high and low levels of dissociation are expected to reflect an inverted response, but identical results to those already stated for mentalisation, emotional dysregulation, and dissociation.

3.3 Method

3.3.1 Participants

Ethical approval was granted from both Eastern Health Research and Ethics Committee, and Swinburne University Human Research Ethics Committee (see appendix D). Participants for study 1 were recruited via word of mouth, internet advertising (i.e., Gumtree, Melbourne Exchange, and Melbourne Chat) and social media websites (i.e. Facebook). 25 male and 25 female participants were sought and tested for study 1. Table 3.1 below, displays the demographics for the participants tested and analysed in the study. Seen in Table 3.1, males and females seemed to have similar ages, handedness, and education levels.

| Table 3.1. Demographic information of the participants in the study |
|-----------------|-----------------|-----------------|
|                 | Males (N = 25)  | Females (N = 25) | Total (N = 50) |
| Age 36.20 (12.48) | 35.92 (14.06) | 36.06 (13.16) |
| R. Hand 76.00% | 88.00% | 82.00% |
| < Year 10 0.00% | 0.00% | 0.00% |
| Year 10 12.00% | 4.00% | 8.00% |
| Year 12 12.00% | 20.00% | 16.00% |
| Diploma 8.00% | 8.00% | 8.00% |
| B. Degree 40.00% | 48.00% | 44.00% |
| P. Grad 28.00% | 20.00% | 24.00% |
3.3.2 Materials

3.3.2.1 Psychometric measures

BPD symptoms

The Personality Assessment Inventory (PAI; Morey, 1991) was used to assess BPD traits within the non-clinical sample. The PAI is a 344 item, self-report inventory that measures various aspects associated with personality. Instead of focussing on diagnostic criteria, the PAI assesses aspects associated with critical personality client variables in clinical settings. Therefore, some sub-factors of the inventory include support, depression, somatic complaints, schizophrenia, mania, paranoia, suicide ideation, dominance, anxiety (i.e., cognitive, affective, physiological through phobias and obsessive compulsiveness), social detachment, affective instability, self-harm, ego-centricism, antisocial behaviour, and aggression. The items within this measure are answered on a 0-3, symptom severity Likert system. The PAI reports to be reliable and valid (Morey, 1991). The PAI features 4 sub-scales (24 items) that pertain to a Borderline Personality sub-factor (PAI-BOR), made from the self-harm (pertains to impulsive behaviours), negative relationships, affective instability, and identity problems sub-factors (all using 6 items each). In this scale, total and subscale raw scores are converted into standardised t-statistic scores according to norms of a sampled group. The PAI-BOR has been used as a BPD screener in clinical (Morey, 1991) and non-clinical settings (Gardner & Qualter, 2009; Trull, 1995).

Ability to regulate emotions

The Difficulties in Emotional Regulation Scale (DERS; Gratz & Roemer, 2004) was used to assesses a person’s awareness and understanding of emotions; acceptance of emotions; the ability to engage in goal-directed behaviour, refraining from impulsive behaviour when experiencing negative emotions; and access to emotion regulation strategies perceived as effective. Factorial evidence on the 36 items of the DERS suggests that emotional regulation can be conceptualised as a non-acceptance of emotional responses (non-acceptance; 6 items); difficulties engaging in goal-directed behaviour (goals; 5 items); impulse control difficulties (impulse; 6 items); lack of emotional awareness
(awareness; 6 items); limited access to emotion regulation strategies (strategies; 8 items); and lack of emotional clarity (clarity; 5 items). “I experience my emotions as overwhelming and out of control” is an example of an item used in the inventory. The measure uses a 1-5 Likert scale design, whereby 1 indicates that the item “almost never happens (0 - 10%)” to them; 3 indicating that the item happens to them “about half the time (36 - 65%)”; 5 indicating that the item “almost always (91 – 100%)” happens to them. Therefore, higher scores in this measure suggest that someone has difficulties in interpreting, paying attention to, and having control of their emotions. The scale is reliable, reporting Cronbach’s alpha values of 0.85, 0.89, 0.86, 0.80, 0.88, and 0.84 for each aforementioned factor, respectively. The scale also reports validity (Gratz & Roemer, 2004).

Dissociation

The Dissociative Experiences Scale-2 (DES-2; Carlson & Putnam, 1993) is a 28 item, self-report inventory was used to assess how regularly an individual experiences common phenomena associated with dissociation. Different factor loadings have been reported for this scale for both clinical and non-clinical cohorts. A total score is an indication of the severity of dissociative experiences between participants. Participants are asked to rate on a 10 point Likert scale how commonly an experience occurs for them from 0% of the time, through to 100% of the time. Consequently, higher scores reflect greater dissociative experiences. An example of an item includes: “Some people have the experience of feeling that other people, objects, and the world around them are not real” is an example of an item in the measure. The measure is reported to be reliable having good test-retest reliability (0.79-0.96), split-half reliability (0.83-0.93), and a Cronbach’s alpha value (0.95). The measure also reports to be valid in predicting those with (74%) and without (80%) a DID (or MPD) diagnosis (Carlson & Putnam, 1993).
Perceptions of self and others

The 24 item, Brief Core Schema Scales (BCSS; Fowler et al., 2006) was used to assess schemata revolving around how strongly someone believes both positive and negative attitudes towards themself and others. Consequently, the scale features 6 items for each of those respective factors: Negative-self; Positive-self; Negative-others; and Positive-others. Respondents mark whether they have an initial belief, and then how strongly they hold that belief (“Believe it slightly” through to “Believe it totally”). For this reason, the scale is based on a 0 to 4 Likert scale, indicating that higher scores reflect that the test-taker has a larger amount of the given belief. Similarly, higher scores for each factor indicate that person has either a good, or bad image of themselves or others, depending on the factor. “I am weak”; “I am talented”; “Others are devious”; and “Others are supportive”; are examples of items from the measure. This measure is reliable, with Cronbach’s alpha values for both non-clinical (0.78; 0.86; 0.88; 0.88, respectively) and clinical samples (0.79; 0.84; 0.84; 0.87, respectively), and good test-retest reliability three weeks after initial assessment (0.84; 0.82; 0.70; 0.72, respectively). The measure also purports to have validity (Fowler et al., 2006).

3.3.2.2 Emotional recognition task

An emotional recognition task was used to investigate if any differences were present between participants in interpreting how someone is feeling based on their facial expression (Donegan et al., 2003; Franzen et al., 2011). Overall, the emotional recognition task used in this study presented 12 independent images of four different people. All three images for each person were presented three times each, and these contributed to the different phases of the task. During each phase, the images were presented in a random order and the images were always presented immediately after a fixation cross.

The images used were selected from the Nim Stim image set (MacArthur Foundation Research), and were selected based on visual search patterns when looking for emotion in facial expressions (Calvo & Marrero, 2009), as well as general compatibility, such as having a similar amount of shoulder exposure. This criterion resulted in the selection of neutral, open
happy faces, and closed angry faces for each person: the chosen image sets were female 1; female 9; male 24; and male 27. Each ‘partner’s’ eyes were lined up to fall between the fixation cross using Adobe Photoshop CS5, and presented in 338 x 408 pixels resolution. Due to this, additional photo manipulation was necessary to add minor missing parts of the partner’s shoulders and/or hair left from the resizing of the images (the images can only be distributed upon request due to copyright clauses), and minor touch ups were made to the images to fix the problems where the photos do not properly segregate the persons hair from the background (e.g., in Photoshop terms, the photos seemed to simply use an arbitrary threshold value using the “magic wand” feature to remove the background, producing the poor background-hair segregation). An example of how the images were manipulated can be found in the appendix (Appendix C).

Phase 1 of the emotion recognition task involved asking participants to pay close attention to the images presented to them on the screen (Phase 1) because they would be asked to rate the physical characteristics of the people in the images the second time (Phase 2), and rate how happy or angry each person was the third time (Phase 3). However, participants were informed that they did not have to try and remember the images in the task, because the images would be displayed whilst being asked each question. More specifically, phase 1 presented each image, one after the other, for 1.5 seconds, with a 1.5 second inter stimulus interval. After which, participants were prompted with an instruction screen reminding them of and informing them to press the spacebar to begin Phase 2.

During phase 2, participants were first presented the neutral faces of their ‘partners’, one-at-a-time, and prompted to rate each person’s static physical characteristics. Such static characteristics include: How pale/dark the person’s skin tone is, as well as how light/dark their hair colour is; how short/long their hair is; how much facial hair they have; how full the person’s lips are; how large the person’s nose as well as their ears are; and how thick the person’s eyebrows are. These were all measured on a 10 – 90 Likert scale format whereby higher scores indicated more extreme levels (i.e., pale/light to dark; short to long; thin to full/thick; small to large). After rating the static physical characteristics of each partner, participants were presented with the 12 unique images for the second time, one-at-a-time, but this time were asked to rate the dynamic physical characteristics. Questions relevant for the dynamic physical characteristics were based on visual search evidence when looking at
facial expressions (Calvo & Marrero, 2009). Therefore, participants were asked to rate how much each partner’s teeth were showing, how high or low each partner’s cheek was raised, and how much they frowned. Responses were recorded in a 10 - 90 Likert scale design, whereby higher scores indicate that the image featured a greater portion of teeth were showing, a higher cheek raise, or the person’s brow was lower. Like the previous phase, images and fixation crosses were both presented for 1.5 seconds each, instigated on participant responses. Reaction time was also collected.

During phase 3, participants were presented with the 12 images for the third time, and, one-at-a-time. However, this time, participants were asked to rate how someone was feeling based on their facial expression. A 10 - 90 Likert scale was used to record the data, whereby participants were first asked to rate the happiness of each image and then the anger, meaning that higher scores indicated that someone was happier or angrier. Like the previous phase, images and fixation crosses were both presented for 1.5 seconds each, instigated on participant responses. Reaction time was also collected. The programming code for the Emotional recognition task can be found in the appendix (Appendix A.1).

3.3.2.3 Trust task

The ability to read the intentions of others was measured by collecting behavioural and neurobiological evidence during a trust task that has been used in the previous literature (Franzen et al., 2011). Franzen, et al. (2011) used a task that involves a monetary exchange between the participant, and four virtual partners presented on a computer screen. The task involved 36 trials (9 trials for each partner), each involving 3 different phases where the participant was presented with different decisions for each of the 36 images. The first phase was referred to as an investment phase; the second phase was referred as a feedback phase; and the third was referred to as an evaluation phase. A replicated, representation of the phases used by Franzen et al. (2011) is demonstrated in Figure 3.1 below.
At the start of each trial (i.e., the investment phase), the participant was given a total of 90 units from which to decide how much of that money they would like to transfer over to the partner displayed in front of them. However, participants were informed that they were required to transfer 10 of their units, at least. Participants were also informed that the amount of money they decided not to transfer was guaranteed to be theirs, but the amount of money they transferred to their partner would be tripled and then the partner would ‘decide’ how much to transfer back to the participants and keep for themselves. Therefore, better abilities at being able to read each partner’s trustworthiness would result in the most money for the participant. Unbeknown to the participants, each image for both partners were pre-programmed to hand back a different percentage amount of whatever money was handed to them by the participant.

To be more specific, two partners were pre-programmed to reciprocate a greater amount (fair partner) of money back to the participants than the others (unfair partners), and both these returns were organised within a nine point continuum. Therefore, fair
partners handed back a mean repayment of 41.3%, with a low of 17% and a high of 66%. On the other hand, the unfair partners returned a mean of 25%, with a low of 0% and a high of 50%. These reciprocation amounts can be seen in Figure 3.2 below, as indicated by the black and white dots above and below the respective partner faces (note that three of the partners displayed in the figure were not used in this study’s task and have been replaced by faces that do not break copyright clauses). Reciprocated values were rounded to the nearest whole number. Using these percentages, if a participant ends up with below 90, they effectively ‘lose’, whereas if they get above 90, they effectively ‘win’. More importantly, this 90 value is a constant regardless of how much the participant originally decides to transfer because of the use of percentile returns. Therefore, the reading of others’ intentions, cooperation, and trust can be assessed by the task regardless of the amount the participant decided to transfer to their virtual partner, because participants were forced to transfer a minimum of 10 units to their virtual partners.

After the participants made their investment, participants were provided details on how much the participant transferred, how much the virtual partner transferred, and an overall tally of how much both the participant and virtual partner own (i.e., the feedback phase). The evaluation phase of the task therefore involves the participant deciding whether their partner’s actions were fair or unfair. At the end of the task, the participant was asked how fair they thought each partner was overall, and how fair they thought they behaved to each partner. All fairness ratings throughout the task were based on a 9 point (10 - 90) Likert scale, whereby higher scores indicate greater fairness: very unfair to very fair. At each and every decision moment (sequential investment and evaluation phases, as well as the overall evaluations), the participant was presented with an image of the respective partner (Franzen et al., 2011).

As a final addition, Franzen et al. (2011) used a gradient scale from happy, neutral, to angry facial expressions, but only for two of the virtual partners. The bigger the smile the more they were programmed to have a greater amount of monetary return; the larger the frown the less monetary return they would return; and neutral faces were programmed to have a mid-range return. The images were presented in a way that one male and one female always featured the emotional cues, whilst also ensuring one fair and one unfair
partner always had emotional cues. This resulted in 8 different image presentation sets. Each trial, and therefore each individual image were presented in randomised order.

Franzen et al's (2011) trust task was programmed using MATLAB software and the Psychophysics toolbox-3 add-on (Brainard, 1997; Kleiner, Brainard, & Pelli, 2007; Pelli, 1997) in this study based on descriptions, keeping in mind user-friendliness and compatibility with EEG acquisition. For each participant, the same images and partner identities that were used in the emotional recognition task were also used in this task. However, in order to both increase power via averaging, and increase the likelihood of accepting epochs for EEG analysis, the increasing intensity of the happy through to angry emotional cues used in Franzen et al's (2011) task was replaced by three happy, three neutral, and three angry, singular emotional intensities. The use of the emotional faces in this study can be seen in Figure 3.2 below.
Figure 3.2. A pictorial representation of the reciprocation rates amongst fair and unfair partners with and without emotional cues.

In addition to the above face presentation modifications, the trust task was reprogrammed by breaking the task up into its individual components to allow the researchers to analyse a defined snapshots of EEG activity during time points of interest. Therefore, participants were presented with an information screen before seeing their partner each round, both reminding them that their money had been replenished to 90, but also to remind participants to make their decision during the next screen.
During this information screen, each participant was presented with the visuals of the four neutral faces of each partner, side-by-side, in a randomised order that continually refreshed for each round throughout the entirety of the task. These images were added to alleviate memory demands in remembering the different identities of partners throughout the task considering the addition of inter-stimulus-intervals lengthened the task time. The randomised presentation was added to remove a spatial memory component, whereby participants could associate a partner’s fairness to a specific location on the screen (e.g., partner in position 2 and 3 are fair, etc.). Participants were also informed at this information screen that they need to press space bar to continue the task, when they were ready (participants were told it could be used as a rest period). Once participants did press the space bar, a fixation cross was presented for 1.5 seconds, and then the image of their partner was presented, fitting in nine other images of the 10 to 90 likert scale at the bottom of the partner’s image. The task stayed on this screen for as long as it took the participant to decide how much to transfer, via clicking on the value that indicated how much they wanted to transfer (10-90) with the mouse.

For the feedback phase, each piece of information (i.e., “you transferred”), as well as its numeric value (i.e., “10”, if the participant transferred 10) were presented one-at-a-time, one second apart, down from the middle of the screen. Once all the lines of the feedback phase were presented, a fixation cross, followed by the image of the partner, and then the synonymous-looking feedback phase to that used by Franzen et al (2011) was presented to the participants (all with an inter stimulus interval of 1.5 seconds). That is, an overview of the feedback information, and an image of the partner. The gender typing language (i.e., “she transfers”) during this feedback phase was removed with neutral language (i.e., “your partner transfers”) for convenience. A representation of the changes made between Franzen et al’s (2011) transfer, feedback, and evaluation phases can be seen in Figure 3.3 below.
Figure 3.3. Visual comparisons between the phases of the trust task used by Franzen et al. (2011; left) and the trust task used by this study (right) to allow for compatibility with EEG acquisition techniques.
Additional programming included recording the time it took participants to make decisions, rested for, and an overall score value. This overall score value added the amount of money owned by the participant after each round, meaning that high scores indicate that the person ‘won’ more money. This was used as a general indicator of how well participants read the intentions of others, but this value was not displayed nor informed to the participants. Both the 36 images of the partners used in the task, and the ordering of the partners presented in the four overall fairness rating rounds at the end of the task were presented in a randomised order. The programming for the trust task can be found in the appendix (Appendix A.2), but an overall diagrammatic representation of the task is presented in Figure 3.4 below.

Figure 3.4. A pictorial representation of the alterations made to Franzen et al.’s (2011) trust task to maximise its compatibility and user friendliness with EEG acquisition methods.
3.3.2.4 EEG acquisition and analysis

EEG data was recorded and digitised using the 64 channel EEG system from Advanced Neuro Technology, using Advanced Source Analysis data acquisition software. The 64 channel WaveGuard montage was used in data acquisition, therefore an average reference was used along with a forehead ground. Two computer systems were used: one to record EEG data and one to present the tasks. A custom designed trigger box was made and used in order to facilitate and delineate the differences from the larger amount of specific event presentations used for this project. A simplified and generic experimental setup used in this study has been depicted in Figure 3.5 below.

![Experimental Setup Diagram](image)

1. Task presentation computer
2. Trigger box
3. ANT amplifier
4. ANT Waveguard 64, EEG cap
5. EEG recording computer

*Figure 3.5. The experimental setup used in the study.*
The EEG data file compatible with Advanced Source Analysis was converted into a Vision Analyser 2 compatible file format. Vision analyser 2 was used to prepare (i.e., filtering, ocular correction) and epoch the EEG data. Relevant epoch, exports from Vision Analyser were analysed using the Key institute’s sLORETA program to obtain source localisation data values. All other analyses were performed using SPSS 22.

During EEG data preparation, a 0.5 – 20 Hertz band pass filter with 48 decibel per octave drop off was used to remove slow wave potentials, keep the traditional shape of the eye blink response, as well as allowing for the greatest attenuation of any EMG activity. This 20 Hertz high-cut filter was based on standards on EMG data processing and reporting, whereby 20 Hertz has been recommended as the lowest, high-pass filter (De Luca, Donald Gilmore, Kuznetsov, & Roy, 2010; Van Boxtel, 2001). In other words, EMG activity is minimalized by setting a 20 Hertz low-pass filter. Notably, this recommendation for a 20 Hertz filter has changed from previous thoughts that a 10 Hertz (Winter, Rau, Kadefors, Broman, & De Luca, 1980), or even as low as 5 Hertz (Merletti & di Torino, 1999) may be necessary for filtering (De Luca et al., 2010). A 50 Hertz notch filter was also used to reduce any possibility of related interference. Eye movement artefacts were then removed using an Independent Component Analysis correction technique comparing to whole data, and the global field power setting was used with a 30% correlation trigger. The Fpz site was used for vertical (and blinks) and horizontal eye movements. After ICA ocular correction, a 3 Hertz, low cut filter was applied to the data to smooth out any residual slow wave potentials left after the ICA procedure. These protocols were maintained strictly to preserve as many epochs as possible, which subsequently allows for the investigation of theta through to beta 1 activity. For the purposes of this study, standardised values within the sLORETA program itself were used to analyse results. Therefore, delta, theta, alpha, and beta 1 were signified by the following frequency ranges: 4-7, 8-12, 13-18 Hertz, respectively (KEY Institute, 2014).

### 3.3.3 Procedure

Participants were asked to complete the DES-II, DERS, BCSS, PAI-BOR and then perform the emotional recognition task and trust task. Participants were debriefed after completing the trust task. For the emotional recognition task, 1.5 second EEG epochs were
used for each facial expression starting at the presentation of the images. This totalled 18 seconds of data for each emotional expression.

For the trust task, 1.5 second epochs were used for all transfer decisions and all fairness decisions. Transfer decisions were epoched 750 milliseconds before the transfer decision until 750 milliseconds after the decision. Fairness decisions were epoched 1 second before the decision until 500 milliseconds after it. Therefore, both transfer and fairness decisions totalled to 27 seconds of data for the partners without emotional cues and 16 seconds for the partners with emotional cues.

3.3.3.1 Data analysis

Analysis of the trust task

**Partners with emotional cues**

Each partner's happy and angry faces would be averaged together, into “time 1” and “time 2” categories. “Time 1” indicated that the happy and angry faces were presented in the first half of the analysis, and “time 2” indicated the cues were presented in the second half of the analysis. More specifically then, “time 1” consisted of the results from the first 3 happy face presentations which were averaged together with the first three angry presentations. Although this averaging was in accordance to time and emotion, partner identity was not disregarded because of the use of a “first 2, first 1 rule”. In other words, if the first three emotion presentations only included one identity, the analysis took this into account by using the first two presentations of that partner/identity and then the first presentation of the other partner/identity. The analysis was done in this way in case participants were unsure whether higher/lower reciprocity with happy/angry faces carried over to the other partner. Furthermore, the averaging of results at “time 1”, regardless of whether they were a happy or angry cue, is considered to be an indication of the amount of hostility for participants, influenced by a person’s perceptions of trust. However, further calculations are required to investigate mentalisation and ACC activity.
Firstly, “time 1” would be required to be compared to a “time 2” taking the learning and behaviour modification into consideration. Hence, whatever epochs were not used in “time 1” were computed together to make a “time 2” value in the same way: the results from happy faces were averaged together with the angry faces. However, because lower transfer values and lower fairness ratings were more congruent to the ideal responding for the angry faces, the transfer values and fairness ratings for angry faces were inverted using \( y = (x - 100)^{-1} \). In this equation, \( y \) represents the calculated score used in the analyses and \( x \) represents the raw score the participant transferred/rated. Therefore, if a participant transferred 20 to an angry face knowing that they were guaranteed to get little back, this value was recalculated to 80 (i.e., \((20 - 100)^{-1} = 80\)) making it more compatible with ideal responding, and therefore it could theoretically be averaged with the responses for the happy faces in a congruent way. Doing this inversion of angry face values in both time 1 and 2 allows a way of investigating how well each participant was able to read the happy and angry emotional cues and therefore ACC, mentalisation, learning and memory processing throughout the task. In which, the subtraction of the values that each participant achieved in the first half of the analysis with those values in the second half of the analysis created a difference value. This difference value provided an indication of whether a participant’s score in the second half of the task is higher or lower than their first half, and therefore whether they were able to read and anticipate reciprocation from the emotional cues. Because of the calculations that were necessary to setup this comparison whereby higher scores indicate higher transfers to happy faces and lower transfers to angry faces, higher scores indicate greater mentalisation abilities. The programming for the analysis of the trust task can be found in the appendix (Appendix B), but a diagrammatic representation of all the analysis steps and rules for the emotional images can be seen in Figure 3.6 below.
Figure 3.6. A visual representation of the step-wise analysis used to investigate both hostility and mentalisation differences in the trust task for the partners with emotional cues.

**Partners without emotional cues**

A fair partner is expected to produce a higher return on average than the unfair partners lower on average return, whereby fairness is dictated by a +/- 90 return value. Hence, a congruent effect can be said to occur when a fair partner returns above 90 (occurs on six occasions), but an incongruent effect occur for a fair partner when they return less than 90 (occurs on three occasions). On the other hand, a congruent effect can be said to occur when an unfair partner transfers less than 90 (occurs on six occasions), and an incongruent effect occurs when an unfair partner returns above 90 (occurs on three occasions).

By taking this congruency into consideration an analysis can be setup controlling for randomly good or bad starts. A randomly good start could be considered to be a start whereby an unfair partner presents a number of returns that are above 90 and therefore seems to be fair, and possibly when a fair partner presents their top three returns whereby they seem to be more unreliable or deceitful later on by transferring less. The opposite
could be said for a randomly bad start: when a fair partner presents their worst three returns at the start, and possibly when an unfair partner presents their worst three returns at the start of the task. Nevertheless, it is the highest returns for the fair partner, and the lowest returns that differentiate the fair partners from the unfair partners, and hence producing the differences in averaged return. For this reason, it is possible to analyse results of the trust task for the partner’s without emotional cues when a variable is made that determines what returns were given in the first 4 presentations for each partner based on congruency to control for randomly good and bad starts. The allocation of the congruency weights are depicted in Figure 3.7 below.

Figure 3.7. A visual representation displaying the allocation of congruency weights in accordance to partner fairness. Note: The horizontal line in the middle of the Figure represents partner transfers that would equate to participants finishing with the 90 dollars they started with.
Seen in Figure 3.7, a value of +1 is given to the highest three returns for the fair partner and the lowest three returns of the unfair partner; a value of 0 is given to the middle three returns for each partner; and a value of -1 is given to the lowest three returns of the fair partner and highest three returns of the unfair partner. In this analysis pipeline, the behavioural results (amount the participant transferred and rated) from the first four presentations of the fair partner and first four presentations of the unfair partner are averaged together. However, the congruency values (the sum of the +1’s, 0’s, and -1’s) of the fair and unfair partner would be treated differently to control for the effects of the random presentations. So, instead of adding and averaging like that mentioned previously for the transfer and rating values, the congruency values will begin on a +3 value and will thereafter be calculated by adding the congruency values for each partner.

Once congruency values are determined from the first four presentations for both partners, the value used in the analysis is then created by subtracting the unfair partner’s congruency value from the fair partner’s congruency value (i.e., fair partner congruency value – unfair partner congruency value). Therefore, the +3 value forms a baseline for the congruency values, forcing it to begin at zero when considering a worst case scenario (all the incongruent values are found in the first half of the analysis), further allowing an interpretable and reliable subtraction technique with the other partner. By using the congruency values in this way, it is possible to investigate the effects of randomly good and bad starts. A positive congruency value indicates that the effect of the fair partner was greater than the effect of the unfair partner. Put more simply, the fair partner presented more congruent presentations in the first half of the task then the unfair partner. The same can be said of negative values, but in favour of the unfair partner. However, ultimately, more positive and more negative values indicate that it is more difficult to differentiate the fair from the unfair partner, based on the presentations at the start of the task. By doing these methods, it is possible to investigate any hostility differences between the fair and unfair partner, whilst keeping in mind randomly good or bad starts.

A similar process is carried out when investigating mentalisation processes. That is, the participants value transferred and rated partner fairness is taken from the first four
presentations for each partner and compared in the same way as the emotional cues (e.g., \( y = (x - 100)^{-1} \)) with the last four presentations. However, in order to calculate the effect of the random presentations throughout the task with the partners without emotional cues, the congruency values for each partner are taken from the first five presentations of each partner, and then the unfair partner value is subtracted from the fair partner. The programming for the analysis of the trust task can be found in the appendix (Appendix B), but a diagrammatic representation of all the analysis steps and rules for the non-emotional images can be seen in Figure 3.8 below.
Figure 3.8. A visual representation of the step-wise analysis used to investigate both hostility and mentalisation differences in the trust task for the partners without emotional cues.
Chapter 4: Results of study 1

4.1 Psychosocial data

4.1.1 Data screening

Prior to analysis, the data was screened for missing data, outliers and normality. A total of 12 missing values were found across a number of psychometric measures. The most affected measure was the BCSS with item 8 having 2 (4%) missing data, whereas items 10, 18, 19, 20 and 23, also reported missing cases. One missing case was also found the DES-2, item 14 and item 7 of the DERS. These missing values were replaced the Maximum Likelihood Estimation using a 5000 iteration Missing Values Analysis, which Little’s MCAR test suggested the values were missing completely at random ($\chi^2 (1118) < 0.001, p = 1.000$).

Multiple imputation methods, such as Maximum Likelihood Estimation, are regarded as an acceptable way to handle and replace missing data (Donders, van der Heijden, Stijnen, & Moons, 2006; Fox-Wasylyshyn & El-Masri, 2005; Kang, 2013; Musil, Warner, Yobas, & Jones, 2002; Rubin, Witkiewitz, Andre, & Reilly, 2007), whereby 10% missing data has been considered to be a small amount of missing data, 30% moderate, and 40% a high amount of missing data (Musil et al., 2002). The Missing Values Analysis was conducted by inputting each item from each questionnaire, entering sex, education, and handedness categorical data, and participant number as case values. Because the imputed values did not represent whole numbers, all numbers were rounded to the nearest whole number for each measure. This was performed to maintain the psychometric properties of the measures. Normality for the data was determined statistically and assessed according to a 0.05 significance value when dividing skewness by the standard error of skewness (an answer above 1.96, or below -1.96 was determined to be an indication of a significant skew).

Data screening indicated that some variables needed to be transformed for later analysis. The Square root of X (X representing the following mentioned variables) was used to transform the age, DES total, BCSS negative other, PAI-BOR total, affective instability, negative relationship variables, and the log10 of X was used to transform the DERS total, non-acceptance, impulse, awareness, strategy, clarity variables. The BCSS negative self was transformed using “(-1/(X+0.5)) + transformed minimum value” and the PAI self-harm scores
were transformed using “(-1/X) + transformed minimum value” - the addition of the minimum value ensured scores had positive values whereas the addition of 0.5 for negative self ensured that scores of 0 were transformed. Outliers were considered as data that was outside a 2 standard deviation range of the mean, provided that the removal of that case (and subsequent cases, if relevant) resolved the skew and it was not directly adjacent to the main dataset when viewed by a boxplot. Based on this approach, no outliers were identified.

4.1.2 Descriptive and statistical comparisons for participants by sex

Of first mention, there were no significant differences between handedness ($\chi^2 (1) = 1.220, p = 0.269$) and education ($\chi^2 (4) = 2.015, p = 0.733$) between males and females using Pearson Chi Square statistical coefficients. In order to ascertain any psychosocial factors that may relate to this studies sample, the means and standard deviations for each raw and transformed variables are in Table 4.1 below. The theoretical ranges for the measures used in the study and their reliability statistics are similarly presented in Table 4.1.
Table 4.1. Descriptive statistics and psychometric properties of the psychosocial variables used in the study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Original (M, SD)</th>
<th>Transformed (M, SD)</th>
<th>TR reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Males (n = 25)</td>
<td>Females (n = 25)</td>
</tr>
<tr>
<td>age</td>
<td>36.06 (13.16)</td>
<td>36.20 (12.48)</td>
<td>35.92 (14.06)</td>
</tr>
<tr>
<td>PAI-BOR total</td>
<td>52.58 (11.43)</td>
<td>51.64 (10.21)</td>
<td>53.52 (12.67)</td>
</tr>
<tr>
<td>PAI-BOR aff inst</td>
<td>52.52 (10.99)</td>
<td>52.08 (11.22)</td>
<td>52.96 (10.96)</td>
</tr>
<tr>
<td>PAI-BOR id prob</td>
<td>52.54 (9.94)</td>
<td>52.24 (9.13)</td>
<td>52.84 (10.87)</td>
</tr>
<tr>
<td>PAI-BOR neg rel</td>
<td>51.16 (10.00)</td>
<td>49.72 (10.39)</td>
<td>52.60 (9.60)</td>
</tr>
<tr>
<td>PAI-BOR s harm</td>
<td>51.86 (13.50)</td>
<td>51.00 (11.52)</td>
<td>52.72 (15.43)</td>
</tr>
<tr>
<td>DERS total</td>
<td>75.16 (22.42)</td>
<td>73.12 (17.77)</td>
<td>77.20 (26.49)</td>
</tr>
<tr>
<td>DERS non-acc</td>
<td>12.38 (5.27)</td>
<td>11.80 (4.47)</td>
<td>12.96 (6.00)</td>
</tr>
<tr>
<td>DERS goals</td>
<td>13.36 (4.43)</td>
<td>13.40 (4.14)</td>
<td>13.32 (4.79)</td>
</tr>
<tr>
<td>DERS impulse</td>
<td>9.80 (3.81)</td>
<td>9.40 (2.60)</td>
<td>10.20 (4.75)</td>
</tr>
<tr>
<td>DERS aware</td>
<td>13.86 (3.59)</td>
<td>13.92 (3.35)</td>
<td>13.80 (3.88)</td>
</tr>
<tr>
<td>DERS strat</td>
<td>15.14 (6.94)</td>
<td>14.84 (6.52)</td>
<td>15.44 (7.45)</td>
</tr>
<tr>
<td>DERS clarity</td>
<td>8.84 (2.74)</td>
<td>8.12 (1.96)</td>
<td>9.56 (3.23)</td>
</tr>
<tr>
<td>DES total</td>
<td>8.12 (6.96)</td>
<td>8.08 (5.53)</td>
<td>8.15 (8.26)</td>
</tr>
<tr>
<td>BCSS neg self</td>
<td>2.20 (3.36)</td>
<td>2.56 (3.94)</td>
<td>1.84 (2.70)</td>
</tr>
<tr>
<td>BCSS pos self</td>
<td>15.06 (4.19)</td>
<td>15.48 (3.58)</td>
<td>14.64 (4.76)</td>
</tr>
<tr>
<td>BCSS neg other</td>
<td>2.87 (3.13)</td>
<td>3.30 (3.54)</td>
<td>2.44 (2.68)</td>
</tr>
<tr>
<td>BCSS pos other</td>
<td>13.44 (4.48)</td>
<td>13.44 (3.33)</td>
<td>13.44 (5.47)</td>
</tr>
</tbody>
</table>

Seen in Table 4.1, the measures used in the study were reliable and therefore any psychosocial results can be interpreted more confidently. However, the DERS’s awareness sub-factor and the PAI-BOR’s identity problems and negative relationships sub-factors can be said to be generally reliable. Also seen in Table 4.1, participants tended to score low in dissociation, and generally had high abilities in accepting emotions, keeping to goals, controlling impulses, having an awareness, having strategies and clarity around emotions. Participants reported to have higher positive perceptions of self and others and low negative perceptions of self and others. Participants in this study reported to have average levels of symptoms associated with BPD, according the PAI-BOR and its subscales. When comparing between sex, males and females appeared to report similar scores for each variable, and this was confirmed with non-significant differences when using Multivariate Analysis of Variance (MANOVA), main effects only model (F (18, 31) = 0.445, p = 0.963).
4.1.3 Median split of BPD symptoms

Knowing that no sex differences were reported between vital psychosocial variables in this study, a median split was performed for the total score of the PAI-BOR, DES-2 and DERS in order to assess if there were any differences in psychosocial measures based on related symptoms. According to a MANOVA, main effects only model, there were significant differences in psychosocial measures between those that reported lower and high BPD (F (18, 31) = 5.238, p < 0.001). Table 4.2 below shows the average scores and standard deviations for each variable for those who reported to have lower versus higher BPD traits according to a median of 7.14.

Table 4.2. Descriptive and comparative statistics in psychosocial variables for the participants in the study based on a high and low BPD-trait median split.

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 24)</th>
<th>High (n = 26)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>5.83 (0.21)</td>
<td>6.00 (0.21)</td>
<td>1</td>
<td>48</td>
<td>0.329</td>
<td>0.569</td>
<td>0.007</td>
<td>0.087</td>
</tr>
<tr>
<td>PAI-BOR total</td>
<td>6.60 (0.10)</td>
<td>7.78 (0.10)</td>
<td>1</td>
<td>48</td>
<td>74.205</td>
<td>&lt; 0.001</td>
<td>0.607</td>
<td>1.000</td>
</tr>
<tr>
<td>PAI-BOR aff inst*</td>
<td>6.75 (0.12)</td>
<td>7.64 (0.12)</td>
<td>1</td>
<td>48</td>
<td>27.188</td>
<td>&lt; 0.001</td>
<td>0.362</td>
<td>0.999</td>
</tr>
<tr>
<td>PAI-BOR id prob*</td>
<td>44.79 (1.34)</td>
<td>59.69 (1.29)</td>
<td>1</td>
<td>48</td>
<td>64.331</td>
<td>&lt; 0.001</td>
<td>0.573</td>
<td>1.000</td>
</tr>
<tr>
<td>PAI-BOR neg rel</td>
<td>6.71 (0.11)</td>
<td>7.50 (0.11)</td>
<td>1</td>
<td>48</td>
<td>25.563</td>
<td>&lt; 0.001</td>
<td>0.347</td>
<td>0.999</td>
</tr>
<tr>
<td>PAI-BOR s harm</td>
<td>0.007 (0.001)</td>
<td>0.012 (0.001)</td>
<td>1</td>
<td>48</td>
<td>40.111</td>
<td>&lt; 0.001</td>
<td>0.455</td>
<td>1.000</td>
</tr>
<tr>
<td>DERS total</td>
<td>1.78 (0.02)</td>
<td>1.93 (0.02)</td>
<td>1</td>
<td>48</td>
<td>35.739</td>
<td>&lt; 0.001</td>
<td>0.427</td>
<td>1.000</td>
</tr>
<tr>
<td>DERS non-acc</td>
<td>0.96 (0.03)</td>
<td>1.15 (0.03)</td>
<td>1</td>
<td>48</td>
<td>18.085</td>
<td>&lt; 0.001</td>
<td>0.274</td>
<td>0.986</td>
</tr>
<tr>
<td>DERS goals*</td>
<td>10.88 (0.77)</td>
<td>15.64 (0.74)</td>
<td>1</td>
<td>48</td>
<td>20.163</td>
<td>&lt; 0.001</td>
<td>0.296</td>
<td>0.993</td>
</tr>
<tr>
<td>DERS impulse</td>
<td>0.88 (0.03)</td>
<td>1.04 (0.03)</td>
<td>1</td>
<td>48</td>
<td>19.780</td>
<td>&lt; 0.001</td>
<td>0.292</td>
<td>0.992</td>
</tr>
<tr>
<td>DERS aware</td>
<td>1.10 (0.02)</td>
<td>1.15 (0.02)</td>
<td>1</td>
<td>48</td>
<td>2.394</td>
<td>0.128</td>
<td>0.047</td>
<td>0.329</td>
</tr>
<tr>
<td>DERS strat</td>
<td>1.02 (0.03)</td>
<td>1.25 (0.03)</td>
<td>1</td>
<td>48</td>
<td>32.217</td>
<td>&lt; 0.001</td>
<td>0.402</td>
<td>1.000</td>
</tr>
<tr>
<td>DERS clarity</td>
<td>0.86 (0.02)</td>
<td>0.99 (0.02)</td>
<td>1</td>
<td>48</td>
<td>20.991</td>
<td>&lt; 0.001</td>
<td>0.304</td>
<td>0.994</td>
</tr>
<tr>
<td>DES total*</td>
<td>2.11 (0.21)</td>
<td>3.09 (0.20)</td>
<td>1</td>
<td>48</td>
<td>11.495</td>
<td>0.001</td>
<td>0.193</td>
<td>0.913</td>
</tr>
<tr>
<td>BCSS neg self</td>
<td>0.52 (0.16)</td>
<td>1.23 (0.15)</td>
<td>1</td>
<td>48</td>
<td>10.556</td>
<td>0.002</td>
<td>0.18</td>
<td>0.889</td>
</tr>
<tr>
<td>BCSS pos self</td>
<td>16.67 (0.80)</td>
<td>13.58 (0.77)</td>
<td>1</td>
<td>48</td>
<td>7.711</td>
<td>0.008</td>
<td>0.138</td>
<td>0.777</td>
</tr>
<tr>
<td>BCSS neg other</td>
<td>1.06 (0.23)</td>
<td>1.49 (0.22)</td>
<td>1</td>
<td>48</td>
<td>1.940</td>
<td>0.170</td>
<td>0.039</td>
<td>0.276</td>
</tr>
<tr>
<td>BCSS pos other</td>
<td>14.88 (0.88)</td>
<td>12.12 (0.84)</td>
<td>1</td>
<td>48</td>
<td>5.130</td>
<td>0.028</td>
<td>0.097</td>
<td>0.602</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences; * = significant Levenes
Seen in Table 4.2, those that scored higher in BPD traits reported to have significantly higher levels of dissociation, and poorer abilities at accepting emotions, keeping to goals, controlling impulses, having strategies to combat and clarity around emotions compared to those with lower BPD traits. This was also the case for awareness of emotions, but it did not achieve significance. Those with higher BPD traits also reported significantly lower positive self and other perceptions and higher negative self-perceptions compared to those with lower BPD traits. Those with high BPD traits also reported to have greater negative perceptions of others but this did not achieve significance. Table 4.2 also indicates that those with higher BPD traits reported to have significantly higher overall BPD symptoms, and in each sub-factor of the PAI-BOR. Age was not reported to be an influence between those with high and low BPD traits. However, it should be noted that the distribution of scores between the low and high BPD trait groups were unequal for dissociation ($F(1, 48) = 5.098, p = 0.029$), goals ($F(1, 48) = 6.453, p = 0.014$), affective instability ($F(1, 48) = 4.069, p = 0.049$), and identity problems ($F(1, 48) = 5.059, p = 0.029$) according to a significant Levene’s statistic, and therefore some caution is warned for those variables.

4.1.4 Median split of difficulties with emotion regulation

A MANOVA, main effects only model was performed to determine if there were any differences between psychosocial variables according high and low scorers with difficulties with emotion regulation. Statistical differences were reported between those that scored low and high on difficulties with emotion regulation ($F (18, 31) = 5.702, p < 0.001$). Table 4.3 below displays the means and standard deviations for each variable in accordance to the median split of 1.85 for the low and high difficulties with emotion regulation groups.
Table 4.3. Descriptive and comparative statistics in psychosocial variables for the participants in the study based on a high and low emotion dysregulation median split.

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 26)</th>
<th>High (n = 24)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>5.68 (0.96)</td>
<td>6.18 (1.06)</td>
<td>1</td>
<td>48</td>
<td>2.993</td>
<td>0.090</td>
<td>0.059</td>
<td>0.396</td>
</tr>
<tr>
<td>PAI-BOR total</td>
<td>6.75 (0.53)</td>
<td>7.71 (0.66)</td>
<td>1</td>
<td>48</td>
<td>33.062</td>
<td>&lt; 0.001</td>
<td>0.408</td>
<td>1.000</td>
</tr>
<tr>
<td>PAI-BOR aff inst*</td>
<td>6.78 (0.46)</td>
<td>7.68 (0.71)</td>
<td>1</td>
<td>48</td>
<td>28.462</td>
<td>&lt; 0.001</td>
<td>0.372</td>
<td>0.999</td>
</tr>
<tr>
<td>PAI-BOR id prob</td>
<td>46.46 (6.41)</td>
<td>59.13 (8.87)</td>
<td>1</td>
<td>48</td>
<td>33.860</td>
<td>&lt; 0.001</td>
<td>0.414</td>
<td>1.000</td>
</tr>
<tr>
<td>PAI-BOR neg rel</td>
<td>6.79 (0.63)</td>
<td>7.48 (0.56)</td>
<td>1</td>
<td>48</td>
<td>16.621</td>
<td>&lt; 0.001</td>
<td>0.257</td>
<td>0.979</td>
</tr>
<tr>
<td>PAI-BOR s harm</td>
<td>0.008 (0.004)</td>
<td>0.011 (0.005)</td>
<td>1</td>
<td>48</td>
<td>5.838</td>
<td>0.020</td>
<td>0.108</td>
<td>0.658</td>
</tr>
<tr>
<td>DERS total</td>
<td>1.77 (0.06)</td>
<td>1.95 (0.09)</td>
<td>1</td>
<td>48</td>
<td>70.853</td>
<td>&lt; 0.001</td>
<td>0.596</td>
<td>1.000</td>
</tr>
<tr>
<td>DERS non-acc</td>
<td>0.93 (0.12)</td>
<td>1.20 (0.12)</td>
<td>1</td>
<td>48</td>
<td>65.411</td>
<td>&lt; 0.001</td>
<td>0.577</td>
<td>1.000</td>
</tr>
<tr>
<td>DERS goals*</td>
<td>11.00 (2.79)</td>
<td>15.92 (4.51)</td>
<td>1</td>
<td>48</td>
<td>21.880</td>
<td>&lt; 0.001</td>
<td>0.313</td>
<td>0.996</td>
</tr>
<tr>
<td>DERS impulse</td>
<td>0.90 (0.10)</td>
<td>1.04 (0.15)</td>
<td>1</td>
<td>48</td>
<td>14.514</td>
<td>&lt; 0.001</td>
<td>0.232</td>
<td>0.962</td>
</tr>
<tr>
<td>DERS aware</td>
<td>1.09 (0.10)</td>
<td>1.17 (0.10)</td>
<td>1</td>
<td>48</td>
<td>6.613</td>
<td>0.013</td>
<td>0.121</td>
<td>0.712</td>
</tr>
<tr>
<td>DERS strat</td>
<td>1.01 (0.10)</td>
<td>1.28 (0.14)</td>
<td>1</td>
<td>48</td>
<td>59.939</td>
<td>&lt; 0.001</td>
<td>0.555</td>
<td>1.000</td>
</tr>
<tr>
<td>DERS clarity</td>
<td>0.86 (0.09)</td>
<td>1.00 (0.11)</td>
<td>1</td>
<td>48</td>
<td>25.200</td>
<td>&lt; 0.001</td>
<td>0.344</td>
<td>0.998</td>
</tr>
<tr>
<td>DES total</td>
<td>2.29 (0.89)</td>
<td>2.97 (1.28)</td>
<td>1</td>
<td>48</td>
<td>4.804</td>
<td>0.033</td>
<td>0.091</td>
<td>0.575</td>
</tr>
<tr>
<td>BCSS neg self</td>
<td>0.59 (0.77)</td>
<td>1.21 (0.81)</td>
<td>1</td>
<td>48</td>
<td>7.730</td>
<td>0.008</td>
<td>0.139</td>
<td>0.778</td>
</tr>
<tr>
<td>BCSS pos self</td>
<td>16.65 (3.96)</td>
<td>13.33 (3.80)</td>
<td>1</td>
<td>48</td>
<td>9.133</td>
<td>0.004</td>
<td>0.160</td>
<td>0.842</td>
</tr>
<tr>
<td>BCSS neg other</td>
<td>1.13 (1.11)</td>
<td>1.44 (1.13)</td>
<td>1</td>
<td>48</td>
<td>0.964</td>
<td>0.331</td>
<td>0.020</td>
<td>0.161</td>
</tr>
<tr>
<td>BCSS pos other</td>
<td>14.73 (4.31)</td>
<td>12.04 (4.31)</td>
<td>1</td>
<td>48</td>
<td>4.845</td>
<td>0.033</td>
<td>0.920</td>
<td>0.578</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences; * = significant levenes

Seen in Table 4.3, those that had greater difficulties with emotion regulation reported to have significantly greater levels of dissociation, and had difficulties with accepting, staying goal directed, controlling impulses, having an awareness, lacking strategies and clarity around emotions, compared to those with lower difficulties with emotion regulation. Those with greater difficulties around emotion regulation also reported to have significantly less positive perceptions of self and of others, and more negative perceptions of themselves compared to those lower in difficulties with emotional regulation. Negative perceptions of others had the same trend as negative perceptions of the self, but it was not significant. Those who had greater difficulties in emotional regulation, also reported to have greater BPD traits, affect instability, identity problems, negative relationships, and self-harming tendencies, compared to those with lower
difficulties with emotion regulation. However, it should be noted that the distribution of scores between the low and high dissociation groups were unequal for goals (F(1, 48) = 8.424, p = 0.006) and affective instability (F(1, 48) = 4.030, p = 0.050) according to a significant Levene’s statistic, and therefore some caution is warned for those variables.

4.1.5 Median split of dissociative symptoms

A MANOVA, main effects only model was performed to determine if there were any differences between psychosocial variables according to high and low scorers on dissociative experiences. Differences were reported between those low and high in dissociative tendencies (F (18, 31) = 5.370, p < 0.001). Table 4.4 below displays the means and standard deviations for each variable in accordance to the median split of 2.39 for the low and high dissociation groups.

Seen in Table 4.4, those who scored higher on dissociative measures reported to have significantly more dissociative symptoms, and have more difficulties having acceptance, staying goal orientated, resisting impulses, and had less strategies around emotions, compared to those with lower levels of dissociation. This was also the case for awareness and clarity around emotions, but these were not significant. Those with greater levels of dissociation reported to have less positive views of themselves and others, less negative views of others, and more negative views of themselves. However, only negative views of the self was significant compared to those with less dissociative tendencies. Those with greater levels of dissociation reported to have greater BPD traits, having more affect instability, identity problems, negative relationships and self-harm issues - negative relationships was the only BPD-related variable to not be significant. However, it should be noted that the distribution of scores between the low and high dissociation groups were unequal for dissociation (F(1, 48) = 5.303, p = 0.026), affective instability (F(1, 48) = 6.038, p = 0.018), and self-harm (F(1, 48) = 8.078, p = 0.007) according to a significant Levene’s statistic, and therefore some caution is warned for those variables.
Table 4.4. Descriptive and comparative statistics in psychosocial variables for the participants in the study based on a high and low dissociation median split.

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 22)</th>
<th>High (n = 28)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>5.83 (1.10)</td>
<td>5.99 (1.00)</td>
<td>1</td>
<td></td>
<td>0.295</td>
<td>0.589</td>
<td>0.006</td>
<td>0.083</td>
</tr>
<tr>
<td>PAI-BOR total</td>
<td>6.84 (0.58)</td>
<td>7.51 (0.78)</td>
<td>1</td>
<td></td>
<td>11.440</td>
<td>0.001</td>
<td>0.192</td>
<td>0.912</td>
</tr>
<tr>
<td>PAI-BOR aff inst*</td>
<td>7.00 (0.56)</td>
<td>7.38 (0.83)</td>
<td>1</td>
<td></td>
<td>3.437</td>
<td>0.070</td>
<td>0.067</td>
<td>0.443</td>
</tr>
<tr>
<td>PAI-BOR id prob</td>
<td>46.50 (7.18)</td>
<td>57.29 (9.28)</td>
<td>1</td>
<td></td>
<td>20.203</td>
<td>&lt;0.001</td>
<td>0.296</td>
<td>0.993</td>
</tr>
<tr>
<td>PAI-BOR neg rel</td>
<td>6.92 (0.66)</td>
<td>7.28 (0.67)</td>
<td>1</td>
<td></td>
<td>3.514</td>
<td>0.067</td>
<td>0.068</td>
<td>0.451</td>
</tr>
<tr>
<td>PAI-BOR s harm*</td>
<td>0.008 (0.003)</td>
<td>0.011 (0.004)</td>
<td>1</td>
<td></td>
<td>6.376</td>
<td>0.015</td>
<td>0.117</td>
<td>0.696</td>
</tr>
<tr>
<td>DERS total</td>
<td>1.79 (0.10)</td>
<td>1.91 (0.11)</td>
<td>1</td>
<td></td>
<td>15.549</td>
<td>&lt;0.001</td>
<td>0.245</td>
<td>0.971</td>
</tr>
<tr>
<td>DERS non-acc</td>
<td>0.97 (0.15)</td>
<td>1.13 (0.16)</td>
<td>1</td>
<td></td>
<td>11.994</td>
<td>0.001</td>
<td>0.200</td>
<td>0.924</td>
</tr>
<tr>
<td>DERS goals</td>
<td>11.32 (3.20)</td>
<td>14.96 (4.65)</td>
<td>1</td>
<td></td>
<td>9.830</td>
<td>0.003</td>
<td>0.170</td>
<td>0.867</td>
</tr>
<tr>
<td>DERS impulse</td>
<td>0.92 (0.11)</td>
<td>1.00 (0.16)</td>
<td>1</td>
<td></td>
<td>4.607</td>
<td>0.037</td>
<td>0.088</td>
<td>0.557</td>
</tr>
<tr>
<td>DERS aware</td>
<td>1.10 (0.09)</td>
<td>1.15 (0.12)</td>
<td>1</td>
<td></td>
<td>2.756</td>
<td>0.103</td>
<td>0.054</td>
<td>0.370</td>
</tr>
<tr>
<td>DERS strat</td>
<td>1.04 (0.15)</td>
<td>1.22 (0.16)</td>
<td>1</td>
<td></td>
<td>18.058</td>
<td>&lt;0.001</td>
<td>0.273</td>
<td>0.986</td>
</tr>
<tr>
<td>DERS clarity</td>
<td>0.90 (0.13)</td>
<td>0.95 (0.12)</td>
<td>1</td>
<td></td>
<td>2.061</td>
<td>0.158</td>
<td>0.041</td>
<td>0.290</td>
</tr>
<tr>
<td>DES total*</td>
<td>1.67 (0.50)</td>
<td>3.36 (0.91)</td>
<td>1</td>
<td></td>
<td>61.149</td>
<td>&lt;0.001</td>
<td>0.560</td>
<td>1.000</td>
</tr>
<tr>
<td>BCSS neg self</td>
<td>0.69 (0.79)</td>
<td>1.04 (0.87)</td>
<td>1</td>
<td></td>
<td>2.140</td>
<td>0.150</td>
<td>0.043</td>
<td>0.300</td>
</tr>
<tr>
<td>BCSS pos self</td>
<td>15.73 (4.30)</td>
<td>14.54 (4.10)</td>
<td>1</td>
<td></td>
<td>0.996</td>
<td>0.323</td>
<td>0.020</td>
<td>0.165</td>
</tr>
<tr>
<td>BCSS neg other</td>
<td>1.34 (1.16)</td>
<td>1.24 (1.10)</td>
<td>1</td>
<td></td>
<td>0.107</td>
<td>0.745</td>
<td>0.002</td>
<td>0.062</td>
</tr>
<tr>
<td>BCSS pos other</td>
<td>14.45 (4.74)</td>
<td>12.64 (4.18)</td>
<td>1</td>
<td></td>
<td>2.056</td>
<td>0.158</td>
<td>0.041</td>
<td>0.290</td>
</tr>
</tbody>
</table>

Notes: Values in bold report significant differences; * = significant levenes

4.2 Emotional recognition task: behavioural results

4.2.1 Data screening

Prior to analysis, the data was screened for outliers and normality, as there was no chance for missing data due to the programming and saving of the task data. Normality for the data was determined statistically and assessed according to a 0.05 significance value using skewness divided by standard error of skewness. Outliers were considered as data that was outside a 2 standard deviation range of the mean, provided that the removal of that case (and subsequent cases, if relevant) resolved the skew and it was not directly adjacent to the main dataset when viewed by a boxplot. This approach lead to the removal of 1 data point for the mean of dynamic raising of cheek decision for the happy faces.
Although the mean of the dynamic frowning decision for the happy faces had 5 outliers, 3 standard deviations from the mean, these outliers were left in because parametric analyses with that variable would be unrealistic because of the spread of data for that variable – 45 cases answered 10, leaving any score above that 3 standard deviations above the mean.

Scores for the dynamic raising of cheek and frown decision for the neutral faces were transformed using “(-1/X) + transformed minimum value”, whereas the dynamic teeth decision had 48 cases on 10. However, the neutral faces, cheek decision needed to be transformed by adding 0.1 and then using the “(-1/X) + transformed minimum value” transformation a second time. It should also be noted that 23 cases reported 10 in this variable. With regards to the angry face dynamic face decisions, the cheek decision was transformed using “(-1/X) + transformed minimum value”, whereas the frown decision was transformed by the power of 5; the teeth decision reported 49 cases on 10. On the other hand, for the happy face, the happy decision responses required to cubed, whereas the angry face had 45 cases answering 10. For the angry face’s happy decision, it should be first noted that 28 cases responded 10 and the removal of 7 step-wise outliers did not fix the skew. Therefore, upon transforming the variable using the “(-1/X) + transformed minimum value” three times (the second and third time the transformation was used, 0.1 was added to the variable beforehand) to force a non-significant skew, a bimodal distribution resulted which may be a concern for later analysis.

The removal of two outliers resulted in non-significant skew for the angry face’s angry decision. These missing values were replaced using the Maximum Likelihood Estimation using a 2000 iteration Missing Values Analysis, which Little’s MCAR test suggested the values were missing completely at random ($\chi^2 (724) = 2e22, p = 1.000$). In this Missing Value Analysis, all the task data (including the trust task) and all the psychosocial variables were entered into the computations. The worst case of missing data was for 1 having 4% missing data, and therefore imputation is reliable (Musil et al., 2002).
4.2.2 Judging emotions from facial expressions

4.2.2.1 Validity checks and comparisons by sex

Although the Nimstim face sets have been validated in the past, that validation considered the whole dataset, as opposed to the specific twelve faces (four face identities for each of the 3 emotions) used in this current study (Tottenham et al., 2009). For this reason, it is important to provide adequate validity and reliability specifically for the twelve images used in this study. Consequently, in order to get an idea of how participants in this study interpreted and judged the emotions associated with the emotional expressions used in this study, the means and standard deviations for each raw and transformed variables are in Table 4.5 below. The theoretical ranges for the measures used in the study and their reliability statistics are also presented in Table 4.5.

Table 4.5. Descriptive and psychometric statistics when making happy and angry decisions in judging emotional expressions (happy, neutral, angry) by sex.

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>Transformed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>happy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>happy</td>
<td>81.60 (7.53)</td>
<td>81.10 (8.23)</td>
</tr>
<tr>
<td>angry*</td>
<td>10.70 (2.11)</td>
<td>10.40 (1.56)</td>
</tr>
<tr>
<td>neutral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>happy</td>
<td>37.20 (14.20)</td>
<td>31.80 (11.76)</td>
</tr>
<tr>
<td>angry</td>
<td>29.80 (14.74)</td>
<td>31.00 (14.31)</td>
</tr>
<tr>
<td>angry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>happy</td>
<td>13.00 (5.91)</td>
<td>14.70 (9.14)</td>
</tr>
<tr>
<td>angry</td>
<td>76.98 (9.07)</td>
<td>76.98 (11.04)</td>
</tr>
</tbody>
</table>

Notes
* = normal distribution was not possible

In order to ascertain whether happy faces were more associated with happiness, and the angry face were more associated with anger, the one sample Wilcoxon signed-rank test, a non-parametric analysis was used on original data. Testing against a Bonferroni corrected alpha (i.e., 0.0125), results suggest that the happy faces were rated the most happy (median = 82.50), followed by the neutral faces (median = 37.50), and then the angry faces (10.00).
This is because when the happy decision for the happy faces were significantly higher than the neutral faces (p < 0.001) and angry faces (p < 0.001), and the neutral faces were significantly higher than the angry faces (p < 0.001). The opposite trend was found in the angry decision for the happy (median = 10.00), neutral (median = 32.50) and angry faces (median = 77.50). This is because the angry decision for the happy faces were significantly lower than the neutral faces (p < 0.001), which were significantly lower than the angry faces (p < 0.001), and the angry decision for the neutral faces were significantly lower than the angry faces (p < 0.001). Happy faces were significantly judged to be rated happy than angry (p < 0.001), the angry faces were significantly rated to be angry than happy (p < 0.001), and the neutral faces was significantly rated to be more happy than angry (p = 0.003). While the above significant differences suggest predictable patterns when reading the emotions from facial features, Cronbach’s alpha reliabilities displayed in Table 4.5 indicate each face used in the study were coherent and complimentary of each other. For these two reasons, it can be confidently said that the faces used in this study were valid and reliable, allowing for further analysis.

Knowing that the faces presented in the study are valid and reliable a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting the facial movements between sex, but only for data that is normally distributed. Univariate statistics indicated that there were no significant differences between sex when making happy (F (1, 48) = 0.050, p = 0.824) decisions for a happy face, happy (F (1, 48) = 2.144, p = 0.150) and angry (F (1, 48) = 0.085, p = 0.771) decisions for a neutral face, and happy (F (1, 48) < 0.001, p = 0.983) and angry (F (1, 48) < 0.001, p = 1.000) decisions for an angry face. Knowing that no sex differences were found in judging facial movements in accordance to the emotional expression, other psychosocial factors were investigated (low and high BPD traits, dissociation, and emotional regulation).

### 4.2.2.2 Comparisons by BPD traits

To ascertain whether those with low and high BPD traits reported to interpret emotional expressions differently a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting emotions from the
emotional expressions between BPD traits. The means and standard deviations for each variables were compared using univariate statistics and both were displayed in Table 4.6 below. Seen in Table 4.6, although those with greater BPD traits reported each emotional decision less emotional than lower BPD trait counterparts, only the happy decision for the neutral face was statistically significant.

Table 4.6. Descriptive and comparative statistics when making happy and angry decisions in judging emotional expressions (happy, neutral, angry) based on a high and low BPD-trait median split.

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 24)</th>
<th>High (n = 26)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>happy</td>
<td>85.08 (8.26)</td>
<td>80.67 (7.47)</td>
<td>1</td>
<td>48</td>
<td>0.402</td>
<td>0.529</td>
<td>0.008</td>
<td>0.095</td>
</tr>
<tr>
<td>happy</td>
<td>38.54 (11.28)</td>
<td>30.77 (13.92)</td>
<td>1</td>
<td>48</td>
<td>4.657</td>
<td>0.036</td>
<td>0.088</td>
<td>0.561</td>
</tr>
<tr>
<td>angry</td>
<td>33.33 (15.14)</td>
<td>27.67 (13.38)</td>
<td>1</td>
<td>48</td>
<td>1.956</td>
<td>0.168</td>
<td>0.039</td>
<td>0.278</td>
</tr>
<tr>
<td>happy</td>
<td>4.40 (4.89)</td>
<td>4.06 (4.83)</td>
<td>1</td>
<td>48</td>
<td>0.062</td>
<td>0.804</td>
<td>0.001</td>
<td>0.057</td>
</tr>
<tr>
<td>angry</td>
<td>77.69 (9.92)</td>
<td>76.33 (10.22)</td>
<td>1</td>
<td>48</td>
<td>0.227</td>
<td>0.636</td>
<td>0.005</td>
<td>0.075</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences

4.2.2.3 Comparisons by emotion dysregulation

To ascertain whether those with low and high difficulties with emotion regulation reported to interpret emotional expressions differently a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting emotions from the emotional expressions between emotion regulation difficulty. The means and standard deviations for each variables were compared using univariate statistics and both were displayed in Table 4.7 below. Seen in Table 4.7, those with greater difficulties with emotion regulation judged the emotions of all the emotional faces as less emotional than those with less difficulties with emotion regulation, however only the happy decision for the neutral face was significant.
### Table 4.7. Descriptive and comparative statistics when making happy and angry decisions in judging emotional expressions (happy, neutral, angry) based on a high and low emotion dysregulation median split.

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 26)</th>
<th>High (n = 24)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>happy</td>
<td>81.44 (8.44)</td>
<td>81.25 (7.26)</td>
<td>1</td>
<td>48</td>
<td>0.007</td>
<td>0.932</td>
<td>&lt; 0.001</td>
<td>0.051</td>
</tr>
<tr>
<td>neutral</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>happy</td>
<td>38.46 (11.14)</td>
<td>30.21 (14.10)</td>
<td>1</td>
<td>48</td>
<td>5.317</td>
<td>0.025</td>
<td>0.100</td>
<td>0.618</td>
</tr>
<tr>
<td>angry</td>
<td>32.69 (14.73)</td>
<td>27.92 (13.88)</td>
<td>1</td>
<td>48</td>
<td>1.386</td>
<td>0.245</td>
<td>0.028</td>
<td>0.211</td>
</tr>
<tr>
<td>angry</td>
<td>4.44 (4.89)</td>
<td>3.99 (4.82)</td>
<td>1</td>
<td>48</td>
<td>0.745</td>
<td>0.745</td>
<td>0.002</td>
<td>0.062</td>
</tr>
<tr>
<td>angry</td>
<td>77.29 (9.82)</td>
<td>76.64 (10.39)</td>
<td>1</td>
<td>48</td>
<td>0.051</td>
<td>0.823</td>
<td>0.001</td>
<td>0.056</td>
</tr>
</tbody>
</table>

Notes: Values in bold report significant differences.

#### 4.2.2.4 Comparisons by dissociative experiences

To ascertain whether those with low and high dissociative tendencies reported to interpret emotional expressions differently a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting emotions from the emotional expressions between dissociative tendency. Univariate statistics indicated that there were no significant differences between groups with low and high dissociative tendencies when making happy (F (1, 48) = 0.214, p = 0.645) decisions for happy faces, happy (F (1, 48) = 0.157, p = 0.694) decisions for happy faces, and angry (F (1, 48) = 1.611, p = 0.210) decisions for neutral faces, and happy (F (1, 48) = 0.025, p = 0.876) and angry (F (1, 48) = 0.010, p = 0.920) decisions for angry faces.
4.2.3 Judging face characteristics for each emotion

4.2.3.1 Validity checks and comparisons by sex

In order to get an idea of how participants in this study interpreted and judged the physical characteristics associated with the emotional expressions used in this study, the means and standard deviations for each raw and transformed variables are in Table 4.8 below. The theoretical ranges for the measures used in the study and their reliability statistics are also presented in Table 4.8.

Table 4.8. Descriptive and psychometric statistics when judging physical characteristics of emotional expressions (happy, neutral, angry) by sex.

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>Transformed</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Total</td>
<td>Males</td>
<td>Females</td>
<td>Total</td>
<td>TR</td>
<td>reliability</td>
</tr>
<tr>
<td>happy</td>
<td>cheek</td>
<td>69.22 (10.30)</td>
<td>67 (13.83)</td>
<td>68.11 (12.12)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
</tr>
<tr>
<td></td>
<td>teeth</td>
<td>72.80 (10.61)</td>
<td>72.4 (13.70)</td>
<td>72.6 (12.13)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
</tr>
<tr>
<td></td>
<td>frown*</td>
<td>10.70 (1.84)</td>
<td>10.40 (2.00)</td>
<td>10.55 (1.91)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
</tr>
<tr>
<td>neutral</td>
<td>cheek</td>
<td>18.80 (11.73)</td>
<td>15.40 (10.12)</td>
<td>17.1 (10.98)</td>
<td>2.05 (1.66)</td>
<td>1.22 (1.67)</td>
<td>1.63 (1.70)</td>
<td>10-90</td>
</tr>
<tr>
<td></td>
<td>teeth*</td>
<td>10.10 (0.50)</td>
<td>10.20 (1.00)</td>
<td>10.15 (0.78)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
</tr>
<tr>
<td></td>
<td>frown</td>
<td>18.30 (11.31)</td>
<td>19.80 (16.02)</td>
<td>19.05 (13.75)</td>
<td>0.03 (0.03)</td>
<td>0.03 (0.03)</td>
<td>0.03 (0.03)</td>
<td>10-90</td>
</tr>
<tr>
<td>angry</td>
<td>cheek</td>
<td>22.40 (11.33)</td>
<td>20.40 (15.18)</td>
<td>21.4 (13.30)</td>
<td>0.04 (0.03)</td>
<td>0.03 (0.03)</td>
<td>0.04 (0.03)</td>
<td>10-90</td>
</tr>
<tr>
<td></td>
<td>teeth*</td>
<td>-</td>
<td>10.10 (0.50)</td>
<td>10.05 (0.35)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
</tr>
<tr>
<td></td>
<td>frown</td>
<td>76.40 (18.01)</td>
<td>69.30 (23.45)</td>
<td>72.85 (21.00)</td>
<td>42e6 (21e6)</td>
<td>35e6 (25e6)</td>
<td>39e6 (23e6)</td>
<td>10-90</td>
</tr>
</tbody>
</table>

Notes
* = normal distribution was not possible

In order to ascertain whether happy faces were more associated with a cheek raise, and the angry face were more associated with frowning than the other faces, as well as determining the most influential physical characteristic for each emotion, the one sample Wilcoxon signed-rank test, a non-parametric analysis was used on original data. Testing against an Bonferroni corrected alpha (i.e., 0.00625), when the median of the cheek raise from the happy face (i.e., 67.81) was compared to the median of the cheek raise in the neutral (i.e., 12.50) and angry faces (i.e., 15.00), results indicate that happy faces were significantly related to cheek raises more than neutral (p < 0.001) and angry faces (p < 0.001).
When using the median of the neutral cheek raise, the angry faces were significantly associated with a cheek raise than neutral faces (p < 0.001). When the median of the teeth shown from the happy face (i.e., 75.00) was compared to the median of the teeth shown in the neutral (i.e., 10.00) and angry faces (i.e., 10.00), results indicate that happy faces were significantly related to teeth shown more than neutral (p < 0.001) and angry faces (p < 0.001). Furthermore, when using the median of the neutral teeth shown, the angry faces were not significantly associated with teeth shown than neutral faces (p = 0.317).

When the median of the frown from the happy face (i.e., 10.55) was compared to the median of the frown in the neutral (i.e., 19.05) and angry faces (i.e., 80.00), results indicate that happy faces were less significantly related to frown more than neutral (p < 0.001) and angry faces (p < 0.001). Furthermore, when using the median of the neutral frown, the angry faces were significantly associated with a frown than neutral faces (p < 0.001).

When comparing between the physical characteristic judgments within happy faces, results suggest that both the cheek raise (median = 67.81) and teeth shown (median = 75.00) were the best predictors for a happy face, compared to a frown (median = 10.55). This is because the differences between teeth shown and cheek raise judgments was not significant (p = 0.016), but the differences between the cheek raise (p < 0.001) and teeth shown (p < 0.001) was significantly different when compared to frowning. When comparing between the physical characteristic judgments within neutral faces, results suggest that the neutral face was associated with both the cheek raise (median = 12.50) and frown (median = 19.05), but not teeth shown (median = 10.00). This is because the cheek raise was significantly higher than the teeth shown judgment (p < 0.001), but not frowning (p = 0.018), whereas teeth shown was significantly different from frowning (p < 0.001). When comparing between the physical characteristic judgments within angry faces, results suggest that frowning (median = 80) was most associated with judging angry faces, well over cheek raise (median 15.00) and teeth shown (median = 10), but the cheek raise did contribute in a minor way to the perception of anger. This is because both teeth shown (p < 0.001) and
frowning (p < 0.001) were significantly different from cheek raises, and teeth shown was significantly different from frowning (p < 0.001). While the above significant differences suggest predictable patterns when reading the emotions from facial features, high Cronbachs alpha reliabilities displayed in Table 4.8 above suggest each face used in the study were coherent and complimentary of each other. For these two reasons, it can be confidently said that the faces used in this study were valid and reliable, allowing for further analysis.

Knowing that the faces presented in the study are valid and reliable, a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting the facial movements between sex, but only for data that is normally distributed. Univariate statistics indicated that there were no significant differences between sex when judging facial movements: happy cheek raise (F (1, 48) = 0.0416, p = 0.522) and teeth (F (1, 48) = 0.013, p = 0.909); neutral cheek raise (F (1, 48) = 3.121, p = 0.084) and frown (F (1, 48) = 0.221, p = 0.641); and angry cheek raise (F (1, 48) = 3.106, p = 0.084) and frown (F (1, 48) = 1.127, p = 0.294). Knowing that no sex differences were found in judging facial movements in accordance to the emotional expression, other psychosocial factors were investigated (low and high BPD traits, dissociation, and emotional regulation).

### 4.2.3.2 Comparisons by BPD traits

To ascertain whether those with low and high BPD traits reported to interpret facial movements associated with the various emotions a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting the facial movements between BPD traits. The means and standard deviations for each variables were compared using univariate statistics and both were displayed in Table 4.9 below.
Table 4.9. Descriptive and comparative statistics of judging physical characteristics of emotional expressions (happy, neutral, angry) based on a high and low BPD-trait median split.

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 24)</th>
<th>High (n = 26)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheek</td>
<td>70.00 (10.29)</td>
<td>66.37 (13.55)</td>
<td>1</td>
<td>48</td>
<td>1.123</td>
<td>0.295</td>
<td>0.023</td>
<td>0.18</td>
</tr>
<tr>
<td>teeth</td>
<td>72.71 (11.18)</td>
<td>72.50 (13.17)</td>
<td>1</td>
<td>48</td>
<td>0.004</td>
<td>0.952</td>
<td>&lt; 0.001</td>
<td>0.050</td>
</tr>
<tr>
<td>neutral</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheek</td>
<td>1.26 (1.56)</td>
<td>1.97 (1.78)</td>
<td>1</td>
<td>48</td>
<td>2.231</td>
<td>0.142</td>
<td>0.044</td>
<td>0.310</td>
</tr>
<tr>
<td>frown*</td>
<td>0.015 (0.023)</td>
<td>0.041 (0.031)</td>
<td>1</td>
<td>48</td>
<td>11.263</td>
<td>0.002</td>
<td>0.19</td>
<td>0.908</td>
</tr>
<tr>
<td>angry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheek</td>
<td>0.034 (0.034)</td>
<td>0.038 (0.030)</td>
<td>1</td>
<td>48</td>
<td>0.185</td>
<td>0.669</td>
<td>0.004</td>
<td>0.071</td>
</tr>
<tr>
<td>frown</td>
<td>36e6 (23e6)</td>
<td>41e6 (24e6)</td>
<td>1</td>
<td>48</td>
<td>0.677</td>
<td>0.415</td>
<td>0.014</td>
<td>0.127</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences; * = significant Levene's

Seen in Table 4.9, it appears that those with greater BPD traits reported to read the cheek movement less important to a happy face than those with lower BPD traits, but this was not significant as was the amount of teeth showing. Those with greater BPD traits reported to interpret a neutral face having a higher cheek raise and greater frown than those with lower BPD traits, but only the frown was significantly different between the groups. However it should be noted that distribution of scores between the low and high BPD trait groups for the frown in the neutral faces was not equal according to a significant Levene’s test of equality of variance (F (1, 48) = 4.690, p = 0.035), and therefore caution is warned. With regards to the angry face, both the cheek raise and frown appeared to be rated more important for those with greater BPD traits compared to those with less BPD traits, but these differences were not significant.

4.2.3.3 Comparisons by emotion dysregulation

To ascertain whether those with low and high difficulties with emotion regulation reported to interpret facial movements associated with the various emotions a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting the facial movements between emotional regulation difficulty.
Univariate statistics indicated that there were no significant differences between the low and high dissociation groups for the happy cheek (F (1, 48) = 0.195, p = 0.660) and teeth (F (1, 48) = 0.212, p = 0.647), neutral cheek (F (1, 48) = 0.018, p = 0.894) and frown (F (1, 48) = 1.281, p = 0.263), and angry cheek (F (1, 48) = 0.004, p = 0.948) and frown (F (1, 48) = 0.119, p = 0.732).

4.2.3.4 Comparisons by dissociative experiences

To ascertain whether those with low and high dissociative tendencies reported to interpret facial movements associated with the various emotions a MANOVA, main effects only model was performed to determine if there were any mean differences between interpreting the facial movements between dissociative tendency. Univariate statistics indicated that there were no significant differences between the low and high dissociation groups for the happy cheek (F (1, 48) = 0.315, p = 0.577) and teeth (F (1, 48) = 0.282, p = 0.598), neutral cheek (F (1, 48) = 0.010, p = 0.922) and frown (F (1, 48) = 1.303, p = 0.259), and angry cheek (F (1, 48) = 0.963, p = 0.331) and frown (F (1, 48) = 0.020, p = 0.889).

4.3 Emotional recognition task: EEG source localisation results

4.3.1 Data screening

In order to investigate differences in brain activity, as measured and computed by eLORETA, data was exported out of Vision Analyser into the sLORETA program (KEY Institute, 2014). eLORETA values were calculated in the sLORETA program (KEY Institute, 2014) and were then exported into SPSS 22 so that it was possible to screen the data. Screening of the data was especially important considering that minor EEG artefacts persisted even after the filtering and ICA ocular correction. Therefore data screening are considered a final quality control process. During data screening, a significant skew was determined by dividing the skew by the standard error of the skew. Outliers were considered any data point (or collection of data points) that was outside half a standard
deviation from the next data point (or collection of data points). Outliers were deleted from the data set with intentions to use data imputation methods. During data deletion, the various severities of missing data were considered when performing the missing value analysis; attempts were made to keep missing data below 30% to ensure imputation did not exceed a moderate level and is therefore acceptable, but 40% was set at an absolute highest value (Musil et al., 2002). If missing data exceeded 40%, those variables were not used in any analysis.

After missing values were replaced using data imputation, the data was screened again using the same definitions of an outlier. According to the same half a standard deviation method mentioned above, if outliers were found, those values were replaced with the next nearest value. This approach kept the data numbers intact for the upcoming MANOVA analyses, which has a habit excluding cases from all statistical comparisons, even though only one of those comparisons would be affected by that missing data case. These strict data screening procedures were performed on Brodmann areas that relate to emotion recognition, regulation and mentalisation, as highlighted in chapter 1 and 2: left and right Brodmann area 6; 7; 9; 10; 11; 13; 17; 18; 19; 20; 21; 22; 23; 24; 31; 32; 34; 35; 36; 37; 38; 39; 40; 44; 45; 46; 47. Because of the strict EEG ocular correction and filtering, use of data imputation beforehand and the attempt to replace the outlier case with the next nearest number, it is deemed that the researchers made necessary and un-biased attempts of saving and handling risks associated with EEG artefact data.

In order to investigate the results of the emotional recognition EEG results, 9 missing value analyses were conducted for each combination of condition (neutral, happy and angry) and frequency (theta, alpha, and beta 1) in order to replace missing values left over from the data screening process. In each missing value analysis, all of the missing values were replaced using a 5000 iteration, Maximum Likelihood Estimation method by adding in the total psychometric variables and demographics (i.e., BPD traits, difficulties with emotion regulation, dissociative experiences, sex, handedness, education, and age).

For the neutral faces, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (991) = 834.195, p = 1.000$), alpha ($\chi^2 (1210) = 974.627, p = 1.000$), and beta 1 ($\chi^2 (1349) = 1046.524, p = 1.000$), respectively. The highest
amount of missing data was 20% for theta, 24% for alpha, and 26% for beta 1 frequency. For the happy faces, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1334) = 1094.430, p = 1.000$), alpha ($\chi^2 (1308) = 1042.580, p = 1.000$), and beta 1 ($\chi^2 (1255) = 1010.699, p = 1.000$), respectively. The highest amount of missing data was 24% for theta, 26% for alpha, and 26% for beta 1 frequency. For the angry faces, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1012) = 805.648, p = 1.000$), alpha ($\chi^2 (1049) = 871.925, p = 1.000$), and beta 1 ($\chi^2 (1057) = 873.791, p = 1.000$), respectively. The highest amount of missing data was 24% for theta, 26% for alpha, and 28% for beta 1 frequency.

### 4.3.2 Processing facial expressions

#### 4.3.2.1 Comparisons by sex

In order to investigate whether any sex differences existed when viewing the neutral facial, happy and angry expressions for theta, alpha and beta 1, 9 main effects only MANOVA’s were conducted between biological sex (1 for each facial expression and frequency). Brodmann areas were inputted as the dependent and BPD traits were inputted as the independent variable. The results of the univariate analyses for all MANOVA’s are presented in Figure 4.1 below.
Figure 4.1. Source localisation significances between sex by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Seen in Figure 4.1 above, univariate statistics indicate that females reported to have increased oscillations in numerous brain regions when compared to males across each frequency band used in the study (i.e., theta, alpha, beta 1). Sex differences were reported involved extensive frontal, temporal, parietal and occipital brain activation, and appear to be somewhat, universally consistent across comparisons. Significant difference between sex in the neutral face expression was only found in the angular area, and a difference in insula activity only existing between sex when viewing the angry facial expression. All the results were of a positive trend favouring greater oscillatory activity in females, when compared to males. As discussed later when mentioning empirical emotion and brain-based sex.
differences, such sex effects suggest that further psychometric analysis investigating BPD traits, difficulties with emotion regulation, and dissociation should be conducted independently for each sex. For this reason median splits were performed on psychometric data (BPD, DERS, DES tendency) independently for males and females to ensure as equal group sizes as possible for analysis. For the purposes of the analysis, the median splits were 7.07, 1.85, 2.32 for females and 7.28, 1.85, 2.60 for males with regard to BPD, difficulties with emotion regulation and dissociative tendencies, respectively. In order to investigate whether there were BPD trait, emotion dysregulation and dissociative differences for males and females when viewing the neutral facial, happy and angry expressions for theta, alpha and beta 1, 9 main effects only MANOVA’s were conducted between the high and low BPD trait groups (1 for each facial expression and frequency) for each sex. Brodmann areas were inputted as the dependent and BPD traits were inputted as the independent variable.

4.3.2.2 Comparisons by BPD traits

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.2 below for females with respect to BPD traits.
Figure 4.2. Source localisation significances between a high and low female BPD-trait group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Seen in Figure 4.2, univariate significances for females were found only in the beta 1 frequency in the pre-motor and posterior ACC areas when viewing neutral and happy facial expressions. The neutral faces and angry faces particularly displayed differences in temporal regions, and both neutral and angry faces presented with right insula activation. All the results were of a positive trend favouring greater oscillatory activity in females with greater BPD traits, when compared to low.
Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.3 below with respect to BPD traits for males. Seen in Figure 4.3, differences between males according to BPD traits were only found with the beta 1 oscillations in the happy face within frontal and anterior ACC regions. These differences in activation favoured greater oscillations in males with greater BPD traits, when compared to low.

<table>
<thead>
<tr>
<th>COND</th>
<th>FREQ</th>
<th>LAT</th>
<th>FRONTAL</th>
<th>TEMPORAL</th>
<th>PARIETAL</th>
<th>OCCIPITAL</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>6  9 10 11 24 44 45 46 47 20 21 22 34 35 36 37 38 7 23 31 40 17 18 19 39</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>NF</td>
<td>THETA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td>THETA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AF</td>
<td>THETA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.3. Source localisation significances between a high and low male BPD-trait group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.
### 4.3.2.3 Comparisons by emotion dysregulation

**Females**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.4 below for females with respect to the median split on difficulties with emotion regulation.

![Table and diagram showing source localisation significances](image)

**Figure 4.4.** Source localisation significances between a high and low female emotion dysregulation group by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Seen in Figure 4.4, females with greater emotion dysregulation tendencies reported to have lower activation in the right premotor cortex across every emotion. Neutral faces
reported a greater deactivation in the posterior ACC for those with greater emotion dysregulation, whereas the same trend was found for the happy and angry expressions in the inferior-posterior temporal cortex.

Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.5 below for males with respect to the median split on difficulties with emotion regulation.

<table>
<thead>
<tr>
<th>COND</th>
<th>FREQ</th>
<th>LAT</th>
<th>FRONTAL</th>
<th>TEMPORAL</th>
<th>PARIETAL</th>
<th>OCCIPITAL</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF</td>
<td>THETA</td>
<td>LEFT</td>
<td>6 9 10 11</td>
<td>12 13 14</td>
<td>15 16 17</td>
<td>18 19 20</td>
<td>21 22</td>
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<td></td>
<td>ALPHA</td>
<td>LEFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BETA 1</td>
<td>LEFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>HF</td>
<td>THETA</td>
<td>LEFT</td>
<td>23 24 25</td>
<td>26 27 28</td>
<td>29 30 31</td>
<td>32 33 34</td>
<td>35 36</td>
</tr>
<tr>
<td></td>
<td>ALPHA</td>
<td>LEFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BETA 1</td>
<td>LEFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AF</td>
<td>THETA</td>
<td>LEFT</td>
<td>37 38 39</td>
<td>40 41 42</td>
<td>43 44 45</td>
<td>46 47 48</td>
<td>49 50</td>
</tr>
<tr>
<td></td>
<td>ALPHA</td>
<td>LEFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BETA 1</td>
<td>LEFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4.5. Source localisation significances between a high and low male emotion dysregulation group by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.*
Seen in Figure 4.5, males with greater emotion dysregulation reported to have greater activation in the left premotor cortex, when considering all emotions, and particularly for happy and angry faces. Left prefrontal alpha activity was associated with only happy and angry faces for males, where greater activity was associated with greater emotion dysregulation. The posterior ACC was also associated with activity across each emotion in the beta 1 frequency; greater activation was associated with greater emotion dysregulation, except for in the neutral faces which presented the opposite trend for males.

4.3.2.4 Comparisons by dissociative experiences

**Females**

According to univariate statistics, there were no significant differences for any frequency in any condition (neutral, happy, angry faces) for females according to a median split on dissociative experiences.

**Males**

The results of the univariate analyses for all MANOVA’s pertaining to dissociation are presented in Figure 4.6 below for males with respect to the median split on dissociative experiences. However, in an attempt to be more ruthless regarding data interpretation, because of numerous significant differences when tested at an alpha of 0.05, the results presented below represent significances under an alpha of 0.01 only.
According to the results of the univariate statistics represented in Figure 4.6, according to a median split on high and low dissociation for males there were numerous significant differences across all frequencies and conditions. Premotor and frontal regions, particularly left lateralised, reported to be a common presentation for all conditions and frequencies. Theta activity was associated with temporal lobe activity in all faces, whereas alpha activity was only associated with temporal lobe activation in the neutral and happy faces. Theta activation was also associated with insula activity in all faces. Similarly, lateral-posterior parietal activity was associated with the neutral and angry faces for beta 1 activity, whereas only theta activity reported a difference between those high and low on

**Figure**: 4.6. Source localisation significances between a high and low male dissociation group by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.
dissociative tendency in the angry face. As an overall note, all of these differences reported to be a lower activity for those males who presented with greater dissociative experiences.

4.4 Trust task: behavioural results

4.4.1 Data screening

Data screening procedures and data imputation analysis have already been reported in previous sections (4.2.1). One variable was considered an outlier in the in the fairness ratings of the happy faces, as well as in the change of transfer values between the first and second half of the task for partners without emotional cues. Further to this, the fairness ratings for the lowest return values for the emotional faces (i.e., angry faces) and overall score for partners without emotional cues both required to be transformed using the logarithm of 10.

4.4.2 Judging the fairness of others

4.4.2.1 Validity checks and comparisons by sex

In order to get an idea of how participants in this study interpreted the trustworthiness of the partners in the tryst task, the means and standard deviations for each raw and transformed variables are presented in Table 4.10 below.
Table 4.10. Trust task behavioural descriptive and comparative statistics in all participants in the study and between sex.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>overall fair fair</td>
<td>59.20 (11.43)</td>
<td>57.80 (11.91)</td>
<td>58.50 (11.57)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>48</td>
<td>0.180</td>
<td>0.673</td>
<td>0.004</td>
<td>0.070</td>
</tr>
<tr>
<td>overall unfair fair</td>
<td>36.20 (14.38)</td>
<td>38.40 (12.64)</td>
<td>37.30 (13.45)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>48</td>
<td>0.330</td>
<td>0.568</td>
<td>0.007</td>
<td>0.087</td>
</tr>
<tr>
<td>overall self fair to fair</td>
<td>64.40 (17.22)</td>
<td>59.20 (13.28)</td>
<td>61.80 (15.44)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>48</td>
<td>1.429</td>
<td>0.238</td>
<td>0.029</td>
<td>0.216</td>
</tr>
<tr>
<td>overall self fair to unfair</td>
<td>59.40 (19.38)</td>
<td>49.60 (12.90)</td>
<td>54.50 (17.03)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>48</td>
<td>4.429</td>
<td>0.041</td>
<td>0.084</td>
<td>0.541</td>
</tr>
</tbody>
</table>

Before discussing any group differences in variables, it is important to first assess the validity of the trust task, making sure that expected trends exist regarding the conditions. The first of these comparisons is whether fair partners were interpreted as being fairer than unfair partners, which according to a Paired Samples t-test was significantly the case (t (1, 49) = 6.945, p < 0.001) as seen in Table 4.10. In order to ascertain whether the high, moderate, and low returns of the partners in the trust task were interpreted as being fairer throughout the task, comparisons were made between return values. Seen in Table 4.10, paired Samples t-tests were performed for return value for the non-emotional cue condition, which indicated that high returns were rated throughout the task as being fairer than moderate returns (t (1, 49) = 13.659, p < 0.001), and low returns (t (1, 49) = 29.276, p <
Similarly, moderate returns were rated as being fairer than low returns (t (1, 49) = 17.538, p < 0.001). However, due to the transformed variable for the emotional cue condition, the medians of the high (median = 72.83), moderate (median = 45.00) and low (median = 25.00) returns for partners with emotional cues were compared using a Related-Samples Wilcoxon Signed Rank Test. Each of these comparisons was significant (p < 0.001). Therefore, because fair partners were rated as fairer than unfair partners and the high, moderate and low returns during the task produced expected trends, it can be said that the trust task was valid for the assessment of group psychometric data.

In order to investigate if any differences in behavioural results in the trust task were found between males and females, main effects only MANOVA model was performed to determine if there were any mean differences for data that is normally distributed. Seen in Table 4.10, there were significant differences between sex when participants rated their own fairness of how they acted towards unfair partners, and when judging the fairness of the low return values in both partners with and without emotional cues. Males rated their behaviour towards unfair partners as being fairer than females, and similarly, females rated the partner’s behaviours in the low return condition to be fairer than males. Males seemed to have a higher overall score for partners with emotional cues than females. Because of the sex differences in the trust task results, it was decided to analyse the other psychometric data (BPD, DERS, DES, BCSS measures) independently for males and females. Although it is noted that doing this runs the risk of making the analyses underpowered, it does provide added insight into what could explain neurobiological data later on. With this said, in order to investigate these psychometric differences median splits for both males and females were performed on those aforementioned variables, from which 2 independent, main effect only model MANOVA’s were performed for each sex.

4.4.2.2 Comparisons by BPD traits

Female

According to univariate statistics, there were no significant differences between a high and a low BPD trait group for females on any of the variables in the trust task.
Male

In order to get an idea of how a high and low BPD trait group of males interpreted trustworthiness in the trust task, the means, standard deviations and statistical data was presented in Table 4.11 below. Seen in Table 4.11, according to univariate statistics, males with greater BPD traits reported to interpret the average of the first 6 of the emotional expression transfers as being fairer than those with lower BPD traits.

Table 4.11. Trust task behavioural descriptive and comparative statistics based on a high and low BPD-trait median split for males.

<table>
<thead>
<tr>
<th>Original variables</th>
<th>Transformed variables</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovr fair fair</td>
<td>Low (n = 12)</td>
<td>60.83 (13.62)</td>
<td>57.69 (9.27)</td>
<td>1</td>
<td>17</td>
<td>0.803</td>
<td>0.383</td>
</tr>
<tr>
<td>Ovr unfair fair</td>
<td>High (n = 13)</td>
<td>37.92 (16.16)</td>
<td>34.62 (12.98)</td>
<td>1</td>
<td>17</td>
<td>0.001</td>
<td>0.981</td>
</tr>
<tr>
<td>Ovr self fair fair</td>
<td>Low (n = 12)</td>
<td>64.58 (19.82)</td>
<td>64.23 (15.25)</td>
<td>1</td>
<td>17</td>
<td>0.040</td>
<td>0.845</td>
</tr>
<tr>
<td>Ovr self fair unfair</td>
<td>High (n = 13)</td>
<td>55.00 (20.34)</td>
<td>63.46 (18.30)</td>
<td>1</td>
<td>17</td>
<td>0.082</td>
<td>0.778</td>
</tr>
<tr>
<td>Partners without emotional cues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair of high return</td>
<td>Low (n = 12)</td>
<td>62.18 (6.64)</td>
<td>54.57 (9.35)</td>
<td>1</td>
<td>17</td>
<td>2.544</td>
<td>0.129</td>
</tr>
<tr>
<td>Fair of mod return</td>
<td>High (n = 13)</td>
<td>39.90 (6.93)</td>
<td>35.93 (8.89)</td>
<td>1</td>
<td>17</td>
<td>0.342</td>
<td>0.566</td>
</tr>
<tr>
<td>Fair of low return</td>
<td>Low (n = 12)</td>
<td>17.52 (5.71)</td>
<td>15.74 (6.22)</td>
<td>1</td>
<td>17</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Congruency weight</td>
<td>Low (n = 12)</td>
<td>-0.08 (2.35)</td>
<td>0.15 (1.86)</td>
<td>1</td>
<td>17</td>
<td>0.036</td>
<td>0.851</td>
</tr>
<tr>
<td>Congruency weight 2</td>
<td>High (n = 13)</td>
<td>-0.42 (1.56)</td>
<td>0.23 (1.79)</td>
<td>1</td>
<td>17</td>
<td>0.153</td>
<td>0.701</td>
</tr>
<tr>
<td>Hostility transfers</td>
<td>Low (n = 12)</td>
<td>61.11 (18.81)</td>
<td>60.26 (13.79)</td>
<td>1</td>
<td>17</td>
<td>0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hostility fairness</td>
<td>High (n = 13)</td>
<td>61.25 (12.08)</td>
<td>56.67 (14.19)</td>
<td>1</td>
<td>17</td>
<td>0.002</td>
<td>0.965</td>
</tr>
<tr>
<td>Trdec sub</td>
<td>Low (n = 12)</td>
<td>-7.42 (8.26)</td>
<td>-7.12 (12.86)</td>
<td>1</td>
<td>17</td>
<td>2.234</td>
<td>0.153</td>
</tr>
<tr>
<td>Fadec sub</td>
<td>High (n = 13)</td>
<td>2.40 (18.34)</td>
<td>-1.35 (14.14)</td>
<td>1</td>
<td>17</td>
<td>0.462</td>
<td>0.506</td>
</tr>
<tr>
<td>Overall score</td>
<td></td>
<td>1618.58 (37.18)</td>
<td>1620.00 (61.17)</td>
<td>1</td>
<td>17</td>
<td>0.492</td>
<td>0.492</td>
</tr>
<tr>
<td>Partners with emotional cues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair of high return</td>
<td>Low (n = 12)</td>
<td>73.47 (6.49)</td>
<td>70.51 (9.75)</td>
<td>1</td>
<td>17</td>
<td>0.043</td>
<td>0.838</td>
</tr>
<tr>
<td>Fair of mod return</td>
<td>High (n = 13)</td>
<td>44.58 (7.39)</td>
<td>42.82 (11.61)</td>
<td>1</td>
<td>17</td>
<td>0.146</td>
<td>0.707</td>
</tr>
<tr>
<td>Fair of low return</td>
<td>Low (n = 12)</td>
<td>22.64 (9.73)</td>
<td>25.38 (11.43)</td>
<td>1</td>
<td>17</td>
<td>2.484</td>
<td>0.133</td>
</tr>
<tr>
<td>Hostility transfers</td>
<td>Low (n = 12)</td>
<td>48.06 (10.63)</td>
<td>43.33 (12.51)</td>
<td>1</td>
<td>17</td>
<td>&lt;0.001</td>
<td>0.999</td>
</tr>
<tr>
<td>Hostility fairness</td>
<td>High (n = 13)</td>
<td>46.67 (9.69)</td>
<td>44.62 (10.28)</td>
<td>1</td>
<td>17</td>
<td>4.762</td>
<td>0.043</td>
</tr>
<tr>
<td>Trdec sub</td>
<td>Low (n = 12)</td>
<td>10.28 (17.54)</td>
<td>6.54 (16.17)</td>
<td>1</td>
<td>17</td>
<td>0.586</td>
<td>0.455</td>
</tr>
<tr>
<td>Fadec sub</td>
<td>High (n = 13)</td>
<td>3.61 (8.64)</td>
<td>-2.56 (9.32)</td>
<td>1</td>
<td>17</td>
<td>3.138</td>
<td>0.094</td>
</tr>
<tr>
<td>Overall score</td>
<td>Low (n = 12)</td>
<td>1179.33 (67.05)</td>
<td>1213.85 (62.64)</td>
<td>1</td>
<td>17</td>
<td>2.083</td>
<td>0.167</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences; ovr fair fair = overall fairness rating of fair partners; ovr unfair fair = overall fairness rating of unfair partners; ovr self fair to fair = self rating of fairness to fair partners; ovr self fair to unfair = self rating of fairness to unfair partners; 
fair of high return = fairness of high partner returns; fair of mod return = fairness of moderate partner returns; fair of low return = fairness of low partner returns; 
hostility transfers = transfer values of participants within the first halves of the task; hostility fairness = fairness ratings of partners in the first halves of the task; 
trdec sub = change in transfers between first and second halves of the task; fadec sub = change in fairness ratings between first and second halves of the task; 
congruency weight = congruency values in the first 4 presentations of each partner; congruency weight 2 = congruency values in the first 5 presentations of each partner.
4.4.2.3 Comparisons by emotion dysregulation

Female

In order to get an idea of how a high and low BPD trait group of females interpreted trustworthiness in the trust task, the means, standard deviation, and statistical data was presented in Table 4.12 below. Seen in Table 4.12, according to univariate statistics females that reported more emotional dysregulation reported to rate the low and moderate returns of the partners without emotional cues as being fairer. The same trend was found in the high and moderate transfers of the partners with emotional cues. The average of the first 6 of the emotional expression transfers were also reported as being fairer for those with greater emotion dysregulation when compared to low.
### Table 4.12. Trust task behavioural descriptive and comparative statistics based on a high and low emotion dysregulation median split for females.

<table>
<thead>
<tr>
<th>Original variables</th>
<th>Transformed variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (n = 11)</td>
</tr>
<tr>
<td>ovr fair fair</td>
<td>55.00 (13.42)</td>
</tr>
<tr>
<td>ovr unfair fair</td>
<td>37.27 (12.32)</td>
</tr>
<tr>
<td>ovr self fair to fair</td>
<td>55.91 (12.41)</td>
</tr>
<tr>
<td>ovr self fair to unfair</td>
<td>45.00 (11.62)</td>
</tr>
</tbody>
</table>

Partners without emotional cues

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 11)</th>
<th>high (n = 14)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair of high return</td>
<td>57.12 (9.26)</td>
<td>61.20 (8.22)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>1.29</td>
<td>0.272</td>
<td>0.071</td>
</tr>
<tr>
<td>Fair of mod return</td>
<td>32.74 (9.82)</td>
<td>48.47 (8.54)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>7.374</td>
<td>0.015</td>
<td>0.303</td>
</tr>
<tr>
<td>Fair of low return</td>
<td>18.20 (6.92)</td>
<td>25.10 (6.55)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>5.502</td>
<td>0.031</td>
<td>0.245</td>
</tr>
<tr>
<td>Congruency weight</td>
<td>-0.64 (1.75)</td>
<td>-0.71 (1.68)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.384</td>
<td>0.544</td>
<td>0.022</td>
</tr>
<tr>
<td>Congruency weight 2</td>
<td>-0.18 (1.78)</td>
<td>0.57 (2.06)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.253</td>
<td>0.622</td>
<td>0.015</td>
</tr>
<tr>
<td>Hostility transfers</td>
<td>60.15 (17.91)</td>
<td>61.78 (14.46)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.001</td>
<td>0.972</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hostility fairness</td>
<td>58.64 (10.87)</td>
<td>68 (15.11)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>1.989</td>
<td>0.176</td>
<td>0.105</td>
</tr>
<tr>
<td>Fadec sub</td>
<td>-4.20 (10.67)</td>
<td>-2.50 (11.23)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.065</td>
<td>0.802</td>
<td>0.004</td>
</tr>
<tr>
<td>Overall score</td>
<td>1649.64 (38.63)</td>
<td>1637.36 (40.57)</td>
<td>3.22 (0.01)</td>
<td>3.21 (0.01)</td>
<td>1 17</td>
<td>0.022</td>
<td>0.883</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Partners with emotional cues

<table>
<thead>
<tr>
<th></th>
<th>Low (n = 11)</th>
<th>high (n = 14)</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Obs power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair of high return</td>
<td>67.42 (7.69)</td>
<td>76.71 (6.76)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>5.26</td>
<td>0.035</td>
<td>0.236</td>
</tr>
<tr>
<td>Fair of mod return</td>
<td>41.67 (7.89)</td>
<td>53.09 (12.97)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>5.551</td>
<td>0.031</td>
<td>0.246</td>
</tr>
<tr>
<td>Fair of low return</td>
<td>28.64 (13.01)</td>
<td>32.26 (12.60)</td>
<td>1.42 (0.19)</td>
<td>1.48 (0.17)</td>
<td>1 17</td>
<td>1.53</td>
<td>0.233</td>
<td>0.083</td>
</tr>
<tr>
<td>Hostility transfers</td>
<td>44.24 (8.24)</td>
<td>42.98 (13.59)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.042</td>
<td>0.84</td>
<td>0.002</td>
</tr>
<tr>
<td>Hostility fairness</td>
<td>47.12 (7.82)</td>
<td>50.83 (13.39)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>5.171</td>
<td>0.036</td>
<td>0.233</td>
</tr>
<tr>
<td>Fadec sub</td>
<td>4.39 (9.75)</td>
<td>9.17 (10.06)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.045</td>
<td>0.834</td>
<td>0.003</td>
</tr>
<tr>
<td>Overall score</td>
<td>1172.55 (61.80)</td>
<td>1151.79 (51.29)</td>
<td>-</td>
<td>-</td>
<td>1 17</td>
<td>0.094</td>
<td>0.763</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences; ovr fair fair = overall fairness rating of fair partners; ovr unfair fair = overall fairness rating of unfair partners; ovr self fair to fair = self rating of fairness to fair partners; ovr self fair to unfair = self rating of fairness to unfair partners; fair of high return = fairness of high partner returns; fair of mod return = fairness of moderate partner returns; fair of low return = fairness of low partner returns; hostility transfers = transfer values of participants within the first halves of the task; hostility fairness = fairness ratings of partners in the first halves of the task; trdec sub = change in transfers between first and second halves of the task; fadec sub = change in fairness ratings between first and second halves of the task; congruency weight = congruency values in the first 4 presentations of each partner; congruency weight 2 = congruency values in the first 5 presentations of each partner.

#### Male

According to univariate statistics, there were no significant differences between a high and a low emotional dysregulation for males on any of the variables in the trust task.
4.4.2.4 Comparisons by positive views of others

Females

According to univariate statistics, there were no significant differences between high and low positive views of others for females on any of the variables in the trust task.

Males

In order to get an idea of how a high and low positive views of others group of males interpreted trustworthiness in the trust task, the means, standard deviations and statistical data was presented in Table 4.13 below. Seen in Table 4.13, according to univariate statistics, males with greater positive views of others reported to interpret the average of the first 6 of the emotional expression transfers as being fairer than those with lower BPD traits.
Table 4.13. Trust task behavioural descriptive and comparative statistics based on a high and low median split on positive views of others for males.

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Notes

Values in bold report significant differences; ovr fair fair = overall fairness rating of fair partners; ovr unfair fair = overall fairness rating of unfair partners; ovr self fair to fair = self rating of fairness to fair partners; ovr self fair to unfair = self rating of fairness to unfair partners; fair of high return = fairness of high partner returns; fair of mod return = fairness of moderate partner returns; fair of low return = fairness of low partner returns; hostility transfers = transfer values of participants within the first halves of the task; hostility fairness = fairness ratings of partners in the first halves of the task; trdec sub = change in transfers between first and second halves of the task; fadec sub = change in fairness ratings between first and second halves of the task; congruency weight = congruency values in the first 4 presentations of each partner; congruency weight 2 = congruency values in the first 5 presentations of each partner.

4.4.2.5 All other comparisons

According to univariate statistics, there were no significant differences between high and low dissociative tendencies, positive and negative views of the self, and negative views of others for females and males in the trust task.
4.5 Trust task: EEG source localisation results

4.5.1 Data screening

The data screening process used for the trust task was identical to those previously described (Section 4.3.1). However, the trust tasks fairness decision reaction times were screened in an attempt to identify whether fairness decisions were influenced by other factors, such as if participants made the decision to move on to the next partner within the 500 millisecond EEG epoch length. Screening suggested that this was not the case, and even decisions within 800 milliseconds did not seem to occur: only 12 participants responded within the first 800 milliseconds, with maximum amounts of decisions being 9 once, 7 twice, and 5 once. Therefore, out of 36 EEG epochs, the majority can be confidently said to not be affected by another post-moment decision.

In order to investigate the results of the trust task’s EEG results, 18 missing value analyses were conducted for each combination of condition (partners with and without emotional cues), decision (fairness, transfer, and fairness minus transfer decision) and frequency (theta, alpha, and beta 1) in order to replace missing values left over from the data screening process. In each missing value analysis, all of the missing values were replaced using a 5000 iteration, Maximum Likelihood Estimation method by adding in the total psychometric variables, task data, and demographics (i.e., BPD trait, difficulties with emotion regulation, dissociative experiences, negative and positive views of the self and others, sex, handedness, education, and age. The hostility transfer and fairness ratings, differences in transfer and fairness ratings from the first and second halves of the task, the overall score, and congruency weights were also entered into the relevant analyses. That is, for example, the congruency weights were not entered into the missing values analyses of the analysis of the emotional cue partners).

For the partners without emotional cues and fairness decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2_{(1381)} = 1018.291, p = 1.000$), alpha ($\chi^2_{(1877)} = 1348.391, p = 1.000$), and beta 1 ($\chi^2_{(1552)} = 116$).
The highest amount of missing data was 22% for theta, 30% for alpha, and 26% for beta 1 frequency. For the transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1552) = 1134.025, p = 1.000$), alpha ($\chi^2 (1777) = 1257.069, p = 1.000$), and beta 1 ($\chi^2 (1478) = 1067.259, p = 1.000$), respectively. The highest amount of missing data was 28% for theta, 30% for alpha, and 32% for beta 1 frequency. For the fairness minus transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1443) = 1040.192, p = 1.000$), alpha ($\chi^2 (1496) = 1092.139, p = 1.000$), and beta 1 ($\chi^2 (1636) = 1150.715, p = 1.000$), respectively. The highest amount of missing data was 28% for theta, 28% for alpha, and 32% for beta 1 frequency. For the fairness minus transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (2209) = 1546.486, p = 1.000$), alpha ($\chi^2 (2384) = 1628.183, p = 1.000$), and beta 1 ($\chi^2 (2031) = 1384.522, p = 1.000$), respectively. The highest amount of missing data was 30% for theta, 30% for alpha, and 40% for beta 1 frequency (with the next worst case being 34%).
### 4.5.2 Comparisons by sex

#### Non-emotional cues

In order to investigate whether any sex differences existed in neurobiological results when participants made transfer and fairness decisions for the partners without emotional cues, significant results were collated into Figure 4.7 below.

**Figure 4.7. Source localisation significances between males and females by Brodmann area (6…39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.**
Seen in Figure 4.7, there were a number of sex differences in all conditions. Generally speaking, results reflected bilateral differences between sex in frontal, parietal and occipital regions. More specifically, occipital regions in fairness decisions were associated with right sex differences across all frequencies, whereas only theta activity was associated with sex differences between fairness and transfer decisions in occipital regions. Sex differences in beta 1 activity were found between fairness and transfer decisions only in right parietal regions and insula regions. All significances reflected increased oscillations in females except for the right insula activity between fairness and transfer decisions. In light of the sex differences above, results indicate that males and females needed to be analysed separately. However, before going onto these analyses, sex differences will be investigated with respect to the partners in the trust task that feature emotional cues.

**Emotional cues**

In order to investigate whether any sex differences existed in neurobiological results when participants made transfer and fairness decisions for the partners with emotional cues, significant results were collated into Figure 4.8 below. Seen in Figure 4.8, general bilateral sex differences existed in the fairness and transfer decisions in frontal, parietal, and occipital regions. Right temporal differences were found in the theta and Beta 1 ranges when making fairness decisions, and left temporal regions were found when making transfer decisions in the alpha range. Bilateral premotor, dorsal anterior cingulate, right ventral anterior cingulate, medial temporal and left lateral temporal were also found between sex in the beta 1 frequency between fairness and transfer decisions (fad-trd). The differences between fairness and transfer decisions suggested a general right lateralisation of theta, alpha, and beta 1 frequency between sex in parietal regions between sex, and only the alpha range indicated significant differences between sex in occipital regions. In light of the sex differences above, results indicate that males and females needed to be analysed separately.
Figure 4.8. Source localisation significances between males and females by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

4.5.3 Validation of mentalisation regions

Because of the low amount of epochs and data screening procedures used in the study, it was decided that a validation analysis was necessary to provide evidence that the other results in the study were reliable. In order to identify regions of the brain that are involved in the mentalisation process, the two variables that best represent a learning, behaviour change, or ability element were used: the overall score and change in transferred
values between the first and second half of the task. Median splits were performed separately for each sex on these variables in accordance to a high and low mentalisation ability groups in both the partners with and without emotional cues. In order to investigate these variables, 18 (sex x frequency x condition) individual Multivariate Analyses of Variance were conducted inputting both measures of mentalisation in the analysis.

4.5.3.1 Partners without emotional cues

Females

In order to investigate the differences in brain activity associated with the transfer changes between the first and second of the task the significant differences were presented in Figure 4.9 below.
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</table>

- **Figure 4.9.** Source localisation significances for females between increased and decreased transfers overtime by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.9, changes between the first and second half of the task were associated with medial temporal regions in the beta 1 frequency when females were making transfer decisions, in which those with greater mentalisation ability had decreased activity compared to those with less ability. Transfer decisions were associated with increased left orbitofrontal and posterior cingulate, right posterior lateral parietal region, and bilateral anterior parietal activity for those with less mentalisation ability in the alpha frequency range. The same bilateral differences were found in the same condition, in the theta activity range. On the other hand, in the fairness minus transfer decision condition produced
significantly greater activity in the dorsolateral prefrontal region and decreased angular area activity for those with greater mentalisation ability in the theta range. Whereas alpha frequencies within this same condition reported to be decreased in those with greater mentalisation ability in the dorsal anterior cingulate region.

In order to investigate the differences in brain activity associated with the overall scores in the task the significant differences were presented in Figure 4.10 below.

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_Figure 4.10. Source localisation significances between high and low female scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues._
Seen in Figure 4.10, fairness decisions were associated with decreased activity for those with greater mentalisation ability in bilateral orbitofrontal, Broca, lateral and medial temporal and insula regions in the beta 1 frequency when making fairness decisions. Beta 1 was also associated with the same trends in left lateralised orbitofrontal, Broca, broad lateral temporal, medial temporal, temporopolar, and insula regions when making transfer decisions. Regarding the fairness minus transfer decision condition, left middle frontal, fusiform, posterior lateral parietal, right medial temporal and bilateral premotor areas reported to be decreased in those with greater mentalisation ability in the theta frequency. Contralateral posterior lateral parietal, ipsilateral fusiform were also implicated in the results of beta 1 frequency in the same condition, showing the same mentalisation ability trends, as well as left medial temporal regions. Alpha frequency in the fairness minus transfer decision showed a decreased activity for those with greater mentalisation ability in right posterior lateral parietal, posterior cingulate, left occipital and dorsal anterior cingulate, with the right ventral anterior cingulate region revealing the opposite trends. Therefore, based on the results for both measures of mentalisation ability, related brain activity associated with mentalisation is being accurately recorded - this is largely based on expected activity witnessed in ACC regions.

Males

In order to investigate the differences in brain activity associated with the transfer changes between the first and second of the task the significant differences were presented in Figure 4.11 below.
Figure 4.11. Source localisation significances for males between increased and decreased transfers overtime by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.11, males reported increased left Broca and posterior cingulate region activity for those with greater mentalisation ability when making fairness decisions for theta and beta 1 frequency, respectively. Transfer decisions reported increases in activation for those with greater mentalisation ability in left medial temporal regions in all frequencies, whereas left superior posterior temporal, lateral posterior parietal and occipital region increases were found in the alpha frequency. Bilateral beta 1 activity for those with greater mentalisation was found in posterior cingulate activity in beta 1 frequency when making transfer decisions. The fairness minus transfer decision condition revealed significant decreases in left occipital and medial orbitofrontal regions for those with greater
mentalisation ability. Left middle frontal, fusiform, and posterior superior temporal regions decreases were found for those with greater mentalisation ability in the beta 1 frequency range in that same condition, whereas posterior lateral parietal regions reported the same trends in the alpha frequency.

In order to investigate the differences in brain activity associated with the overall scores in the task the significant differences were presented in Figure 4.12 below.

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Figure 4.12. Source localisation significances between high and low male scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.
Seen in Figure 4.12, right Broca and dorsolateral prefrontal and temporo-polar regions were significantly lower in those with greater mentalisation ability in the fairness minus transfer decision condition in the theta frequency range. Whereas, the beta frequency range showed the same trends in the same condition, in left lateral temporal, right medial orbitofrontal, bilateral dorsolateral prefrontal and ventral anterior cingulate regions. Therefore, based on the results of both measures of mentalisation ability, it can be said that a mentalisation ability is being accurately recorded and can be determined with the mentalisation task - this is largely based on expected activity witnessed in ACC regions. Potentially, the ACC activity for males seems to be of a different nature for males according to the dorsal versus ventral activity difference between males and females. It appears that, at least for the non-emotion cue partners, the overall score seems to be the best measure of mentalisation ability. Further to this, the results suggest that the matching of the fairness and transfer decisions via subtraction is a necessary analysis to pin point a mentalisation, error-reward process in the trust task.

4.5.3.2 Partners with emotional cues

Females

In order to investigate the differences in brain activity associated with the transfer changes between the first and second of the task the significant differences were presented in Figure 4.13 below.
Figure 4.13. Source localisation significances for females between increased and decreased transfers overtime by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.13, the fairness minus transfer decision condition was associated with significant decreases in right Broca, middle and orbitfrontal, as well as angular regions for those with greater mentalisation ability in the theta frequency. In this same condition, alpha frequency was associated with the same trends in lateral temporal regions, and also in the right premotor area for beta 1 frequency.
In order to investigate the differences in brain activity associated with the overall scores in the task the significant differences were presented in Figure 4.14 below.

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Figure 4.14. Source localisation significances between high and low female scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.14, those with greater mentalisation ability reported to have a lower activity in right orbitofrontal, Broca, generally left temporal lateral regions, and bilateral medial temporal, temporo-polar, and insula regions when making fairness decisions in the theta frequency range. Alpha frequency, in this same condition, presented the same trends
in left dorsal anterior cingulate, Broca, middle, dorsolateral, and orbitofrontal regions, left lateral and medial temporal regions, and in the right insula. Beta 1 on the other hand, revealed bilateral broad superficial frontal and medial temporal deactivation for those with greater mentalisation ability. The same trends were found for the same frequency and the same condition in left dorsal anterior cingulate, posterior lateral parietal, right ventral anterior cingulate temporo-polar and bilateral insula regions.

Transfer decisions on the other hand were associated with decreased activity for those with greater mentalisation ability in the right ventral anterior cingulate, Broca, middle, dorsolateral, orbitofrontal, left lateral temporal and insula and bilateral medial temporal and posterior cingulate regions. Whereas, alpha frequency produced the same trends in the same condition in broad bilateral frontal regions (including the anterior cingulate cortex), medial temporal, and right temporo-polar regions. Bilateral dorsolateral, middle, orbitofrontal and medial temporal areas were indicated to be significantly lower in those with greater mentalisation ability, as well as in right ventral anterior cingulate, and temporo-polar regions too.

Regarding the fairness minus transfer decision condition, posterior lateral parietal regions were reported to be decreased in those with greater mentalisation ability in the theta and alpha frequencies. However, alpha also showed the same trends in lateral temporal and medial temporal regions. Beta 1 frequency on the other hand reported significant decreases in right premotor, left middle frontal and bilateral dorsal anterior cingulate regions for those with greater mentalisation ability. Therefore, based on these results it can be said that a mentalisation process is being recorded, based on the ACC activity and that the overall score appears to be the best predictor of mentalisation based error-reward processing.
Males

In order to investigate the differences in brain activity associated with the transfer changes between the first and second of the task the significant differences were presented in Figure 4.15 below.

Figure 4.15: Source localisation significances for males between increased and decreased transfers overtime by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.
Seen in Figure 4.15, males reported increased theta oscillations when making fairness decisions in left Broca and temporo-polar regions. Alpha frequency on the other hand, reported decreases in left medial temporal and occipital regions for those with greater mentalisation ability. Beta 1 frequency revealed the same trends in the same condition in bilateral occipital, posterior cingulate, and medial temporal regions, as well as left lateral orbitofrontal regions. Left medial temporal, posterior cingulate and occipital regions were also found to be different by those with greater mentalisation ability in the alpha range when making transfer decisions. The same trends in the same condition was also found in beta 1 frequency in left lateral orbitofrontal, medial temporal, occipital and bilateral posterior cingulate regions. In the fairness minus transfer decision condition, left medial orbitofrontal decreases were found for those with greater mentalisation ability, but decreases were found in left Broca, bilateral medial temporal and occipital regions in the alpha frequency range. Beta 1 frequency reported to be increased in right occipital and decreased in left posterior cingulate regions for those with higher mentalisation ability in the fairness minus transfer decision condition.

In order to investigate the differences in brain activity associated with the overall scores in the task the significant differences were presented in Figure 4.16 below.
Figure 4.16. Source localisation significances between high and low male scorers in the trust task by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.16, fairness decisions were associated with decreased alpha activity for those with greater mentalisation ability in right dorsal anterior cingulate, occipital and left fusiform and posterior cingulate regions. Transfer decisions were associated with an increased theta activity for those with greater mentalisation ability in left lateral orbitofrontal and temporo-polar areas, but a decrease in left posterior cingulate regions.

On the other hand, the fairness minus transfer decision condition revealed that those with...
greater mentalisation ability had decreased theta activity in left orbito and dorsolateral prefrontal, temporo-polar and insula regions and decreased posterior lateral parietal regions in the beta 1 frequency. Based on these results, although a strong ACC affect did not seem to present at all, the weak ACC evidence and evidence of temporo-polar activity suggest that a mentalisation ability should not be completely discounted. Therefore, despite the evidence against males using error-reward, mentalisation processing was used for the partners with emotional cues with the above comparisons, the planned comparisons (i.e., BPD, emotion dysregulation, dissociation, negative and positive views of the self and other median splits) would still be worthwhile investigating, considering a strong ACC affect has been found across all analyses, except for this last one. Upon reflecting on the evidence of those planned comparisons the question of whether an ACC, mentalisation affect was absent for males for partners with emotional cues can be better validated.

4.5.4 Decisions for partners without emotional cues

4.5.4.1 Comparisons by BPD traits

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.17 below for females with respect to the median split on BPD traits.
Seen in Figure 4.17, transfer and fairness decisions were generally associated with left lateralised activity differences when comparing females between high and low BPD traits. Beta 1 frequency was associated with parietal differences in both conditions, whereas parietal regions were associated with differences in alpha frequency when making fairness decisions. Left frontal region differences were associated with significant beta 1 activation only in transfer decisions. Comparatively, the differences between fairness and transfer decisions were generally associated with right lateralised activation in alpha frequency, but only in orbitofrontal, posterior cingulate, and angular regions. On the other hand, beta 1

**Figure 4.17. Source localisation significances between a high and low female BPD-trait median split by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.**
frequency was associated with posterior temporal and cingulate regions in the same condition. Generally speaking, the significant differences revealed greater oscillations for those with greater BPD traits.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.18 below for males with respect to the median split on BPD traits.

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Figure 4.18. Source localisation significances between a high and low male BPD-trait median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.
Seen in Figure 4.18, the left middle prefrontal cortex produced greater alpha oscillations for males when comparing between high and low BPD traits during transfer decisions. The left orbitofrontal, dorsolateral prefrontal cortex, and Broca’s area produced less theta oscillations for males with lower BPD traits in the fairness minus the transfer decision condition.

4.5.4.2 Comparisons by emotion dysregulation

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.19 below for females with respect to the median split on high and low difficulties with emotion regulation.
Figure 4.19. Source localisation significances between a high and low female emotion dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.19, results indicate that beta 1 oscillations tended to be decreased in parietal and occipital regions for both the fairness and transfer decisions for those with greater emotional dysregulation. To be more specific, there seemed to be a left lateralised activation for the beta 1 activity in the transfer decision only. Comparatively, the differences between the fairness and transfer decisions indicated beta 1 was significantly decreased in bi-lateral orbitofrontal and Broca regions for those with greater emotion dysregulation. In
contrary to this, greater oscillations were found with beta 1 frequency in parietal regions, except for the posterior right lateral region which was lower for those with greater emotion regulation. This greater oscillation trend for those with greater emotion dysregulation continued in the left posterior cingulate cortex, as well as in occipital regions. The right insula region also reported lower beta 1 oscillations for those with greater emotion dysregulation. On the other hand, alpha activity in the right temporal regions produced was greater in those with more emotion dysregulation tendencies.

Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.20 below for males with respect to the median split on high and low difficulties with emotion regulation.
Figure 4.20 Source localisation significances between a high and low male emotion dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.20, the right posterior cingulate and occipital area produced greater alpha oscillations for those with lower emotion dysregulation with both fairness and transfer decisions, when comparing between males with high and low emotion dysregulation. A right lateralised deactivation was found with orbital and Broca frontal regions, as well as broad temporal and insula regions for those with greater emotional dysregulation for the beta 1 frequency in the fairness minus transfer decision condition. In this same condition, greater theta activation was found for in the right dorsolateral prefrontal cortex for those with lower emotional dysregulation.
### 4.5.4.3 Comparisons by dissociative experiences

**Females**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.21 below for females with respect to the median split on high and low dissociative experiences.

![Figure 4.21. Source localisation significances between a high and low female dissociation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.](image)

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- Red with green border: high DES < low DES, but significant using Levene's test
Seen in Figure 4.21, bilateral dorsolateral and Broca frontal regions produced greater activation in those with greater dissociative experiences when comparing the differences between the fairness and transfer decisions. This same trend continued in the left insula and entorhinal region for the same condition and same frequency. On the other hand, occipital regions produced a deactivation in beta 1 frequency for those with greater dissociative experiences in the fairness minus transfer decision condition. Significant differences were also found for the entorhinal cortex for theta activity showing decreased activity in the fairness decision, but increased activity for the fairness minus transfer decision conditions for those with greater dissociative experiences.

Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.22 below for males with respect to the median split on high and low dissociative experiences. When making transfer decisions, it should be noted that an alpha value of 0.025 was used to determine significant differences in the theta and beta 1 frequency.
Figure 4.22. Source localisation significances between a high and low male dissociation median split by Brodmann area (6...39), frequency (theta, alpha, beta 1) and laterisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.22, the fairness and transfer decisions all showed significant increases in oscillations for those with greater dissociative experiences whereas the fairness minus the transfer decision condition showed significant decreases in oscillations. The pre-motor cortex (Brodmann area 6) produced bilateral deactivation for those with greater dissociative experiences in the alpha range in both the transfer and fairness decisions, but only in the theta range for the fairness decision. Only the fairness decision and theta activity was associated with a deactivation for those with greater dissociative experiences in bilateral parietal regions. Left temporal regions showed significant differences with transfer
decision in the theta and alpha frequencies, and with the fairness minus transfer decision condition in the alpha and beta 1 frequency ranges. Also in the fairness minus transfer decision condition, orbitofrontal and middle frontal regions (i.e., Brodmann area 10) reported to be significantly different between those with high and low dissociative experiences in the theta and beta 1 frequencies. Oscillations in the Brocas area was found to be significantly different in theta activity in all conditions in the theta frequency. Dorsal anterior cingulate regions were significantly different with beta 1 frequency in the fairness decision, and ventral anterior cingulate regions were significantly different with theta activity in the transfer decision.

4.5.4.4 Comparisons by negative views of self

**Females**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.23 below for females with respect to the median split on high and low negative views of oneself.
Figure 4.23. Source localisation significances between a high and low negative views of self median split in females by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.23, the transfer decision was associated with a significant increase in left posterior cingulate regions, as well as bilateral occipital regions for those with more negative views of themselves. Results include anterior cingulate deactivation in the dorsal anterior cingulate region in the fairness minus the transfer decision condition for those with greater negative views of the self. Theta and beta 1 frequencies also showed significant differences in right ‘Broca’ regions for those with greater negative views of themselves, the prior being an increase and the latter being a decrease. Theta activity also produced right
temporal cortex deactivation for those with more negative views of themselves in the fairness minus transfer decision condition.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.24 below for males with respect to the median split on high and low negative views of oneself.

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*Figure 4.24. Source localisation significances between a high and low negative views of self median split in males by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and laterisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.*
Seen in Figure 4.24, increased theta oscillations were associated with negative views of selves in ventral anterior cingulate regions for the fairness and transfer decisions. Beta 1 deactivation was associated with negative views of the self in left temporal regions in the fairness and transfer decisions too. Increased parietal and posterior cingulate activation was associated with both fairness and transfer decisions for the alpha frequency, and beta frequency in the transfer decision. Increased angular area activity was also associated with the transfer decision for theta and alpha frequencies, but decreased beta 1 frequency oscillation in that same region in the fairness minus transfer decision condition.

4.5.4.5 Comparisons by Positive views of self

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.25 below for females with respect to the median split on high and low positive views of oneself.
Figure 4.25. Source localisation significances between a high and low positive views of self median split in females by Brodmann area (6.. 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

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- [Green] high P.S. > low P.S.
- [Red] high P.S. < low P.S.
- [Green] high P.S. > low P.S., but sig levenes
- [Red] high P.S. < low P.S., but sig levenes

Seen in Figure 4.25, the transfer decision was associated with decreased theta oscillations in the middle frontal cortex for those with lower positive views of the self. Only the angular and posterior parietal cortices reported to produce greater theta oscillations for those with lower positive views in the fairness minus transfer decision condition.
Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.26 below for males with respect to the median split on high and low positive views of oneself.

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Figure 4.26. Source localisation significances between a high and low positive views of self median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and laterisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.26, the fairness minus transfer decision produced significant decreases in beta 1 oscillations in those with high levels of positive views of the self in right
medial orbitofrontal, medial temporal and occipital regions. Theta oscillation differences in the same conditions and comparisons revealed decreased left Broca area for those with greater positive views.

4.5.4.6 Comparisons by negative views of others

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.27 below for females with respect to the median split on high and low negative views of others.

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- high N.O. > low N.O.
- high N.O. < low N.O.
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Figure 4.27. Source localisation significances between a high and low negative views of others median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.
Seen in Figure 4.27, fairness decisions produced increased theta oscillations in right occipital regions, and decreased alpha oscillations in the right posterior cingulate cortex for those with more negative thoughts of others. Transfer decisions produced increased alpha and beta 1 oscillations in medial temporal and posterior cingulate regions for those with more negative thoughts of others. In this same condition, beta 1 and alpha frequency was significantly lower for those with greater negative views of others in left Broca and dorsal anterior cingulate cortex areas, respectively. On the other hand, the fairness minus transfer decision condition produced left lateralised deactivation of beta 1 in lateral orbitofrontal, ventral anterior cingulate, dorsolateral, Broca, temporal, and posterior cingulate region significances for those with greater negative views of others. These same trends, in the same condition, continued in bilateral insula regions too. Alpha frequency reported to be decreased in right posterior cingulate regions and theta reported to be increased in right temporal regions for those with greater negative views of others in the fairness minus transfer decision condition.

**Males**

The results of the univariate analyses for all MANOVA's are presented in Figure 4.28 below for males with respect to the median split on high and low negative views of others.
Figure 4.28. Source localisation significances between a high and low negative views of others median split in males by Brodmann area (6...39), frequency (theta, alpha, beta 1) and laterisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.28, the fairness decisions generally produced right lateralised theta deactivations in temporal regions and bilateral temporal region theta deactivations for transfer decisions for those with negative views of others. Lower angular and posterior-lateral parietal regions theta activity in the fairness and transfer decisions was found for those with more negative views of others. A lower right middle frontal gyrus theta activity and parietal alpha activity was found for those with greater negative thoughts of others when making transfer decisions. A lower posterior cingulate alpha activity was found for those with greater negative thoughts of others when making fairness decisions. On the other hand, the fairness minus transfer decision condition revealed three significant...
increases in activity for those with greater negative views of others. This included the right medial temporal region for theta activity, the right Broca area for alpha, and the left fusiform area for beta 1.

### 4.5.4.7 Comparisons by positive views of others

#### Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.29 below for females with respect to the median split on high and low positive views of others.

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*Figure 4.29 Source localisation significances between a high and low positive views of others median split in females by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.*
Seen in Figure 4.29, for positive views of others, only the fairness minus transfer decision produced significant results. In this condition, left ventral anterior cingulate area produced higher activity in beta 1 frequency for those with lower positive views of others. A higher activity for those with more positive views of others was for in the left posterior cingulate and left occipital region. Activity in the anterior parietal area was greater for those with higher positive views of others for theta and alpha activity.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.30 below for males with respect to the median split on high and low positive views of others.
Figure 4.30. Source localisation significances between a high and low positive views of others median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 4.30, increased beta 1 activity was found for those with greater positive views of others in posterior cingulate regions for both the transfer and fairness decisions. The same trends were found in medial temporal regions for alpha activity in the transfer decisions. On the other hand, in the fairness minus transfer decisions, those with lower positive views of others had a greater theta activity than those with higher positive views in right orbitofrontal and middle frontal regions, as well as right medial temporal areas.
4.5.5 Decisions for partners with emotional cues

4.5.5.1 Comparisons by BPD traits

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.31 below for females with respect to the median split on BPD traits.

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156
Seen in Figure 4.31, transfer and fairness decisions were generally associated with greater left lateralised activity in anterior and posterior-lateral parietal regions for those with greater BPD traits when comparing females between high and low BPD traits. In these results, the angular area was indicated to be associated with making fairness decisions. For the fairness minus transfer decision condition, lateral premotor areas were indicated to be significantly higher for those with less BPD traits in premotor areas. Whereas a general greater right lateralised activity was found for those with greater BPD traits in frontal regions which include bilateral activation from ventral-anterior cingulate and OFC areas. A deactivation was found for those with greater BPD traits in dorsolateral prefrontal regions.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.32 below for males with respect to the median split on BPD traits.
Figure 4.32. Source localisation significances between a high and low male BPD-trait median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.32, bilateral middle frontal and orbitofrontal regions reported to have significantly greater alpha and beta 1 oscillations for those with greater BPD traits when making fairness decisions. In this same condition, the same trends were found but only in the beta 1 range in left insula and temporal regions. Transfer decisions reported to have increased beta 1 oscillations in left middle frontal, and orbitofrontal regions, right dorsal anterior cingulate, and bilateral ventral anterior cingulate regions for those with greater BPD traits. Within the fairness minus transfer decision condition, right lateral temporal regions were reported to be decreased for those with greater BPD traits.
4.5.5.2 Comparisons by emotion dysregulation

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.33 below for females with respect to the median split on high and low difficulties with emotion dysregulation.

Figure 4.33. Source localisation significances between a high and low female emotion dysregulation median split by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.
Seen in Figure 4.33, results indicate that a left lateralised parietal, occipital, and angular region deactivation was found with those with greater difficulties with emotion regulation in the theta range for both fairness and transfer decisions. The same trends were found with the same frequency in right temporal and insula regions, as well as in the left dorsal anterior cingulate region, but only in the transfer decision. An alpha frequency deactivation was found in the left fusiform area when making fairness decisions for those with greater difficulties with emotion regulation. In the fairness minus transfer decision condition, bilateral premotor and right lateral temporal regions were reported increased theta oscillations for those with greater difficulties with emotion regulation. Both alpha and beta 1 frequencies reported the same trends in the same condition in occipital regions, but only alpha frequency reported a significant increase in activity for those with greater difficulties with emotion regulation in left ventral anterior cingulate regions.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.34 below for males with respect to the median split on high and low difficulties with emotion dysregulation.
Figure 4.34. Source localisation significances between a high and low male emotion dysregulation median split by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

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Seen in Figure 4.34, beta 1 oscillations reported significant increases for those with greater difficulties with emotion regulation in left Broca, lateral orbitofrontal, insula, temporo-polar and medial temporal regions when making fairness decisions. The same trends in the same frequency were also found in temporo-polar and lateral orbitofrontal regions for those with greater difficulties with emotion regulation when making transfer decisions. On the other hand, whilst making transfer decisions, a deactivation was found in
posterior cingulate regions for those with greater emotion dysregulation in the alpha frequency range. In the fairness minus transfer decision condition, only the right dorsolateral prefrontal cortex was reported to have a significant difference: those with greater difficulties with emotion regulation reported increased beta 1 oscillations.

### 4.5.5.3 Comparisons by dissociative experiences

#### Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.35 below for females with respect to the median split on high and low dissociative experiences.

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Legend:
- **Green**: high DES > low DES
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- **Orange**: high DES < low DES, but sig levenes
Figure 4.35. Source localisation significances between a high and low female dissociation dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and laterisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.35, a significant theta oscillation increase was found for those with greater dissociative tendency in the right temporal area when making transfer decisions. More broad right temporal region deactivation was found for those with greater dissociative tendency in the theta range in the fairness minus transfer decision condition. In this same condition, the same trends were found in the alpha range in right dorsolateral prefrontal regions, but also in bilateral premotor and left dorsal anterior cingulate regions in the beta 1 frequency.

Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.36 below for males with respect to the median split on high and low dissociative experiences. When making fairness and transfer decisions, it should be noted that an alpha of 0.01, 0.025
and 0.025 were used to identify significant differences for theta, alpha and beta 1 frequency, respectively.

Figure 4.36. Source localisation significances between a high and low male dissociation dysregulation median split by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and laterlisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.36, when making fairness decisions, those with greater dissociative tendencies reported to have decreased theta oscillations in left premotor, middle frontal, orbitofrontal, Broca, insula regions and temporal regions, as well as bilateral posterior parietal regions. In this same condition, the same trends were found with alpha oscillations in bilateral premotor, dorsolateral, middle frontal and ventral anterior cingulate regions, as well as right medial orbitofrontal, left lateral orbitofrontal, Broca and temporo-polar regions. Bilateral, middle and orbitofrontal regions, also produced the same significant trends in the same condition, in the beta 1 frequency. Also in this condition, the same trends were found in the same frequency in left dorsal anterior cingulate, Broca, temporo-polar, medial temporal and insula regions.

Regarding the transfer decisions, left Broca, lateral orbitofrontal, lateral temporal, temporo-polar, posterior lateral parietal, occipital, insula, and bilateral fusiform regions reported to be decreased in those with greater dissociative tendencies in the theta frequency. Similar trends were observed in the alpha frequency with the exception that the fusiform area only revealed a left lateralised decrease in oscillations for those with greater dissociative tendency as opposed to bilateral, there was also no insula significance and there was the addition of a left lateralised premotor deactivation. In the transfer decisions and beta 1 frequency, there were significantly decreased in the left premotor, dorsal anterior cingulate, Broca, lateral orbitofrontal, insula, and medial temporal and temporo-polar areas for those with greater dissociative tendencies. The same trends in the same frequency and
comparisons were found in the same condition for right fusiform and lateral posterior parietal regions. On the other hand, the left temporo-polar and posterior lateral parietal areas were significantly higher for those with greater dissociative tendencies in the fairness minus transfer decisions for theta and beta 1 frequencies, respectively.

4.5.5.4 Comparisons by negative views of self

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.37 below for females with respect to the median split on high and low negative views of oneself.
Figure 4.37. Source localisation significances between a high and low negative views of self median split in females by Brodmann area (6…39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.37, right temporo-polar and left posterior cingulate regions reported to be significantly different for those with greater negative views of themselves when making transfer decisions for the theta and beta 1 frequency, respectively. Within this comparison, the temporo-polar region reported to have a decreased activity and the posterior lateral parietal region reported to be increased in those with greater negative views of themselves. On the other hand, in the fairness minus transfer decisions, a decreased activity was found in right medial orbitofrontal, lateral temporal, left dorsal anterior cingulate and lateral posterior parietal regions for those with greater negative
views of themselves, whereas an increased activity was found in left temporal regions for those same counterparts. In this same condition, positive trends were found for those with greater negative views of themselves in left orbitofrontal, medial temporal, temporo-polar and posterior cingulate regions in the alpha region. This same trend was found in the same condition, in the left occipital region in the beta 1 frequency.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.38 below for males with respect to the median split on high and low negative views of oneself. It should be noted that when making transfer decisions, an alpha of 0.025 was used to identify significant differences for beta 1 frequency.
Figure 4.38. Source localisation significances between a high and low negative views of self median split in males by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.38, when making fairness decisions an increase in bilateral posterior cingulate and lateral posterior parietal regions was found for those with greater negative views of themselves for the theta and alpha frequencies, respectively. The same trend for the posterior lateral parietal area was found in the beta 1 frequency also, but only on the left hand side. Beta 1 revealed decreased activity in bilateral temporal and insula areas, and in medial temporal and temporo-polar areas for those with greater negative views of themselves when making fairness decisions. Similar trends for beta 1 frequency for fairness decisions also occurred when making transfer decisions in beta 1 frequency too, but transfer
decisions generally involved left temporal regions, left insula and bilateral medial temporal areas. Also, transfer decisions did not produce any differences in lateral posterior regions, but this did occur in the alpha frequency range when making transfer decisions. Notably, all of the beta 1 frequency results were decreased in those with greater negative views of the self and the posterior lateral parietal region indicated an increased alpha activity. In the fairness minus transfer decision condition, the left and right fusiform area were significantly greater for those with greater negative views of themselves for theta and beta 1 frequencies, respectively. Theta activity also produced a significant difference in the left occipital cortex whereby those with greater negative views of themselves reported greater activity. Alpha frequency in this same condition also produced the same trends in left dorsolateral and posterior lateral parietal regions.

4.5.5.5 Comparisons by positive views of self

Females

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.39 below for females with respect to the median split on high and low positive views of oneself.
Seen in Figure 4.39, fairness decision reported to produce significant decreases in theta activity for those with greater positive views of the self in right middle frontal, ventral anterior cingulate, left fusiform, and bilateral orbitofrontal regions. Transfer decisions reported significantly lower theta oscillations for those with greater positive views of themselves in right temporal and temporo-polar areas. On the other hand, in the fairness minus transfer decisions revealed increased activity for those with greater positive views of themselves in right Broca and dorsolateral prefrontal regions, but also right medial temporal and angular regions. Whereas in this same condition, beta 1 frequency indicated increased

![Figure 4.39](image-url)
activity for those with greater positive views of themselves in left orbitofrontal, right medial temporal areas, but a decreased activity in the right angular area.

Males

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.40 below for males with respect to the median split on high and low positive views of oneself.

![Figure 4.40](image)

Figure 4.40. Source localisation significances between a high and low positive views of self median split in males by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.
Seen in Figure 4.40, transfer decision reported to have increased theta oscillations for those with greater positive views of themselves in left Broca and insula, as well as in medial temporal areas. The same regions were reported to show significant differences in the fairness minus transfer decision condition but in the opposite direction and left temporopolar and right lateral regions could also be included on the list of significant brain regions. Beta 1 frequency reported to significantly lower for those with greater positive views of themselves in bilateral dorsal anterior cingulate, right occipital, lateral and medial temporal, left posterior lateral parietal regions in the fairness minus transfer decision condition. The only significant difference in the same condition for alpha was with right medial orbitofrontal region, and this produced the same trends as the other frequencies in the fairness minus transfer decision condition.

4.5.5.6 Comparisons by negative views of others

**Females**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.41 below for females with respect to the median split on high and low negative views of others.
Figure 4.41. Source localisation significances between a high and low negative views of others median split in females by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.41, when making fairness decisions, those with greater negative views of others reported to have lower activity in the left posterior cingulate region. For transfer decisions, alpha frequency was associated with greater bilateral posterior cingulate region and right medial temporal area activity for those with greater negative views of others. Beta 1 frequency was associated with bilateral posterior cingulate and medial temporal, and left Broca and insula increases in activity for those with greater negative views of others. Regarding the fairness minus transfer decisions, theta activity reported to be decreased for those with greater negative views of others in the right ventral anterior cingulate. Bilateral Broca and right dorsolateral prefrontal areas reported to be decreased in...
those with greater negative views of others in the alpha frequency, whereas right lateral temporal regions revealed similar trends in the same condition for beta 1 frequency.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.42 below for males with respect to the median split on high and low negative views of others. It should be noted that when making transfer decisions, an alpha of 0.01 was used to identify significant differences for theta frequency.
Figure 4.42. Source localisation significances between a high and low negative views of others median split in males by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 4.42, left Broca, temporal, insula, right occipital and bilateral posterior lateral parietal and angular regions were significantly higher for those with greater negative views of others when making fairness decisions in the theta range. Transfer decisions were also associated with left temporal decreases for those with greater negative views of others, but also right posterior lateral parietal, occipital, angular, and bilateral fusiform region differences for those with greater negative views of others. Alpha frequency reported the same trends in left lateral posterior parietal and right angular regions, and beta 1 also reported the same trends in left premotor regions and right anterior parietal regions in the same condition. On the other hand, in the fairness minus transfer decision condition, right
lateral temporal, left posterior lateral parietal, and bilateral premotor and dorsal anterior cingulate regions were significantly greater for those with more negative views of others in the beta 1 frequency range.

4.5.5.7 Comparisons by positive views of others

Females

The results of the univariate analyses for all MANOVA's are presented in Figure 4.43 below for females with respect to the median split on high and low positive views of others.

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Figure 4.43. Source localisation significances between a high and low positive views of others median split in females by Brodmann area (6... 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

176
Seen in Figure 4.43, right anterior parietal regions showed significant increases in beta 1 oscillations for those with greater positive views of others when making transfer decisions. Otherwise the only other significant differences were found in the fairness minus transfer decision condition in which the left angular area was significantly lower for those with greater positive views of others in the theta and alpha frequency ranges.

**Males**

The results of the univariate analyses for all MANOVA’s are presented in Figure 4.44 below for males with respect to the median split on high and low positive views of others. Seen in Figure 4.44, fairness decisions were associated with increased activity in left medial temporal areas for alpha and beta 1, and also left posterior cingulate and bilateral anterior parietal regions for the beta 1 frequency for those with greater positive views of others. Transfer decisions seemed only to reflect a significant increase in alpha oscillations in the left fusiform region for those with greater positive views of others. On the other hand, in the fairness minus transfer decision condition, those with greater positive views of others reported to have increased theta oscillations in left Broca, medial temporal, fusiform, and insula regions, but also a decrease in ventral anterior cingulate region for those with greater positive views of others. In this same condition, significant decreases in alpha frequency was found in left posterior cingulate and occipital regions for those with greater positive views of others.
Figure 4.44. Source localisation significances between a high and low positive views of others median split in males by Brodmann area (6…39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.
Chapter 5: Discussion of study 1

5.1 Aims and support for the hypotheses

This study intended to investigate the cognitive and emotional processes associated with BPD in a healthy sample of males and females. Specifically, measures on BPD, dissociation, emotion dysregulation, and perceptions of self and others will allow the researchers to investigate their impact on behaviour and underlying brain activity in an emotional recognition and Franzen et al.’s (2011) trust task.

5.1.1 Psychosocial data

Hypothesis 1: As expected, those with greater BPD traits reported higher levels of negative states of themselves and others, emotion dysregulation, and dissociation.

5.1.2 Emotional recognition task

Hypothesis 2: By comparing between those that present with high and low BPD traits, it was expected that those with greater BPD traits would have more negative perceptions of ambiguous facial stimuli as expressed through difficulties reading ambiguous stimuli and negative bias. Therefore, it is expected that those with greater BPD traits would rate an angry face as more angry, a neutral face as more angry, and happy face as less happy when compared to those with less BPD traits. Overall this hypothesis received little support, as only neutral faces were reported less happy.

Research question 1: Whether those with BPD interpret the facial expressions to be physically different will be explored. Results suggested that neutral faces were reported to be frowning more strongly by those with greater BPD traits.

Hypothesis 3: It is anticipated that those with greater BPD traits would have different brain activity processing, reflected in brain regions involved in attention to and memory retrieval associated with facial recognition. Therefore, ACC, hippocampus, extra-striate cortex, fusiform gyrus, and the superior temporal gyrus are expected to be different
between high and low BPD traits. This hypothesis was supported in the analyses using females participants and only supported in the analyses of males in ACC regions.

Hypothesis 4: Brain regions involved with emotion recognition are also expected to show differences for those with emotional regulation issues (including dissociation), but also with the OFC and sensory regions (i.e., parietal regions). This hypothesis was supported for males with dissociation, and only ACC regions for both males and females in emotion regulation.

5.1.3 Trust task

Hypothesis 5: It is expected that those with high BPD traits (and those with high levels of negative views of the self/others) will perform better at the trust task by identifying that emotional cues relate to high and low monetary responses, compared to those with low BPD traits. Therefore, overtime, those individuals with higher BPD traits and higher negative perceptions (self and other) will transfer more money over to a partner that is smiling, and transfer less to the frowning faces when compared to controls and those with positive perceptions of themselves. There was no support for this hypothesis.

Hypothesis 6: As expected, those with high and low levels of BPD traits, negative views of self and others revealed no differences between partners that do not have emotional cues.

Hypothesis 7: During and between the transfer and evaluation phases, it was expected to witness neurobiological processes specifically involved in mentalisation and episodic memory processing, such as ACC, posterior cingulate, temporal, and angular regions. This hypothesis was generally supported.

Hypothesis 8: It was expected that those with higher levels of BPD, and higher scores on negative perceptions of self and others, will have differences in activity in mentalisation regions when compared to lower symptomatic counterparts. This hypothesis was supported in females between a high and low BPD group, but less so for males and females between high and low negative views of themselves and others.
Hypothesis 9: Episodic memory processes between high and low BPD, negative views of self and others comparisons are expected to be represented by posterior cingulate cortex, retrosplenial region difference when compared to lower score profiles. This hypothesis was generally supported in posterior cingulate regions.

Hypothesis 10: Autobiographical memory processes between high and low BPD, negative views of self and others comparisons are expected to be represented in right prefrontal regions when compared to lower score profiles, particularly in partners with emotion cues. Overall, there seemed to be some support for this hypothesis.

Hypothesis 11: Increased activity in the OFC and parietal regions were anticipated to present between those with greater BPD traits, negative perceptions of self and others, as well as emotion regulation and dissociation as a results of a greater emotional sensitivity. This hypothesis was generally supported for females between BPD traits, and in OFC regions for males using that same comparison group. The hypothesis was marginally supported in parietal regions in males between negative perceptions of self and others. Support was given to males and females in parietal regions between emotion dysregulation, and marginally supported in parietal regions for males by dissociation.

Hypothesis 12: Those that present with high and low levels of dissociation are expected to reflect an inverted response, but identical results to those already stated for mentalisation, emotional dysregulation, and dissociation. Support was given towards the inversed direction of results, and only in ACC regions for mentalisation regions for dissociation with males.

5.2 Psychometric interpretations

There were no reported behavioural sex differences regarding BPD traits, difficulties with emotion regulation, and dissociation. In the current studies sample, all facets of BPD traits seemed to contribute to the overall higher score that those with greater BPD reported. Furthermore, as predicted greater BPD traits were associated with higher levels of dissociation, all facets of difficulties with emotion regulation (except for emotional awareness), negative views of oneself, and lower positive views of oneself and others.
Though the result seemed to trend that way, unexpectedly, negative views of others was not significantly greater for those with greater BPD traits. These same results were found for those with greater emotion regulation difficulties. Those with greater levels of dissociation reported to have more difficulties with emotion regulation, tending to use non-acceptance and have less strategies to deal with emotions, whilst also having greater impulse control and finding it more difficult to stay goal directed when experiencing emotions. Greater levels of affect instability, identity problems, and self-harm behaviour seemed to be most associated with greater levels of dissociation. These results indirectly suggest that in this non-clinical sample, emotional regulation issues could be a particularly influential aspect associated with BPD, as both BPD traits and emotion regulation difficulties seemed to report very similar results. This result is supported by the theories and evidence associated with BPD that highlight emotion dysregulation issues (see Carpenter & Trull, 2013; Crowell et al., 2009; Linehan, 1993).

Dissociation reports to be an avoidance coping strategy that that can be used in times of stress (van der Hart & Horst, 1989) and, if used enough, habitual (Giesbrecht et al., 2008), meaning it makes sense that impulsivity, difficulties staying goal directed, and acceptance and limited strategies to combat emotions would relate to dissociation. When linked to the non-significant results for emotional awareness and clarity, this studies control sample results suggest that in order to utilise dissociation, one can be aware and clear about emotions, perhaps aiding themselves to be placed in some form of dissociation. On the other hand, dissociation is an automatic, almost impulsive, switch into a dissociative state with DID at the more pathological end, nevertheless still requiring a sense of one’s emotional state, vivid or vague, conscious or not (Kihlstrom, 2005; van der Hart & Horst, 1989). Nevertheless, placing oneself in this state of dissociation, due to the attention and memory lapses (Giesbrecht et al., 2008) could be viewed as particularly damaging to staying goal directed. Using dissociation regularly can be related to having less emotion regulation strategies and because avoidance tactics do not resolve issues one experiences, those stressors can persist for longer or become more intense. Therefore chronic periods of dissociation could relate to a build up of emotion, leading to impulsive acts, as has been stipulated in BPD in general (Carpenter & Trull, 2013; Linehan, 1993; Young et al., 2003).
5.3 Emotion recognition interpretations

BPD

According to the results of the emotional recognition task, both males and females reported to interpret the facial expressions of others (amount of cheek raise, teeth shown, and frown) equally for neutral, happy and angry faces. On average, only neutral faces reported to have a greater frown for those with greater BPD traits. When reading facial expressions, males and females also reported to interpret the emotions of others equally. Those with greater BPD and emotion dysregulation tendency reported neutral faces to be less happy, but not more angry as those with less BPD and emotion dysregulation tendencies. Based on prior results, it could be expected that this is occurring due to reading a greater frown. Prior researchers have discussed the effect of a negative bias that exists in BPD (Domes et al., 2009; Unoka et al., 2011), and perhaps this could explain the results for those with BPD and emotion dysregulation tendency, especially when considering a neutral face could be regarded as an ambiguous face. After all, those with greater BPD traits report to have most issues with negative faces (Unoka et al., 2011) in which some have discussed that happy and angry faces can be blended (Domes et al., 2009).

Regarding the neuroscience literature (e.g., Domes et al., 2009), it were anticipated that the emotional recognition task would reveal differences in orbitofrontal, anterior cingulate, medial, superior lateral, fusiform temporal regions between those with high and low symptoms associated with BPD (BPD traits, emotion dysregulation, dissociation). Generally speaking these neurobiological emotional recognition differences were found to be supported for all emotions when considering all comparisons.

Regarding BPD traits, when viewing neutral and angry faces, females with high BPD traits reported to have increased activity in bilateral premotor, dorsal anterior and posterior cingulate regions, and right lateralised medial and broad lateral temporal activity: the
fusiform, superior temporal gyrus and even insula regions are included in this. These differences were not found for males when viewing neutral and angry faces. Happy faces on the other revealed differences in both males and females. For females, happy faces were associated with bilateral dorsal ACC, left posterior cingulate and lateral posterior parietal regions, right fusiform, premotor and posterior superior temporal gyri activity. Regarding angry faces, occipital, right posterior cingulate, medial temporal and broad lateral temporal regions, were used in processing those facial expressions, as well as bilateral angular area and lateral, posterior parietal regions. Males on the other hand, reported orbitofrontal, middle frontal, and ventral anterior cingulate cortex activity increases when viewing happy faces.

Based on these results, it appears that female controls with greater BPD traits utilise greater levels of attention and memory when looking at faces in general. The anterior cingulate regions reflecting attention and emotions (Wingenfeld et al., 2009), posterior cingulate for emotions (Nielsen et al., 2005) temporal for memory (Cabeza & Nyberg, 2000). On the other hand, males with greater BPD traits appear to place stronger emotional attention when viewing happy faces. These female and male differences may reflect the sensitivity (Crowell et al., 2009; Linehan, 1993) that those with BPD when viewing emotion expressions that have been reported in both the neuroscience literature (Domes et al., 2009; Donegan et al., 2003) and behavioural (Domes et al., 2008; Domes et al., 2009).

Emotion dysregulation

Regarding emotional dysregulation, females with greater difficulties with regulating emotion reported deactivation in right dorsal anterior cingulate regions for neutral faces, and right fusiform regions, perhaps indicating less effort, difficulties or bias in interpreting facial expressions - a reduction of cognition from a more negative emotional reaction. Similarly, when males viewed neutral faces, the anterior cingulate area activity reported to be lower for those with greater emotion regulation. Hence, like the results of the female participants, this may indicate that less effort, difficulties in or negative bias in anterior cingulate regions relating to interpreting a neutral faces as having a greater frown and as less happy. Due to the role of the dorsal ACC, perhaps this difficulty, less effort, or bias
underpins the susceptibility to erroneously interpreting the emotions of ambiguous faces (for the neutral facial expression; Bush et al., 2000) and encoding faces differently, perhaps mediating someone’s decision making or creating a negative bias of the emotions of others, akin to that which happens in BPD (Domes et al., 2009; Unoka et al., 2011), especially when under daily stress (Domes et al., 2009). This said, males with greater emotion dysregulation were found to increased dorsolateral prefrontal, premotor area, Broca, and anterior cingulate area activity when viewing happy and angry faces when compared to those with lower emotional dysregulation. Generally, speaking, because these emotions are more straightforward than the more ambiguous neutral face, perhaps this reflects a greater amount of attention and processing (Cabeza & Nyberg, 2000) towards interpreting the expressions due to poorer abilities to do so. However, this can also be explained in another way.

Interestingly, males and females seemed to produce different brain activity for emotion dysregulation, whereby males reported a general increases and females reported general decreases in activity, specifically in frontal regions. Perhaps these results could be explained analogously to the differences in frontal activity as found in a study that investigated working memory performance in males and females when an emotional, face distraction was presented (Iordan, Dolcos, Denkova, & Dolcos, 2013). Although the emotional recognition task used in this study did not have a working memory component, specifically, perhaps the female participants in this study focussed more on the emotions of the faces than males in the study, whereas males observed and were considering their answers/next steps were going to be, as the repetition of questions in the study were predictable. The more broad premotor cortex activity for males in the results adds a little more evidence on this suspicion because of its role in spatial components to motor planning (Brasted & Wise, 2004; Fogassi et al., 1996; Graziano, Reiss, & Gross, 1999; Graziano, Yap, & Gross, 1994; Muhammad, Wallis, & Miller, 2006) as well as reviews indicating that females generally pay more attention to emotions, and encode memories more in accord to their emotional content then males, where females view their emotions as being more important to attend to, analyse, and modify to pursue goals (Nolen-Hoeksema, 2012).
Dissociation

Interestingly, only males reported to have neuroscience results based on dissociation when viewing the various emotional expressions. To which, the male results were so extensive that they needed to be reduced by way of changing the alpha value. Males reported to have extensive frontal (including the anterior cingulate cortex and dorsolateral prefrontal cortex), temporal and insula activity across all frequencies in all emotional expressions. Therefore, the results do line up with areas that would be expected to be involved in processing emotions of faces (Domes et al., 2009). Once more, because all of the activity was decreased, this may represent a disengagement of emotional content for those that use more dissociation strategies. However, the extensive wealth of brain-based dissociation results for males accompanied with the lack of any dissociation results for females requires further exploration. When considering that there were no behavioural differences between males and females in values on dissociation, the behavioural results of which has been found in prior large investigations with a combined clinical and non-clinical sample (Spitzer et al., 2003), the results could likely be explained by one of three things. The first is that results could be due to error in data screening and the epochs were not sufficient, due to changes in emotion regulation tendencies and techniques between males and females and this study recruited, or/and due to a uniqueness with this studies sample.

For the moment, until the results of the trust task are analysed to confirm or disconfirm the data screening issues, the discrepancy between the dissociation results for the males and females will be discussed in terms of changes in emotion regulation overtime, and use of those techniques that reports to be evident between the sexes, as dissociation is an emotion regulation technique (Giesbrecht et al., 2008; Kihlstrom, 2005; Niedtfeld et al., 2012; van der Hart & Horst, 1989; Young et al., 2003). As discussed by a review (Nolen-Hoeksema, 2012), females tend to experience more intense positive and negative emotions in their daily lives, though little difference in moment-by-moment experiences, suggesting that self-perceptions and perceptions of stressfulness of the environment play a role (Nolen-Hoeksema, 2012).
Typically evidence suggests that females use more emotion regulation strategies than males for both problem focussed (e.g., social support, planning) and emotion focussed (e.g., social support, avoidance, rumination, positive reappraisal, etc.), and other (e.g., religion) strategies (Tamres, Janicki, & Helgeson, 2002). Instead, males seem to be more likely to engage in more impulsive, reward seeking strategies to respond to negative emotions due to low effortful control with emotions. An example of this would be the greater rates of males drinking to manage emotions (Nolen-Hoeksema, 2012). Because females pay more attention to emotions, and encode memories more in accord to their emotional content then males, females view their emotions as being more important to attend to, analyse, and modify to pursue goals. This can explain why females can ruminate over emotions and feel trapped from it, but this seems to occur most for females regarding experiences of sadness and anxiety. Males on the other hand tend to ruminate more in response to anger, therefore increasing feelings of anger. This dichotomy indicates that despite the evidence that females use more emotion regulation strategies than males, measures may not be accurate or precise enough to detect the way in which males tend to regulate their emotions. For instance, most measures that investigate emotional understanding, ask participants to indicate what emotions they or others would have across different contexts (Nolen-Hoeksema, 2012).

Evidence suggests that males are beginning to utilise more emotion regulation strategies that they previously did, such as indicated by equal rates of males and females having compulsive buying issues (Koran, Faber, Aboujaoude, Large, & Serpe, 2006) which have previously been against gender role norms for males (Dittmar & Drury, 2000). Also, some males do choose to use emotion focussed strategies in certain circumstances (Nolen-Hoeksema, 2012). Speculatively then, because behavioural differences were not found for dissociation (and emotion regulation) but neuroscience data found major significances in dissociation for males and none for females, perhaps the greater amount of brain activity differences in males in this studies sample are a representation of a greater brain sensitivity difference. For females, differences regarding emotion regulation and dissociation may be
less expected, given the greater societal freedom in expressing their emotions across a larger number of emotion regulation strategies than males. These claims have a little more weight when knowing brain differences can present even in the absence of behavioural results (Wingenfeld et al., 2009), and when acknowledging the recruitment advertisements which made reference to the mentalisation and emotion regulation component of the study. Perhaps males that volunteered were interested in participating because they were, or happened to be, more emotionally open or interested in emotional intelligent processes than the wider male population.

5.4 Trust task interpretations

5.4.1 Behavioural results

Before discussing the results of the trust task, it should first be noted that there were no significant differences between randomly good or bad starts for the partners without emotional cues, according to the congruency weight measure. Therefore, it can be assumed that related affects are irrelevant. According to the results of the trust task, females interpreted their own actions towards the unfair partners as being more unfair than males. Similarly, on the occasions when participants received the lowest transfers from both partners with and without emotional cues, females reported that the transfers were fairer than males. Based on the overall score, males reported to have better mentalistion ability than females when judging the partners with emotions cues. Reasons for these differences will be discussed later, upon reflection upon the sex based sub-sample and more specific independent analyses performed using the same data.

Males with greater BPD traits reported to have more negative perceptions of the fairness of the returns of the first six presentations of emotional cues (according the hostility analysis rules). Males with greater positive views of others reported the returns of the first six emotional cues as being fairer. Females with greater difficulties with emotion regulation, reported to have greater perceptions of the fairness of the low and middle returns of the partners without emotional cues, and greater perceptions of fairness of the
middle and high returns of the partners with emotional cues. Whereas females with greater
difficulties with emotion regulation reported that the fairness of the first six transfers of the
partners with emotional cues were fairer than those with less difficulties with emotion
regulation. Although there are a variety of explanations for the differences in the results,
some of which may not be properly able to be deciphered by the measures used for this
study, the most likely one will be discussed followed by a short discussion of other
considerations.

It could be said that differences with BPD traits between males having more
negative perceptions of the first 6 transfers of the partners with emotional cues, could be
placed on a global representation of the attachment system. This can also be said for the
results of the positive views of others. For instance, because there were no reported
differences in negative views of others, which would typically associate with trauma or
negative mistrust experiences (Bowlby, 1998d; Young et al., 2003), the logical reason behind
the BPD trait differences for non-clinical males could be due to the projection of minor
attachment insecurities, as when separated from an attachment figure anger can be in hope
of reunion and can be directed to people in general (Bowlby, 1998d). Or, by normalising and
inverting the same rationale, regarding positive views, it could be possible that those with
greater positive views of others received more support from attachment figures meaning it
may not necessarily be an attachment issues itself, but better explained by the slightly less
reception of support in childhood that does not constitute abandonment. This could create
a situation whereby negative views of others could be influenced minimally but positive
views could therefore be affected more greatly, making it a better explanation.

Considering attachment to figures in earlier ages is a template that people go into
adulthood with (Bowlby, 1998d) and socialisation practices can have an impact on
perceptions of others, emotion regulation and BPD traits (Crowell et al., 2009; Linehan,
1993), this seems a likely account of the data given negative perceptions of others revealed
no differences for males, but positive perceptions did, which revealed the opposite trends
to BPD-traits in males. Therefore, because attachment insecurities or positive views of
others through attachment styles, can have an impact on perceptions of emotional expressions (Domes et al., 2009), this could be an explanation why results are only significantly different for partners with emotional cues. With this said, the researchers would be much more confident in these claims if an attachment measure was used.

Analogous to the hostility fairness decision results that males rated partners with emotional cues, similar rationale is used for why fairness ratings of the partners with emotional cues were different for females with high and low emotional dysregulation. For females, innate temperamental differences or differences in the slightly less or more reception of support and social practices around emotion regulation in childhood (Crowell et al., 2009; Linehan, 1993) that does not constitute abandonment can explain why perceptions of fairness for the early transfer values of the partners with emotional cues are different between high and low emotion dysregulation for females. For females, because emotion dysregulation was associated with greater perceptions of fairness, it could be said that those high in emotion dysregulation were more emotional and/or less aware of their emotional state and responded differently to those that were less emotional or more immediately aware of their emotional state (Gratz & Roemer, 2004; Linehan, 1993). These explanations can be used to explain the differences between fairness perceptions between the high and moderate return values for partners with emotional cues and the moderate to low returns for partners without emotional cues too.

Based on the within differences between BPD traits, emotion dysregulation, and positive views of others, perhaps it could be said that a combination of or all these differences could be used as an explanation for the sex differences in the trust task. That is, the fairness ratings of the low transfers of the partners with and without emotional cues relating to emotion regulation practices for females, whereas males reporting only differences with the partners with emotional cues, hinting towards a global representation of the attachment system for males (Fonagy & Luyten, 2009). This could also explain why males performed better with the partners with emotional cues and why males viewed their behaviour as fairer to unfair partners: a different part of the attachment system in
comparison to emotion regulation helped them gain a better score, but also helped males separate themselves from their emotions to perceive their behaviour as fairer. With this said, it is also argued by the researchers that other factors would also be involved, which cannot be properly gauged.

The differences between the self-rated fairness between males and females may be influenced by other sex differences. It has already been mentioned that males tend to ruminate more on anger and experience more anger due to it (Nolen-Hoeksema, 2012), therefore this perhaps could underpin the differences between sex when rating their own fairness to unfair partners. That is, males may be more angry at the partners and therefore view their behaviour as more justified than females. Furthermore, perhaps an anger response could be argued to have aided males in remembering the partner’s fairness and get a higher score accordingly. Finally, impulsivity differences between participants in both aggression and impulsivity in general could also be used as an explanation of the differences too. After all, aggression has been reported to affect the amount of co-operation in monetary exchange tasks (New et al., 2009), but also those more impulsive could be argued to act more riskily by transferring more to partners as highlighted in studies (Perry & Carroll, 2008).

On average, meta-analyses have suggested that females are more sensitive to punishment, and there were no differences regarding sensitivity to reward. Males report to be more sensation seeking and risk taking than females, on average (Cross, Copping, & Campbell, 2011). For these reasons, it would be argued that these sex differences may have had a role, whereby males may have been more willing to take a risk and females less likely. Ordinarily, brain activity differences would be used to validate these speculations, but because of the sheer number of influences involved in completing this mentalisation task the brain activity sex differences cannot be used. The mentalisation task in this study would involve processing the social components (Krach et al., 2009), error detection (Bush et al., 2000; Krach et al., 2009; Rolls & Grabenhorst, 2008), face processing (Lovén, Svärd, Ebner, Herlitz, & Fischer, 2014; Rolls & Grabenhorst, 2008), semantic, episodic, and other
memories (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007; Cahill et al., 2004; Lovén et al., 2014; Spalek et al., 2015), emotion regulation (Cahill et al., 2004; Iordan et al., 2013; McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008; Nolen-Hoeksema, 2012; Spalek et al., 2015), and impulsivity, sensation seeking and risk taking on top of these (Bolla, Eldreth, Matochik, & Cadet, 2004), all of which have shown related brain-based sex differences. Fortunately, the comparisons that control sex can help to validate the claims by comparing sex-specific brain activity for the influencing factors for fairness related decisions towards partners with emotional cues.

When making fairness decisions for partners with emotional cues, males with high BPD traits reported to have increased activity in middle frontal and orbitofrontal regions, both involved in decision making processing as well as anterior cingulate regions (Fellows & Farah, 2007; Rolls & Grabenhorst, 2008), when compared to those with lower BPD traits. Given the role of the insula in emotions (Phan, Wager, Taylor, & Liberzon, 2002) and the orbitofrontal regions role in inhibiting emotion regarding BPD psychopathology (New et al., 2009) this may represent the prior claims that males appear to be more prone to anger-related activity in the orbitofrontal cortex. On the other hand, males with high BPD traits appeared to be using right temporal, categorisation (Cabeza & Nyberg, 2000), emotional memory (Teicher et al., 2003), when confirming their initial anticipation of what the partner was going to transfer versus what they actually did. Importantly, these trends only occurred for partners with emotional cues which is where the behavioural results occurred for males.

Regarding males with greater positive views of others, fairness decisions to partners with emotional cues were associated with medial temporal, parietal and posterior cingulate regions activation. For directly comparing the validity of their initial transfers, those with more positive views of others reported decreased ventral anterior cingulate and posterior cingulate activity, as well as increased left Broca, insula, and medial temporal region activity when assessing their transfer based on feedback in the evaluation phase for partners with emotional cues. However, posterior cingulate activity was also found for males when rating fairness in the partners without emotional cues. Therefore, because of the role that the
anterior cingulate (Bush et al., 2000; Wingenfeld et al., 2009), posterior cingulate cortex (Nielsen et al., 2005), and insula (Phan et al., 2002) have in emotions, it could be said that an emotional component is also occurring for males when split by high and low positive views of others. Such an emotional role for males occurring in comparison to females can be established when looking at the results that females report with emotion dysregulation for both partners with emotional cues, because that was the only influencing factor that caused behavioural results.

When females made fairness judgements for partners with emotional cues, parietal, angular and fusiform regions reported decreases in activity. For directly comparing the validity of their initial transfers ventral anterior cingulate, premotor and right lateral temporal regions seemed to be different between those high and low on emotional dysregulation, and this activity seemed to be inverted when compared to males activity as seen in splits in BPD-traits and positive views of others. Importantly, when looking at activity for females high and low in emotion dysregulation for partners without emotional cues, there seemed to be other regions active for females then the ones mentioned above, barring right temporal activity. Instead the partners without emotional cues, seemed to be associated with posterior cingulate, insula, and Broca region activity. As previously mentioned, it was speculated that emotional regulation difficulties could relate to females reporting the transfers as being fairer from not being as consciously aware of their emotions in the task and perhaps this is reflected in the inverted activity when compared to males, but also in the ventral anterior cingulate and angular region (and lack of posterior cingulate) activity which may represent the decision making (Bush et al., 2000) and lack of judgement of other states (Fonagy & Luyten, 2009; Murray et al., 2015), respectively.

Therefore, the brain activity adds weight to the original speculation that an anger component and global aspects of an attachment system in which positive views of others also seemed to contribute for why male differences occurred in the partners with emotional cues, whereas emotion dysregulation in females created a mentalisation deficit, as seen in emotion regulation in BPD (Linehan, 1993). Further support of this emotion dysregulation
deficit may be suggested in the fact that females reported fairness rating differences between with emotion dysregulation in the partners with and without emotional cues. It is important to note that the above speculations consider that there did not appear to be enough evidence to suggest a role of the insula (Preuschoff, Quartz, & Bossaerts, 2008) and middle frontal area (Volz et al., 2005) being involved in an uncertainty of decision outcomes, nor dorsolateral prefrontal or orbitofrontal lateralisation combination hinting towards a sensation seeking/gambling type role between sexes (Bolla et al., 2004), as these do not seem to account for the activity difference between partners with and without emotional cues, or these would be expected to present in partners without emotional cues also.

5.4.2 Brain activity interpretations

5.4.2.1 Partners without emotional expressions

BPD traits

Seen in the neuroscience results of BPD traits in the partners without emotional cues, by visually comparing the within group differences, transfer decisions for females seem to be using areas involved in emotions and episodic memory regarding the posterior cingulate activity (Cabeza & Nyberg, 2000; Nielsen et al., 2005), but also mentalisation regarding lateral parietal and angular area activity (Fonagy & Luyten, 2009) and temporopolar regions (Gallagher & Frith, 2003). Transfer decisions seem to be associated with retrieval of relevant semantic information in left Broca regions (Cabeza & Nyberg, 2000). Except for the last two mentioned, these trends reported to carry over to the fairness minus transfer decision condition too. Therefore, it can be said that a mentalisation processing was occurring for females regarding high and low BPD tendency, based on episodic memory (Nielsen et al., 2005) perceptions of others (Murray et al., 2015). Males on the other hand, reported to have decision making differences in the transfer decision, based on middle frontal differences (Fellows & Farah, 2007; Rolls & Grabenhorst, 2008), where differences in left Broca, dorsolateral, and orbitofrontal regions reported to differ with BPD traits. Therefore, mentalisation differences did not seem to be too apparent between males, instead, as previously mentioned, perhaps the rumination over anger may have been the most influential factor for males. This could also explain why a pain processing did not
reveal for males, as it did for females because anger is an emotion that prepares individuals for aggression (Buss & Perry, 1992). The role that the orbitofrontal cortex has regarding aggression and anger has already been presented (New et al., 2009), however recent evidence suggests that a link between amygdala and the orbitofrontal cortex may not play a role outside of clinical cases (Beyer, Münte, Wiechert, Heldmann, & Krämer, 2014).

**Emotion dysregulation**

Regarding emotion dysregulation in partners without emotional cues, both males and females seemed to be using episodic memory and pain processing according to similarities between the two in posterior cingulate activity (Cabeza & Nyberg, 2000; Nielsen et al., 2005) when making transfer decisions. According to the results of the difference between the fairness and transfer decisions, it appears that females are using episodic, pain perception in posterior cingulate regions (Nielsen et al., 2005), left frontal semantic memory, temporal categorisation, and occipital visualisations (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007) more than males, whereas males are using semantic (Cabeza & Nyberg, 2000), orbitofrontal emotions (New et al., 2009), temporal categorisation (Cabeza & Nyberg, 2000) and emotion or social violation insula activity (King-Casas et al., 2008; Phan et al., 2002). Differences in dorsolateral activity/deactivation between males and females may also suggest males are engaging in the task based on memory searches (Cabeza & St Jacques, 2007), and perhaps this may relate to the suspicions from experiences of anger (Nolen-Hoeksema, 2012) as previously mentioned. Similarly, because emotion regulation after all is associated with automatic and controlled mentalisation differences (Fonagy & Luyten, 2009), perhaps this can explain why posterior cingulate and temporal regions reported completely different trends in activation to frontal areas. In comparison, the male emotion dysregulation results do not reveal such marked switches in activity, and if any switch occurs it is occurring in dorsolateral prefrontal regions which is involved in effortful memory searches (Cabeza & St Jacques, 2007). Therefore, the switches in temporal regions could be associated with the deactivation of temporal regions needed for working memory processes (Cousijn, Rijpkema, Qin, van Wingen, & Fernández, 2012) as a representation of this memory search engagement for males.
Dissociation

Similar to the results of the emotion recognition task, dissociation-related neurobiological differences seemed to stand out more for males, once again. Therefore, this adds more weight to the notions that the previous emotion recognition results are valid, and instead could be related to differences in the sample that this study used, albeit the reasons of those results can only be speculated. Nevertheless, males reported to have extensive parietal and premotor region deactivation for those with greater dissociative experiences when making fairness decisions, as well as dorsal anterior cingulate region activity in the beta 1 frequency. Such regions have been implicated to occur when under the sensation of meta-chlorophenylpiperazine, inducing distress in BPD, therefore implicating its role in emotional discomfort (New et al., 2007), or as an indication that those with less dissociative symptoms were more primed and ready to answer the fairness decision due to the regions role in spatial awareness (Brasted & Wise, 2004; Graziano et al., 1999; Graziano et al., 1994; Muhammad et al., 2006). The same can be said for the parietal (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007) and temporal activity (Cabeza & Nyberg, 2000; Teicher et al., 2003) that is those with greater dissociation had decreased activity due to being less engaged in the task. A disengagement to the task could be further represented when we consider the differences in dorsal anterior cingulate deactivation for those with less dissociative tendencies, considering the difference between fairness and transfer decisions, as both questions force participants to answer and engage in an emotional question which would be expected to surmount in both participants groups in ventral anterior cingulate regions (Bush et al., 2000), hence no differences in the fairness minus transfer condition.

The transfer decision on the other hand, revealed the same premotor activity as fairness decisions, showed differences in the ventral as opposed to dorsal anterior cingulate regions, had a deactivation in dorsolateral prefrontal regions. Therefore, the same rationale could be argued to be occurring in the transfer decisions, with the addition of the use of less effort to engage in memory searches (Cabeza & St Jacques, 2007). Regarding the differences
between the fairness and transfer decision, results suggest that orbitofrontal and middle frontal regions were involved for those with greater levels of dissociation, therefore because of the role that the orbitofrontal cortex has regarding emotion (New et al., 2009), coupled with the role of the middle frontal region has with altering dissociative tendencies (Niedtfeld et al., 2012; Sierra & Berrios, 1998) from decision making (Rolls & Grabenhorst, 2008), such as coping styles. However, interestingly, as originally analysed, activity for males was not in the right middle frontal region (Sierra & Berrios, 1998), but in the left. However, because of the non-clinical sample, generalisations will thus far not be made, apart from notions that perhaps this could have some form of lateralisation difference for males and females, as has been found in other regions for emotion processing (Cahill et al., 2004; Gasbarri et al., 2007).

Investigations that have been used to support this right middle frontal activity have not necessarily all considered sex differences (Niedtfeld et al., 2012; Reinders et al., 2003; Reinders et al., 2006; Sierra & Berrios, 1998) and based on searches performed, sex difference studies are very limited to come across regarding the neuroscience of dissociation. Better insights will also come from a clinical sample. On the other hand, females with high levels of dissociation, reported to dorsolateral increases and occipital decreases but only in the fairness minus transfer decision condition. Therefore, similar to the increases found in that condition for males, perhaps this can be explained by a shut off of engagement to the task as highlighted by memory searches, but in a different way from males. For instance, males did not report differences in occipital regions, and therefore perhaps females had diminished visualisation processes than males when finding out if they were right or wrong in their transfers (Cabeza & St Jacques, 2007).

**Negative views of self**

For males, the results between high and low negative views of the self when making fairness decisions, indicated that increases for those with greater negative views of themselves in ventral anterior cingulate regions, ventral parietal regions, and posterior
cingulate regions, as well as decreases in left temporal areas. Although no behavioural
differences can help ascertain what might be going on here, it is interesting to note that
activity in the anterior and posterior cingulate might represent an attention to emotions
(Bush et al., 2000; Nielsen et al., 2005; Wingenfeld et al., 2009), whereas ventral parietal
may account for processing of episodic memory encoding (Cabeza, 2008; Cabeza et al.,
2012a, 2012d) both from the forcing of differences in processing self-states (i.e., the high
and low self-view median split). This may mean the decrease in temporal activity may relate
to the withdrawal or less focussed processing of long term memory (Cabeza & Nyberg,
2000) from the phasic deactivation of those areas from working memory (Cousijn et al.,
2012) from episodic memory and self-state processing. The same processes mentioned
above, appear to be involved in transfer decisions too, however transfer decisions reported
areas involving processing the states of others too, such as temporal-parietal-junction
regions (Fonagy & Luyten, 2009; Murray et al., 2015). This may suggest that those with
negative states of themselves may have biases from those self-states which impact on
processing on the states of others. On the other hand, results for females were too few to
comment on with a sufficient amount of reliability, and therefore they will not be discussed.
This was the same for positive views of the self.

Negative views of others

Females with greater negative views of others reported a deactivation in dorsal
anterior cingulate regions, left Broca, but an activation in anterior cingulate regions when
making transfer decisions. Males reported orbitofrontal, bilateral temporal, fusiform,
ventral parietal, posterior lateral parietal, and angular region deactivation for those with
greater negative views when making transfer decisions. Of first mention, frontal regions for
females seemed to have increased brain activity with posterior regions being negative,
whereas males reported only deactivations. These results perhaps indicate that females that
have less negative thoughts of others are placing more effort into deciding if a partner is
fair, whereas those with negative thoughts may be happy to go with their more negative
bias of others, in which those with high negative biases experience a strong pain experience
in the episodic memory, trust task. These indications are based on the differences between anterior cingulate regions and posterior cingulate regions.

Males on the other hand, seemed to be processing the states of others, using categorisation long term memory, and orbitofrontal reactions. These differences can therefore be explained similarly to those of emotion regulation, as previously explained. Males have a stronger anger reaction and answer accordingly, whereas females seem to experience pain. Males did not report enough differences in the comparison between the anticipated and observed transfers of the participant and therefore only the results for females will be considered. With this said, posterior cingulate and insula trends can be seen in the fairness minus transfer decision condition in females, both involved in processing emotions (Nielsen et al., 2005; Phan et al., 2002), however because of the increase in temporal categorisation and perhaps left semantic memory differences (Cabeza & Nyberg, 2000), the activity may be best accounted to a combination of emotion and memory processing, inclusive of noticing social violations (King-Casas et al., 2008; Phan et al., 2002).

Positive views of others

Males who reported to have greater positive views of others reported in both fairness and transfer decisions to be using areas involved in episodic memory and pain perception (Nielsen et al., 2005), therefore implicating the pain process being involved in those that do not have as large expectations that others will act unfair to them. Females on the other hand seemed not to produce any results, possibly because the high and low groups could not be differentiated enough by the sample on a variable that did not have a particularly large distribution. With that said both sexes reported to have differences in the fairness minus transfer decision condition. Both sexes reported to have a deactivation in ventral anterior cingulate regions, males reporting decreases in middle frontal and orbitofrontal regions, whereas females reporting increases in posterior cingulate and parietal regions. Such results again emphasise that results for males may reveal an anger component (New et al., 2009) and preparation to act accordingly (Buss & Perry, 1992), as
previously stipulated, whereas females may be processing pain or episodic memory (Nielsen et al., 2005); having a more focus and intensity of emotion in the task (Nolen-Hoeksema, 2012).

5.4.2.2 Partners with emotional expressions

BPD traits

According to the results of a high and low BPD trait group, females with higher BPD traits reported to have anterior parietal, and lateral posterior parietal activity increases in both fairness and transfer decisions. Fairness decisions revealing increases in the temporal-parietal junction. Based on these results, it can be said that when making fairness decisions, those with greater BPD traits reported to be more engaged or required to work harder (similar to the sex differences in Krach et al., 2009) to place themselves in the partners position based on temporal-parietal junction activity (Fonagy & Luyten, 2009; Murray et al., 2015). In which, perhaps the broad parietal activity could be explained by efforts in engagement in the task via episodic or visual imagery (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007). On the other hand, in the fairness minus transfer decision condition, decreased activity was found in premotor and dorsolateral prefrontal regions. Increases were found orbitofrontal, middle frontal, broad anterior cingulate regions. Perhaps these results represent non-pathological, increased orbitofrontal and anterior cingulate behaviour correction process and related decision making (Rolls & Grabenhorst, 2008) for those with greater BPD traits, but based on the supporting literature this activity may be best accounted to the focus on emotions between the transfer and fairness decisions because of the greater role of the ventral anterior cingulate (Bush et al., 2000) and congruent motor planning changes (Brasted & Wise, 2004; Graziano et al., 1999; Graziano et al., 1994; Muhammad et al., 2006).

Males on the other hand, revealed middle frontal and orbitofrontal differences in both transfer and fairness decisions, but transfer decisions reported to have an involvement in broad anterior cingulate regions. Therefore, as suggested when discussing the
behavioural results beforehand, it appears that males with greater BPD traits tended to use emotional orbitofrontal decision making (New et al., 2009; Rolls & Grabenhorst, 2008) in fairness decisions, and ventral anterior cingulate regions (Bush et al., 2000) for transfer decisions, related to processing anger (Nolen-Hoeksema, 2012). The insula activity in these same comparisons further link males to some form of emotional reaction (Phan et al., 2002). Perhaps this can explain why limited results in orbitofrontal and anterior cingulate regions existed for males high and low in BPD traits in the fairness minus transfer decision condition, because anger was apparent in both decisions, perhaps via rumination (Nolen-Hoeksema, 2012), leaving only phasic deactivation (Cousijn et al., 2012) long term memory processes (Cabeza & Nyberg, 2000; Teicher et al., 2003) in the fairness minus transfer decision.

Emotion dysregulation

Females with greater emotion dysregulation seemed to have decreased activity in the angular and posterior lateral parietal region when making fairness decisions. Transfer decisions were associated with dorsal anterior cingulate, lateral temporal, posterior cingulate, posterior lateral parietal, angular, occipital and insula activity, along the same decrease trend as for fairness decisions. Based on the activity of these regions, emotion regulation seemed to be associated with poorer error-reward process decision making (Bush et al., 2000; Rolls & Grabenhorst, 2008) or attention away from negative information (Wingenfeld et al., 2009), episodic memory or detachment from visualisation (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007) and related pain processes (Nielsen et al., 2005; Phan et al., 2002) for transfer decisions in those with greater emotion dysregulation.

Fairness decisions seemed to associate with differences in episodic memory or detachment from visualisations (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007); both fairness and transfer decisions seem to relate to poorer processing of the states of others based on angular area decreases (Fonagy & Luyten, 2009; Murray et al., 2015). As previously mentioned, the decreases in angular regions may have lead to the differences in behavioural results: such as with high emotion dysregulation associating with perceiving low returns as fairer. For the fairness minus transfer decision condition, differences were found in premotor areas, ventral anterior cingulate, right lateral temporal and occipital regions.
Therefore, as based on previous explanation, this may be due to the differences between the two decisions in motor planning (Graziano et al., 1999; Graziano et al., 1994) or focus on physical stress (New et al., 2007), emotional error-reward decision processes or attention to (Bush et al., 2000), long term memory processing and visualisations or episodic memory processes (Cabeza, 2008; Cabeza & Nyberg, 2000).

Males on the other hand, reported to generally have increases in activity as opposed to the decreases witnessed in the female comparisons. When making fairness decisions males with greater difficulties with emotion regulation reported to have left Broca, orbitofrontal, insula medial and temporo-polar temporal region activity. When making transfer decisions males with greater emotion dysregulation reported decreases in posterior cingulate regions and increases in orbitofrontal and temporo-polar areas. Furthermore, the right dorsolateral prefrontal region activity reported to be increased for those with greater emotion dysregulation in the fairness minus transfer decision condition. The fairness decision results may relate to the processing of long term memory associated with mentalisation particular (Gallagher & Frith, 2003), left Broca associated with semantic memory processing (Cabeza & Nyberg, 2000), orbitofrontal (Rolls & Grabenhorst, 2008) and insula (Phan et al., 2002) associated with processing emotions. The medial temporal region may simply reveal memory recognition processes (Cabeza & St Jacques, 2007). In transfer decisions, posterior cingulate deactivation could be interpreted as a processing of pain (Nielsen et al., 2005), considering the temporo-polar and orbitofrontal regions are increased which could also represent long term memory associated with mentalisation (Gallagher & Frith, 2003) and influence of emotions (Rolls & Grabenhorst, 2008), respectively. Therefore, as speculated earlier, these results may suggest that despite experiencing emotions males high and low in emotion dysregulation seem to be reacting in a more aggressive, “I’ll get them” mindset. This approach would explain the processing of emotions, but also why memory areas are also involved, representing the anger but also engagement in the task. In line with this, the differences between the fairness and transfer decisions revealed only differences in dorsolateral prefrontal regions, perhaps as a marker of the memory search (Cabeza & St Jacques, 2007) in the transfer decision.
Dissociation

According to the fairness minus transfer decision results from a high and low dissociation groups for females, results indicate memory search differences (Cabeza & St Jacques, 2007), perhaps disconnection from motor planning (Brasted & Wise, 2004; Graziano et al., 1999; Graziano et al., 1994; Muhammad et al., 2006) or processing of physical distress (New et al., 2007), effortful attention away from the emotions (Bush et al., 2000; Wingenfeld et al., 2009) and a disconnection of categorical, long term memory (Cabeza & Nyberg, 2000; Cousijn et al., 2012). This is indicated by the decreases in activity found in the dorsolateral prefrontal, premotor, dorsal anterior cingulate, and temporal region for those with greater dissociative tendencies, respectively. Males on the other hand, seemed to produce vast differences in both fairness and transfer decisions in frontal, temporal and parietal regions. Collectively, these results could be explained by a disconnection of frontal, temporal and parietal memory processes (Cabeza, 2008; Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007), as well as attention away from cognitive and particularly emotional components for the task based on decreases in anterior cingulate activity (Bush et al., 2000; Wingenfeld et al., 2009). Interestingly, differences in frontal regions seem not to surmount as much in frontal regions when making transfer decisions, thus perhaps representing a difference in activity associated with being forced to engage in the question of whether behaviour was fair: the transfer decision being something one can press based on luck alone, thereby being more able than the fairness decision to emotionally separate oneself from the task. In support, dorsolateral memory searches (Cabeza & St Jacques, 2007), orbitofrontal and middle frontal region decision making (Rolls & Grabenhorst, 2008) is absent in the transfer decision.

Negative views of self

In the fairness minus transfer decision, females with high negative views of themselves reported to have decreased activity in right orbitofrontal and left dorsal anterior cingulate regions, as well as right temporal and left anterior parietal areas. Increases on the
other hand were found in left lateral orbitofrontal, left lateral and medial temporal and posterior cingulate regions. Based on these results, perhaps this represents that females with greater negative views of themselves place less effort into engaging in error-reward processing in the task (Bush et al., 2000; Rolls & Grabenhorst, 2008) and encode or retrieve long term memories from the task based on the right temporals involvement in emotional content (Teicher et al., 2003), whereby those low in negative self-perceptions engage in the task more due to having a less self-cynical attitudes therefore processing mentalisation on a level higher than just the self, i.e., processing the states of themselves and others. However, because angular region activity did not seem to surmount, it does not seem to be as far as processing other states specifically, just being more open to mentalisation processes, as indicated by increased temporo-polar activity (Gallagher & Frith, 2003), but also bilateral (Teicher et al., 2003) and medial temporal (Cabeza & St Jacques, 2007) and episodic (Nielsen et al., 2005) memory. Males on the other hand, seemed to reveal that those with greater negative views tended to withhold on utilising memory components (Cabeza & Nyberg, 2000), instead feeling a greater sense of pain or perhaps episodic processing in the task (Nielsen et al., 2005) in both fairness and transfer decisions. Although a decreased insula response does not match up to this idea of pain processing, it should further be noted that perhaps the decreases in insula activity represent different priorities on, or weaker ability for those with negative perceptions of others to notice social norm violations of others (King-Casas et al., 2008).

Positive views of self

Females with less positive views of themselves reported to have increased activity in orbitofrontal and ventral anterior cingulate regions when making fairness decisions, which could be argued to relate to greater error-reward processing for those with more positive views of themselves. Indeed, the results of the fairness minus transfer decision, seemed to reveal increases in right dorsolateral prefrontal region processing, perhaps as an indication of enhanced memory searches (Cabeza & St Jacques, 2007), and maybe episodic memory retrieval (Cabeza & Nyberg, 2000) as a fall-back suggestion. Somewhat similarly, males revealed right medial temporal and left Broca activation for those with greater positive
views when making transfer decisions, perhaps as a representation of memory retrieval processes (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007). Fairness minus transfer decision results for males indicate that those with less positive views of themselves reported to have increased error-reward processing in the dorsal anterior cingulate regions (Rolls & Grabenhorst, 2008), categorisation processes in temporal regions (Cabeza & Nyberg, 2000), memory processes in medial temporal regions (Cabeza & St Jacques, 2007), and temporo-polar mentalisation processing (Gallagher & Frith, 2003). Therefore, these results could be explained as those low in positive self-perceptions engage in the task and process perceptions of themselves more thoroughly (Murray et al., 2015).

**Negative views of others**

When making transfer decisions females with high negative views of others reported to have increased medial temporal, posterior cingulate and insula region increases in activity. These results suggest that those with greater negative views of others were more engaged in medial temporal memory processing (Cabeza & St Jacques, 2007), episodic memory processing or focus on pain (Nielsen et al., 2005), the latter could also be indicated in processing in insula regions because of its relevance to emotion processing (Phan et al., 2002). In the fairness minus transfer decision, results indicate a decreased activity between the conditions for those high in negative views of others in ventral anterior cingulate, bilateral Broca, and left lateral temporal regions. Perhaps these regional activations suggest that those with less negative views of others are more engaged in the task, not necessarily basing their responses on more ingrained, prior thinking processes (i.e., “others are bad”). Ventral anterior cingulate regions being involved in emotional decision and observations (Rolls & Grabenhorst, 2008), frontal regions being involved in memory searches (Cabeza & St Jacques, 2007) and processing semantic and episodic memory, and temporal regions being involved in processing categorical information (Cabeza & Nyberg, 2000) or periodic deactivation of the temporal cortex for working memory processes (Cousijn et al., 2012).
Males with greater negative views of others reported deactivations in left Broca, lateral temporal, posterior lateral parietal and angular areas when making fairness and transfer decisions. Activity in these regions suggest that males with greater levels of negative thoughts of others, like for females, placing less amount of effort into assessing the validated of the partners, instead going by ingrained beliefs prior to completing the task (i.e., “others are bad”). In particular, this is supported by the decrease in angular area (Fonagy & Luyten, 2009) activity that is essential in processing the states of others (Murray et al., 2015). These claims are further supported by the lack of mentalisation, as perhaps indicated by the decreased activity in temporo-polar regions (Gallagher & Frith, 2003) that exists for those with greater negative views of others, which only occurs when making transfer decisions. Furthermore, when looking at the differences between fairness and transfer decisions, there are reported differences in premotor, dorsal anterior cingulate, right temporal areas, which perhaps reflect the less amount of effort by those with greater negative thoughts in regions involved in motor planning (Brasted & Wise, 2004; Graziano et al., 1999; Graziano et al., 1994; Muhammad et al., 2006), error detection or anticipation (Bush et al., 2000; Rolls & Grabenhorst, 2008), and categorisation memory processing (Cabeza & Nyberg, 2000).

**Negative views of others**

Although there were few significant differences for females based on a high and low split of positive views of others, there does seem to be a trend in the angular area in the fairness minus transfer decision condition. Because there is little else to base speculations on, the trends will not necessarily be discussed. With this said, deactivations were found in the angular area for those with greater positive views of others. Therefore it appears that there are differences going on for those varying positive perceptions of others in regions involved in processing the states of others (Murray et al., 2015). Males with greater positive views of others on the other hand, reported to have increased activity in medial temporal, ventral parietal, and posterior cingulate regions when making fairness decisions. Therefore this could be argued to relate to the processing of memory content, related to episodic memory (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007), and perhaps processing of
pain if a partner behaves against their true, average fairness (Nielsen et al., 2005). Whereas for the fairness minus transfer decision condition, results suggest that medial temporal (Cabeza & St Jacques, 2007) and left Broca (Cabeza & Nyberg, 2000) memory processes were occurring for those with greater positive views, presumably, the decrease in ventral anterior cingulate and posterior cingulate activity represents a learning process in terms of behaviour correction (Rolls & Grabenhorst, 2008) and then pain and episodic memory (Nielsen et al., 2005), respectively.

5.5 Methodological limitations

The largest noteworthy limitation pertains to the EEG epoch size and data screening process. For instance, the smallest amount of epochs in any analysis was a total of 12 epochs equating to 18 seconds of data, when not separated between emotion and partner. Such considerations further delineate the low amount of epochs for the happy and angry faces. Although it would be ideal to analyse the happy and angry faces separately to properly disentangle what is specifically happening for the expressions between each median split in the trust task, the amount of epochs required for that process would likely be jeopardised and therefore produce unreliable results, which is why they were analysed together, why strict guidelines and data handling was implemented, and why a validation exercise was performed.

To support the data handling procedure, results from the study produced generally expected brain region activity in both the median split comparisons, but also in the mentalisation validation. Analysis was specifically chosen with this limitation in mind which included background knowledge that time-frequency methods have been used to measure brain development changes using 16 seconds of resting state EEG data (Hanlon et al., 1999; Thatcher et al., 1987). In fact, 10 seconds of EEG data has been able to distinguish differences between groups with time-frequency analysis methods (Hopper et al., 2002). Also known, time-frequency analysis methods Event-Related-Oscillations do not rely on as large amount of epochs compared to Event-Related-Potential methods (Herrmann et al., 2013). A 20 hertz filter was necessary to attenuate as much muscle activity as possible (De
Luca et al., 2010), thereby the researchers had no intentions of analysing anything above beta 1 frequency. Notably then, because older suggestions indicate 5 (Merletti & di Torino, 1999) and 10 hertz (Winter et al., 1980), some epochs may have been affected by muscle activity, but the mentalisation validation seemed to produce reasonable results.

This study used several median split comparisons (i.e., BPD traits, emotional dysregulation, dissociation, and positive and negative views of self and others) in order to investigate different, but unique aspects associated with BPD. As noted in the introduction and made evident in the results of this study, due to the association that BPD has with all of these concepts it could be argued that the median splits used in this study are statistically analysing and reanalysing the same sample of participant data. Furthermore, the use of univariate statistics in the results mean that the shared variance between variables were not considered. These considerations mean that the study is at risk of committing a type I error, as the study did not control for multiple comparisons (Katz, 2011). Whilst there is an element of truth to the above claims, it is important to reiterate that the median split comparisons are unique aspects associated with BPD. For instance, dissociation is merely one specific example of an emotion dysregulation strategy. On the other hand, measurements and comparisons using perceptions of self and others provide the best investigations of factors associated with identity and social hypervigilance, given no other measures come close to measuring those factors. Furthermore, note that the displayed results are not identical each time, suggesting that despite the inevitable risk of shared variance, different data pools were being analysed.

A further limitation of the statistics used is that it would have been interesting to analyse variables whilst removing the influence of others to properly isolate specific results for variables. For instance, it would have been interesting to investigate BPD trait differences whilst taking out the covariance of emotion dysregulation, especially considering the risk of overlap. Otherwise, regression analyses may have been helpful in teasing out whether specific brain regions were better explained by BPD symptomatology, emotion dysregulation, etc.
Intelligence was never assessed in participants meaning that it can only be cautiously speculated based on the highest of education attained, at best. Because intelligence utilises various brain regions related to memory and attention, the same streams that intelligence uses are also being used by those involved in mentalisation. For instance, parietal regions (including the angular area), interact with frontal regions involved in decision making and working memory processes such as the premotor, DLPFC, middle frontal, Broca and anterior cingulate regions (Deary, Penke, & Johnson, 2010).

Overall, the modifications made to the trust task which made it compatible to EEG acquisition, presumably also extended the overall time to complete the trust task (participants seemed to take about 15-20 minutes to complete the entire task). Despite placing in the images of the four partners together to help alleviate memory demands, the task might represent differences in intelligence processes, in part. Therefore, some part of the results in this study may be attributed to a certain amount of intelligence, which is hard to ascertain even though there were no significant differences in highest level of education attained in the participants. Nevertheless, the fairness minus transfer decision condition would have helped alleviate an amount of the long term memory, intelligence concerns. Furthermore, because the study was interested in delineating differences between controlled and automatic (i.e., emotional) forms of mentalisation, it may be expected to witness intelligence differences anyway. For example, those that use emotional decisions would more likely to rely on sensory areas as opposed to those that think out the steps and past and use fluid intelligence, memory systems such as those that use logic to guide decisions (e.g., Fonagy & Luyten, 2009). Furthermore, those who engage in the task, say compared to those using dissociation, would be using areas related to intelligence as they mentalise compared to those that disengage (cf. Deary et al., 2010; Reinders et al., 2003; Reinders et al., 2006; Sierra & Berrios, 1998).

5.6 Implications

Overall the results of the study imply that there appears to be a reasonable amount of overlap between the areas involved in mentalisation, negative states of oneself and others, emotion-dysregulation, and dissociation. When viewing neutral (i.e., ambiguous)
facial expressions, it appears that the happiness estimates are reported to be lower in those with greater BPD traits, and this could be argued to be a consequence of reading a larger frown. Therefore, this may suggest that when reading facial expressions a negative bias is creating top-down visual distortions for those with BPD, or visual processing is different between those with greater BPD traits. Further research is necessary.

Differences between brain activity between the partners with and without emotional cues consolidate the assumptions that processing the mental states of those partners are different, and these differences seem to yield similar, but also different results to those of pure emotion recognition. Generally speaking, overlaps away from emotion recognition can be argued to evolve around behaviour correction (i.e., the ACC, particularly), episodic memory, pain or other state processing (i.e., the posterior cingulate particularly) but also emotion processing (i.e., the OFC particularly). For males, it was speculated that an anger component initiated by the OFC was the strongest motivator in detecting the partners trustworthiness in the trust task, whereas females seemed to rely more on processing states of pain in posterior cingulate regions. In their own ways, this then provides some preliminary evidence for some regions in the bio-psychosocial model mentioned in earlier sections (i.e., Section 2.3). However, of more importance, the differences found between BPD traits and between the partners with and without emotional cues, seemingly reliability of the analysis pipeline of the trust task, encourage further analysis using a clinical sample.
Chapter 6: Aims, hypotheses and methods of study 2

6.1 Aims

This study intended to investigate the cognitive and emotional processes associated with BPD by comparing a clinical sample to healthy controls. Specifically, measures on dissociation, emotion dysregulation, perceptions of self and others, childhood abuse and neglect, and post-traumatic stress would allow the researchers to investigate their impact on behaviour and underlying brain activity in an emotional recognition and Franzen et al.’s (2011) trust task.

6.2 Hypotheses

6.2.1 Psychosocial data

Hypothesis 1: It was expected that those with BPD would report to have higher levels of negative states of themselves and others, emotion dysregulation, dissociation, childhood abuse and neglect, as well as post-traumatic symptoms.

6.2.2 Emotional recognition task

Hypothesis 2: By comparing between those that present with BPD and healthy controls, it was expected that those with BPD would have more negative perceptions of ambiguous facial stimuli as expressed through difficulties reading ambiguous stimuli and negative bias. Therefore, it was expected that those with BPD would rate an angry face as more angry, a neutral face as more angry, and happy face as less happy when compared to those with less BPD traits.

Hypothesis 3: It was expected that those with BPD would have a negative bias when judging the strength of physical facial characteristics, particularly with neutral facial expressions. In particular, a neutral face would be rated as having a stronger frown compared to healthy controls.
Hypothesis 4: It was further anticipated that those with BPD would have different brain activity processing, reflected in brain regions involved in attention to and memory retrieval associated with facial recognition. Therefore, ACC, hippocampus, extra-striate cortex, fusiform gyrus, and the superior temporal gyrus are expected to be different between those with BPD and healthy controls.

Hypothesis 5: Those with BPD will have increased activity in OFC and sensory regions (i.e., parietal regions).

6.2.3 Trust task

Hypothesis 6: It was expected that those with BPD will perform better at the trust task by identifying that emotional cues relate to high and low monetary responses, compared to healthy controls. Therefore, overtime, those individuals with BPD and negative perceptions will transfer more money over to a partner that is smiling, and transfer less to the frowning faces when compared to healthy controls.

Hypothesis 7: Those with BPD and controls would reveal no differences in transfer amounts between partners that do not have emotional cues.

Hypothesis 8: It is expected that those with BPD would have differences in activity in mentalisation-related regions (i.e., ACC, posterior cingulate, temporal, and angular areas) when compared healthy controls.

Hypothesis 9: Episodic memory processes between those with and without BPD are expected to be represented by posterior cingulate cortex, retrosplenial region differences when compared to healthy controls.

Hypothesis 10: Autobiographical memory processes between those with and without BPD are expected to be represented by right prefrontal region differences when compared to healthy controls, particularly in partners with emotion cues.

Hypothesis 11: Increased activity in the OFC and parietal regions were anticipated to present between those with BPD as a results of a greater emotional sensitivity.
6.3 Method

6.3.1 Participants

Ethical approval was granted from both Eastern Health Research and Ethics Committee, and Swinburne University Human Research Ethics Committee (see appendix D). Control participants for study 2 were recruited via word of mouth, internet advertising (i.e., Gumtree, Melbourne Exchange, and Melbourne Chat) and social media websites (i.e., Facebook). Those with BPD diagnoses were recruited via Spectrum (i.e., a state wide organisation within Eastern Health that specialises in the diagnosis and treatment for the worst BPD cases in both out and inpatient settings, based on self-harm, suicide threats, and emergency department visits, or disruption to the dynamics of the past treatment team. Clients are referred from public mental health systems and intake processes confirm BPD by diagnostic interview). Study 2 recruited 12 female participants from Spectrum, and utilised sex and age matching (+/- 2 years) procedures, therefore recruited 12 females that did not have psychiatric issues. However, due to reports indicating that one participant had BPD ‘in remission’ only 11 participants with BPD were analysed and compared to 11 participants with no psychiatric issues. The Demographics of the participants can be seen in Table 6.1, below.

Table 6.1. *Demographic information of the participants in the study*

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>BPD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>31.00 (11.65)</td>
<td>31.91 (12.30)</td>
<td>31.45 (11.70)</td>
</tr>
<tr>
<td>R. Hand</td>
<td>81.80%</td>
<td>81.80%</td>
<td>81.80%</td>
</tr>
<tr>
<td>&lt; Year 10</td>
<td>0.00%</td>
<td>9.10%</td>
<td>4.55%</td>
</tr>
<tr>
<td>Year 10</td>
<td>0.00%</td>
<td>45.50%</td>
<td>22.75%</td>
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<tr>
<td>Year 12</td>
<td>18.20%</td>
<td>18.20%</td>
<td>18.20%</td>
</tr>
<tr>
<td>Diploma</td>
<td>9.10%</td>
<td>9.10%</td>
<td>9.10%</td>
</tr>
<tr>
<td>B. Degree</td>
<td>27.30%</td>
<td>0.00%</td>
<td>13.65%</td>
</tr>
<tr>
<td>P. Grad</td>
<td>45.50%</td>
<td>18.20%</td>
<td>31.85%</td>
</tr>
</tbody>
</table>
As can be seen in Table 6.1, those with and without BPD reported to have similar age and handedness, but those without BPD seemed to have a higher level of education. Of the control participants, 1 participant was diagnosed as having past Major Depressive Disorder, and 1 participant was diagnosed as having past substance abuse. The diagnoses and medications for those with BPD used in the analyses are presented in Table 6.2 below. It should be noted that, due to administration purposes, 4 participants recruited from Spectrum did not undergo diagnostic interviews for the study, instead diagnoses were collected from their therapists directly.

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>Medications</th>
<th>Frequency</th>
<th>Chemical</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPD</td>
<td>11</td>
<td>Quetiapine</td>
<td>6</td>
<td>25-400 mg</td>
</tr>
<tr>
<td>AvPD</td>
<td>5</td>
<td>Olanzapine</td>
<td>3</td>
<td>10-20 mg</td>
</tr>
<tr>
<td>Depress. PD</td>
<td>4</td>
<td>Duloxetine</td>
<td>3</td>
<td>30-120 mg</td>
</tr>
<tr>
<td>OCPD</td>
<td>4</td>
<td>Sodium Valproate</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Depend. PD</td>
<td>3</td>
<td>Thyroxine</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Schizoid PD</td>
<td>2</td>
<td>Agomelatine</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pas. Agg. PD</td>
<td>1</td>
<td>Setraline</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Venlafaxine</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>Fluoxetine</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Major dep. dis.</td>
<td>4</td>
<td>Escitalopram</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PTSD</td>
<td>4</td>
<td>Aripiprazole</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bipolar I</td>
<td>3</td>
<td>Amilsulpride</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Social phobia</td>
<td>2</td>
<td>Carbamazepine</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Panic w agora</td>
<td>2</td>
<td>Buprenophine</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dysthymia</td>
<td>2</td>
<td>Zopiclone</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Unspec. diss. d.</td>
<td>1</td>
<td>Temazepam</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Binge eating d.</td>
<td>1</td>
<td>Diazepam</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bul. nervosa</td>
<td>1</td>
<td>Lithium</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Seen in Table 6.2, those with BPD diagnoses also reported to have numerous co-morbid issues, and were taking a wide range of anti-depressant, anti-psychotic, and chronic
and acute anti-anxiolytic medication. Furthermore, 2 participants were taking medication for non-psychiatric reasons (i.e., thyroxine).

6.3.2 Materials

6.3.2.1 Psychometric scales and interviews

Diagnostic interviews and screening

The non-patient, research version of the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I/RV-NP; Michael B. First, Spitzer, Gibbon, & Williams, 2010) was used to assess whether participants suffered from an Axis I, psychiatric disorder. The SCID-I/RV-NP is used as a standard diagnostic interview for clinical settings. Both ‘clinical’ and control participants were asked to undergo the SCID-I/RV-NP. Controls and ‘clinical’ participants were assessed by different individuals, whom underwent reliability training with the same psychology professional. On the occasion that inter-rater reliability was collected, it reported to be 96.7% identical (60 matching decisions/criteria out of 62).

The Structured Clinical Interview for DSM-IV Axis II disorders (SCID-II; M. B. First, Gibbon, Spitzer, Williams, & Benjamin, 1997) was used to confirm BPD and other diagnoses for clinical participants. Participants were asked questions to investigate the diagnostic criteria for each featured axis II psychiatric disorder (Paranoid, Schizoid, Schizotypal, Antisocial, Borderline, Histrionic, Narcissistic, Avoidant, Dependent, and Obsessive-Compulsive Personality Disorders). This interview reports to be reliable and valid (M. B. First et al., 1997). For the purposes of this study, a clinically trained professional from Spectrum conducted all of the interviews.

The Personality Diagnostic Questionnaire-4 (PDQ-4; Hyler, 1994) was used to screen control participants for BPD traits. The PDQ-4 is a 99 item, self-report inventory used to measure general personality traits associated with DSM-IV diagnostic criteria. Items pertain to both the established (Paranoid, Schizoid, Schizotypal, Antisocial, Borderline, Histrionic, Narcissistic, Avoidant, Dependent, and Obsessive-Compulsive Personality Disorders) and
research (Passive Aggressive/Negativistic, and Depressive Personality disorders) personality disorder criterion of the DSM-IV. Participants are asked to report how true or false something is of them over the past several years. However, only the 9 items pertaining to BPD were used in this study (referred to as the PDQ-4-BPD). A cut-off score of 5, or above, is used for BPD criterion to warrant attention for a more detailed interview. For this reason, control participants who scored below 5 were invited to participate in the EEG tasks. For the purposes of this study, the PDQ-4-BPD was administered verbatim in interview format. The PDQ has been used for screening purposes in clinical settings (Gardner & Qualter, 2009).

**Ability to regulate emotions**

As has already been described (Section 3.3.2.1), the DERS was used to measure emotion dysregulation in those with and without BPD.

**Dissociative tendencies**

As has already been described (Section 3.3.2.1), the DERS was used to measure dissociation symptoms in those with and without BPD.

**Perceptions of self and others**

As has already been described (Section 3.3.2.1), the DERS was used to measure negative and positive views of themselves and others in those with and without BPD.

**Childhood experiences of abuse and neglect**

Participant perceived levels of childhood abuse was measured using the 28 item version of the Childhood Trauma Questionnaire (CTQ; Bernstein & L., 1998; Bernstein et al., 2003). This particular questionnaire assesses the levels of 5 different forms of childhood abuse, each having 5 items: emotional abuse; physical abuse; sexual abuse; emotional
neglect; and physical neglect. The scale is based on a 1 to 5 Likert scale, whereby 1 indicates that the item was “Never true”; 3 being “Sometimes true”; and 5 being “Very often true”. Therefore, higher scores in each respective factor, indicate greater perceived experiences when growing up as a child. The Questionnaire reports reliable Cronbach’s alpha values in various samples, as well as high test retest reliabilities (all above 0.8) at an average of 3.6 months after first administration. The Questionnaire also purports validity (Bernstein & L., 1998).

Levels of post-traumatic symptoms

Levels of post-traumatic symptoms were measured using the 15 item, Impact of Event Scale (IES; Horowitz, Wilner, & Alvarez, 1979). This measure assesses an individual’s levels subjective stress after being subjected to a stressful experience. The scale assesses these reactions along two dimensions: intrusion, whereby individuals are reminded or experience emotions about and around the event (7 items); and avoidance, whereby individuals attempt to escape those reminders and emotions (8 items). These reactions are measured on a 1 to 4 Likert scale, assessing how regularly they occurred in the last seven days (“Not at all” through to “Often”). An example of an intrusion and avoidance items include, “Other things kept making me think about it”, and “I tried to remove it from memory”, respectively. This measure reports to have good test-retest reliability for the entire measure (0.87), and it’s intrusion (0.89) and avoidance (0.79) dimensions (Horowitz et al., 1979). For the purposes of this study, participants were asked to complete the items in accordance to their experiences of childhood abuse, as reported in the CTQ.

6.3.2.2 Emotional recognition task

As has already been described (Section 3.3.2.2), the emotional recognition task was used to investigate the neural correlates and behaviour associated with interpreting facial expression in those with and without BPD.
6.3.2.3 Trust task

As has already been described (Section 3.3.2.3), the trust task was used to investigate the neural correlates and behaviour associated with reading and judging the fairness of others in those with and without BPD.

6.3.2.4 EEG acquisition and analysis

The EEG acquisition and analysis used in this study has been previously described (see section 3.3.2.4).

6.4.3 Procedure

For study 2, control participants were asked to undergo a phone screening, using the PDQ-4-BPD, before partaking in their EEG testing session. Control participants that scored below 5 in the PDQ-4-BPD were invited to participate in the EEG tasks. Otherwise, all participants completed the SCID-I/RV-NP, DES-II, DERS, BCSS, CTQ, and IES, as well as performing the emotional recognition task and then the trust task. EEG epoching has been described in previous sections (Section 3.3.3).

6.4.3.1 Data analysis

Analysis of the trust task

**Partners without emotional cues**

The analysis of the responses to the partners without emotional cues has been described previously (section 3.3.3.1).

**Partners with emotional cues**

The analysis of the responses to the partners with emotional cues has been described previously (section 3.3.3.1).
Chapter 7: Results of study 2

7.1 Psychosocial data

7.1.1. Data screening

The data screening process used for the psychosocial data was identical to those previously described (Section 4.1.1). However, if a bimodal distribution was found fulfilling criterion of an outlier, the data was deemed to be reliable and valid given the control versus clinical sample used in this study. Generally speaking, this was found to be the case in the data. Prior to analysis, the data was screened for missing data, outliers and normality. A total of 25 missing values were found across all of psychometric measures, which did not exceed more than 1 missing case (4.5%) for any item. 15 of these items were from an ethical decision where a participant was not asked to complete the IES. This participant only completed half of the CTQ (14 items), however, having completed the CTQ at an earlier time in a concordant study, ethical protocols allowed the researchers to get the old CTQ data from that participant. Item to item correlations were made between the available data common to both CTQ’s reported by that participant and was strongly correlated (r = 0.908, p < 0.001), indicating that the past CTQ data was acceptable to use. The most affected measure was the IES with each item having one missing case, where the BCSS reported having 8 missing cases with items 5, 8, 9, 10, 11, 12, 18, and 21. These missing values were replaced the Maximum Likelihood Estimation using a 5000 iteration Missing Values Analysis, which Little’s MCAR test suggested the values were missing completely at random (χ² (635) < 0.001, p = 1.000).

The Missing Values Analysis was conducted by inputting each item from each questionnaire, entering sex, education, and handedness categorical data, and participant number as case values. Because the imputed values did not represent whole numbers, all numbers were rounded to the nearest whole number for each measure. With regard to the IES, the number was rounded to the closest congruent interval (i.e., 0, 1, 3, 5). This was performed to maintain the psychometric properties of the measures. The Square root of X (X representing the following mentioned variables) was used to transform the BCSS negative
other total, whereas the log10 of X was used to transform the emotional awareness, physical neglect, as well as the physical and sexual abuse totals.

7.1.2 Comparisons between the control and BPD sample

Of first mention, there were significant differences between handedness ($\chi^2 (1) < 0.001, p = 1.000$) and education ($\chi^2 (5) = 10.286, p = 0.068$) between those with and without BPD using Pearson Chi Square statistical coefficients. However, the Linear-by-linear association test indicated that there were significant differences between education levels between those with and without BPD ($\chi^2 (1) = 7.219, p = 0.007$). In order to examine any differences in psychometric variables between those with and without BPD, the means and standard deviations are presented in Table 7.1 below. The theoretical ranges and reliability statistics for the measures used in the study are also presented in Table 7.1.
Table 7.1. Descriptive and comparative statistics between those with and without BPD for the psychosocial variables used in the study.

<table>
<thead>
<tr>
<th></th>
<th>Original (M, SD)</th>
<th>Transformed (M, SD)</th>
<th>TR reliability df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
<th>P eta sq</th>
<th>Ob pwr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Controls</td>
<td>BPD</td>
<td>Total Controls</td>
<td>BPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DERS total*</td>
<td>104.50 (38.37)</td>
<td>71.73 (11.50)</td>
<td>137.27 (24.41)</td>
<td>36-180</td>
<td>0.98</td>
<td>1</td>
<td>20</td>
<td>64.912</td>
</tr>
<tr>
<td>DERS non-acc*</td>
<td>16.18 (8.44)</td>
<td>9.55 (2.58)</td>
<td>22.82 (6.78)</td>
<td>6-30</td>
<td>0.95</td>
<td>1</td>
<td>20</td>
<td>36.815</td>
</tr>
<tr>
<td>DERS goals*</td>
<td>18.41 (5.47)</td>
<td>14.27 (4.73)</td>
<td>22.55 (5.05)</td>
<td>5-25</td>
<td>0.91</td>
<td>1</td>
<td>20</td>
<td>30.004</td>
</tr>
<tr>
<td>DERS impulse</td>
<td>16.09 (7.22)</td>
<td>10.64 (4.30)</td>
<td>21.55 (1.63)</td>
<td>6-30</td>
<td>0.93</td>
<td>1</td>
<td>20</td>
<td>29.801</td>
</tr>
<tr>
<td>DERS aware*</td>
<td>15.95 (6.07)</td>
<td>13.09 (2.95)</td>
<td>18.82 (7.12)</td>
<td>1.18 (0.15)</td>
<td>1.11 (0.09)</td>
<td>1.25 (0.17)</td>
<td>6-30</td>
<td>0.89</td>
</tr>
<tr>
<td>DERS strat</td>
<td>23.05 (9.80)</td>
<td>14.18 (3.60)</td>
<td>31.91 (4.01)</td>
<td>8-40</td>
<td>0.95</td>
<td>1</td>
<td>20</td>
<td>118.977</td>
</tr>
<tr>
<td>DERS clarity*</td>
<td>12.41 (5.59)</td>
<td>8.64 (1.91)</td>
<td>16.18 (5.55)</td>
<td>5-25</td>
<td>0.93</td>
<td>1</td>
<td>20</td>
<td>18.196</td>
</tr>
<tr>
<td>DES total</td>
<td>23.72 (18.72)</td>
<td>10.68 (10.06)</td>
<td>36.75 (16.14)</td>
<td>0-100</td>
<td>0.95</td>
<td>1</td>
<td>20</td>
<td>20.670</td>
</tr>
<tr>
<td>BCSS neg self*</td>
<td>8.77 (8.18)</td>
<td>1.36 (1.63)</td>
<td>16.18 (4.12)</td>
<td>0-24</td>
<td>0.95</td>
<td>1</td>
<td>20</td>
<td>123.119</td>
</tr>
<tr>
<td>BCSS pos self</td>
<td>9.36 (6.82)</td>
<td>13.91 (4.76)</td>
<td>4.82 (5.44)</td>
<td>0-24</td>
<td>0.95</td>
<td>1</td>
<td>20</td>
<td>17.397</td>
</tr>
<tr>
<td>BCSS neg other</td>
<td>6.50 (6.52)</td>
<td>2.00 (2.8)</td>
<td>11.00 (6.29)</td>
<td>0-24</td>
<td>0.91</td>
<td>1</td>
<td>20</td>
<td>16.949</td>
</tr>
<tr>
<td>BCSS pos other*</td>
<td>9.91 (4.92)</td>
<td>12.00 (0.10)</td>
<td>7.82 (5.72)</td>
<td>0-24</td>
<td>0.90</td>
<td>1</td>
<td>20</td>
<td>4.673</td>
</tr>
<tr>
<td>CTQ Total</td>
<td>57.45 (27.51)</td>
<td>36.64 (9.42)</td>
<td>78.27 (23.39)</td>
<td>1.71 (0.20)</td>
<td>1.55 (0.10)</td>
<td>1.88 (0.13)</td>
<td>25-125</td>
<td>0.96</td>
</tr>
<tr>
<td>CTQ emot abuse*</td>
<td>12.91 (7.70)</td>
<td>7.55 (3.42)</td>
<td>18.27 (7.03)</td>
<td>5-25</td>
<td>0.96</td>
<td>1</td>
<td>20</td>
<td>20.720</td>
</tr>
<tr>
<td>CTQ phys abuse*</td>
<td>9.45 (6.13)</td>
<td>5.82 (1.33)</td>
<td>13.09 (6.93)</td>
<td>0.47 (0.50)</td>
<td>0.18 (0.26)</td>
<td>0.76 (0.51)</td>
<td>5-25</td>
<td>0.94</td>
</tr>
<tr>
<td>CTQ sexual abuse*</td>
<td>11.27 (8.21)</td>
<td>5.27 (0.90)</td>
<td>17.27 (7.84)</td>
<td>0.51 (0.58)</td>
<td>0.05 (0.18)</td>
<td>0.97 (0.47)</td>
<td>5-25</td>
<td>0.97</td>
</tr>
<tr>
<td>CTQ emot neglect</td>
<td>14.59 (7.04)</td>
<td>9.18 (4.87)</td>
<td>20.00 (4.00)</td>
<td>5-25</td>
<td>0.96</td>
<td>1</td>
<td>20</td>
<td>32.375</td>
</tr>
<tr>
<td>CTQ phys neglect</td>
<td>9.32 (5.34)</td>
<td>6.82 (2.60)</td>
<td>11.82 (6.27)</td>
<td>5-25</td>
<td>0.84</td>
<td>1</td>
<td>20</td>
<td>8.318</td>
</tr>
<tr>
<td>IES Intrusion*</td>
<td>26.50 (26.08)</td>
<td>5.73 (9.52)</td>
<td>47.27 (19.70)</td>
<td>0-75</td>
<td>0.97</td>
<td>1</td>
<td>20</td>
<td>39.667</td>
</tr>
<tr>
<td>IES avoidance*</td>
<td>13.36 (13.07)</td>
<td>4.18 (7.14)</td>
<td>22.55 (11.06)</td>
<td>0-40</td>
<td>0.93</td>
<td>1</td>
<td>20</td>
<td>21.413</td>
</tr>
</tbody>
</table>

Notes:
Values in bold report significant differences; * = significant Levene's.
Seen in Table 7.1, all of the measures in the study reported to be reliable, based on Cronbach’s alpha reliability coefficients. Based on the results a number of comparisons seemed to have unequal distributions between those with and without BPD. In other circumstances this would generally be viewed as a sign of caution regarding interpretation, however because of the control versus clinical sample used in the study, this could be expected. Control participants would be assumed to be less diverse and generally lower array of symptoms than those with BPD whom could be expected to have both a higher and more varied. More specifically, those with BPD reported to have increased dissociative, emotion dysregulation, negative views of self and other, as well as less positive views of themselves and others when compared to control participants. Those with BPD also reported to have increased experiences of childhood abuse and neglect experiences then controls and these memories (and reminders of) seemed to still intrude and be avoided during the last 7 days.

7.2 Emotional recognition task: behavioural results

7.2.1. Data screening

The data screening protocol has been described in previous sections (Section 4.2.1). Although there was no need to implement a missing value analysis, there were variables that required to be transformed. The cheek raised response for happy faces required to be transformed by multiplying the variable by itself, whereas the teeth shown response in the same condition was cubed. The frown response was also cubed when participants were asked to judge angry faces. The cheek raised response for the participants was given a log10 transform after 8 was subtracted from the variable scores when viewing neutral and angry faces. When deciding how emotional each facial expression was, only the angry decision for angry faces required to be transformed using the cubed function.
7.2.2. Judging emotions from facial expressions

In order to get an idea of how participants in this study interpreted and judged the emotions associated with the emotional expressions used in this study, the means and standard deviations for each raw and transformed variables can be seen in Table 4.4 below. The theoretical ranges for the measures used in the study and their reliability statistics are also presented in Table 7.2.

Table 7.2. Descriptive and comparative statistics between those with and without BPD when making happy and angry decisions in judging emotional expressions (happy, neutral, and angry).

<table>
<thead>
<tr>
<th>Original</th>
<th>Transformed</th>
<th>Control</th>
<th>BPD</th>
<th>Total</th>
<th>Control</th>
<th>BPD</th>
<th>Total</th>
<th>TR</th>
<th>reliability</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>happy</td>
<td></td>
<td>80.91 (7.93)</td>
<td>82.50 (6.02)</td>
<td>81.70 (6.92)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neutral</td>
<td></td>
<td>34.55 (12.24)</td>
<td>29.55 (13.78)</td>
<td>32.05 (12.97)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>angry</td>
<td></td>
<td>33.18 (14.41)</td>
<td>43.64 (20.96)</td>
<td>38.41 (18.35)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10-90</td>
<td>0.892</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>angry</td>
<td></td>
<td>87.86 (11.42)</td>
<td>82.73 (10.70)</td>
<td>80.80 (10.70)</td>
<td>52e4 (20e4)</td>
<td>59e4 (18e4)</td>
<td>55e4 (19e4)</td>
<td>10-90</td>
<td>0.808</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Seen in Table 7.2, although each emotion image used in this study reported to be reliable (according to Cronbach’s alpha coefficients), and those with BPD seemed to report neutral faces as more negative than controls, there were no significant differences between those with and without BPD diagnoses.

7.2.3 Judging face characteristics for each emotion

In order to get an idea of how participants in this study interpreted and judged the physical characteristics associated with the emotional expressions used in this study, the means and standard deviations for each raw and transformed variables can be seen in Table 4.5 below. The theoretical ranges for the measures used in the study and their reliability statistics are also presented in Table 7.3.
Table 7.3. Descriptive and comparative statistics between those with and without BPD when making physical characteristic decisions in judging emotional expressions (happy, neutral, and angry).

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>BPD</th>
<th>Total</th>
<th>Control</th>
<th>BPD</th>
<th>Total</th>
<th>TR</th>
<th>reliability df df error F p</th>
</tr>
</thead>
<tbody>
<tr>
<td>happy cheek</td>
<td>62.95 (21.41)</td>
<td>62.95 (10.36)</td>
<td>62.95 (16.41)</td>
<td>4380 (2406)</td>
<td>4060 (1366)</td>
<td>4220 (1916)</td>
<td>10-90</td>
<td>0.849</td>
</tr>
<tr>
<td>teeth</td>
<td>76.82 (10.96)</td>
<td>74.77 (8.69)</td>
<td>75.80 (9.71)</td>
<td>48e4 (18e4)</td>
<td>43e4 (13e4)</td>
<td>46e4 (16e4)</td>
<td>10-90</td>
<td>0.748</td>
</tr>
<tr>
<td>neutral cheek</td>
<td>18.41 (12.71)</td>
<td>13.18 (4.20)</td>
<td>15.80 (9.61)</td>
<td>0.73 (0.51)</td>
<td>0.59 (0.35)</td>
<td>0.66 (0.43)</td>
<td>10-90</td>
<td>0.85</td>
</tr>
<tr>
<td>frown</td>
<td>25.45 (18.23)</td>
<td>28.41 (18.55)</td>
<td>26.93 (18.01)</td>
<td>1.32 (0.29)</td>
<td>1.36 (0.30)</td>
<td>1.34 (0.29)</td>
<td>10-90</td>
<td>0.778</td>
</tr>
<tr>
<td>angry cheek</td>
<td>22.50 (17.85)</td>
<td>22.95 (13.78)</td>
<td>22.73 (15.56)</td>
<td>0.88 (0.51)</td>
<td>1.00 (0.44)</td>
<td>0.94 (0.47)</td>
<td>10-90</td>
<td>0.903</td>
</tr>
<tr>
<td>frown</td>
<td>78.64 (16.45)</td>
<td>75.68 (18.58)</td>
<td>77.16 (17.19)</td>
<td>54e4 (25e4)</td>
<td>50e4 (24e4)</td>
<td>52e4 (24e4)</td>
<td>10-90</td>
<td>0.899</td>
</tr>
</tbody>
</table>

Seen in Table 7.3, the measures used in the study reported to be reliable using Cronach’s alpha statistical coefficients. Nevertheless, there were no reported differences between those with and without BPD diagnoses when reporting on the physical characteristics of the various emotional expressions.

7.3 Emotional recognition task: EEG source localisation results

7.3.1. Data screening

The data screening process has previously been described in earlier sections (Section 4.3.1). However, if a bimodal distribution was found fulfilling criterion of an outlier, the data was deemed to be reliable and valid if that split occurred within the middle 36% of the data given the control versus clinical sample used in this study, regardless of distance. Furthermore, considering the smaller sample size in this study, the half a standard deviation definition was used less stringently. More specifically, cases within variables were not interpreted as an outlier if they were only marginally outside half a standard deviation, specifically values whereby a value of 0.01 would have caused the removal of subsequent cases of data.
For the neutral faces, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (885) > 0.001$, $p = 1.000$), alpha ($\chi^2 (1120) > 0.001$, $p = 1.000$), and beta 1 ($\chi^2 (908) > 0.001$, $p = 1.000$), respectively. Typically, the amount of missing data was below 30%, however the highest amount of missing data was 40.9% for theta on two occasions, 40.9% for alpha on one occasion, and 40.9% for beta 1 frequency on four occasions. For the happy faces, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (777) > 0.001$, $p = 1.000$), alpha ($\chi^2 (987) > 0.001$, $p = 1.000$), and beta 1 ($\chi^2 (886) > 0.001$, $p = 1.000$), respectively. The highest amount of missing data was 36.4% for theta on one occasion, 36.4% for alpha on three occasions, and 36.4% for beta 1 frequency on three occasions. For the angry faces, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (874) > 0.001$, $p = 1.000$), alpha ($\chi^2 (815) > 0.001$, $p = 1.000$), and beta 1 ($\chi^2 (955) > 0.001$, $p = 1.000$), respectively. The highest amount of missing data was 31.8% for theta on one occasion, 36.4% for alpha on one occasion, and 40.9% for beta 1 frequency on two occasions. Regarding data transformations, only the right Brodmann area 40 was required to be transferred for angry faces in the theta frequency using a $y = \log_{10}(x-1)$.

### 7.3.2 Processing facial expressions

In order to investigate neurobiological differences between those with and without BPD when viewing neutral, happy and angry facial expressions for theta, alpha and beta 1 frequencies, 9 main effects only MANOVA’s were conducted. The results of the univariate analyses for all MANOVA’s are presented in Figure 7.1 below.
Figure 7.1. Source localisation significances between a BPD and control group by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) when viewing neutral (NF), happy (HF), and angry (AF) faces.

Seen in Figure 7.1, those with BPD reported to have all round increases in activity in each frequency for each facial expression. Neutral faces were associated with increases in theta activity for those with BPD in right orbitofrontal, middle frontal, medial temporal, and anterior and lateral posterior parietal regions, as well as left ventral anterior cingulate cortex, insula and occipital regions. Alpha activity was associated with increases in activity in bilateral middle temporal, Broca, and dorsolateral prefrontal regions increases for those with BPD diagnoses. Increases were also found in right lateral temporal regions and left posterior lateral parietal regions. Beta 1 activity reported to be increased for those with BPD...
in right orbitofrontal, middle frontal, Broca, lateral temporal, fusiform, and posterior cingulate regions, as well as bilateral ventral anterior cingulate regions.

Happy faces were associated with increases in theta oscillations in right middle frontal, dorsolateral prefrontal, medial temporal, left ventral anterior cingulate and lateral temporal regions, as well as bilateral orbitofrontal and anterior parietal regions. Right insula, middle frontal, posterior cingulate, and left dorsolateral prefrontal and lateral temporal regions, as well as bilateral Broca region alpha oscillation increases for those with BPD difficulties. Right middle frontal, orbitofrontal, Broca, and angular, left posterior lateral parietal, and bilateral dorsolateral prefrontal and ventral anterior cingulate regions were increased in those with BPD difficulties compared to controls in the beta 1 frequency range.

Angry faces were associated with increased theta oscillations in right Broca, medial temporal, temporopolar, left anterior parietal and bilateral middle frontal and orbitofrontal regions for those with BPD difficulties. Alpha was increased in right lateral and medial temporal, posterior cingulate, left ventral anterior cingulate, Broca, posterior lateral parietal, and bilateral dorsolateral prefrontal and angular regions for those with BPD difficulties. Right orbitofrontal, Broca and medial temporal regions, as well as bilateral dorsolateral prefrontal, ventral and dorsal anterior cingulate regions were found to have increased beta 1 oscillations for those with BPD difficulties.

7.4 Trust task: behavioural results

7.4.1 Data screening

The data screening protocol has been previously described in previous sections (Section 4.4.1). There was no need to use a missing value analysis. In order to create a normal distribution, the overall participant self-rated fairness to fair partners was transformed using the square computation. When making fairness decisions regarding the partners without emotional cues, both the high and low partner reciprocity values were
transformed: the prior with the squared function and the latter with the logarithm of 10. Similarly, the fairness ratings for the high and low partner reciprocity returns were also transformed: the prior using a cubed function and the latter by using the logarithm of 10.

7.4.2 Judging the fairness of others

In order to investigate whether those with and without BPD interpreted the trustworthiness of the partners in the trust task a single, main effects only Multivariate Analysis of variance was conducted. The means, standard deviations of each raw and transformed variable can be seen in Table 7.4 below.
Table 7.4. Trust task behavioural descriptive and comparative statistics between those with and without BPD.

<table>
<thead>
<tr>
<th></th>
<th>Original variables</th>
<th>Transformed variables</th>
<th>df</th>
<th>df error</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>BPD</td>
<td>Total</td>
<td>Control</td>
<td>BPD</td>
<td>Total</td>
</tr>
<tr>
<td>ovr fair fair</td>
<td>55.00 (17.32)</td>
<td>52.27 (16.94)</td>
<td>53.64 (16.77)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>ovr unfair fair</td>
<td>33.64 (11.42)</td>
<td>35.91 (14.11)</td>
<td>34.77 (12.58)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>ovr self fair to fair</td>
<td>62.27 (14.38)</td>
<td>59.09 (18.68)</td>
<td>60.68 (16.35)</td>
<td>4065 (1613)</td>
<td>3809 (2087)</td>
<td>3937 (1825)</td>
</tr>
<tr>
<td>ovr self fair to unfair</td>
<td>53.18 (19.53)</td>
<td>51.82 (21.25)</td>
<td>52.50 (19.92)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Partners without emotional cues

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>fair of high return</td>
<td>54.18 (18.03)</td>
<td>60.00 (12.53)</td>
<td>57.09 (15.44)</td>
<td>3230 (1830)</td>
<td>3742 (1388)</td>
<td>3486 (1607)</td>
</tr>
<tr>
<td>fair of mod return</td>
<td>34.96 (16.61)</td>
<td>36.06 (9.41)</td>
<td>35.51 (13.19)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>fair of low return</td>
<td>12.26 (5.93)</td>
<td>19.74 (8.38)</td>
<td>17.50 (7.44)</td>
<td>1.15 (0.17)</td>
<td>1.26 (0.18)</td>
<td>1.21 (0.18)</td>
</tr>
<tr>
<td>congruency weight</td>
<td>-0.55 (1.51)</td>
<td>-0.45 (1.51)</td>
<td>-0.50 (1.47)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>congruency weight 2</td>
<td>-1.36 (1.43)</td>
<td>-0.91 (1.76)</td>
<td>-1.14 (1.58)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>hostility transfers</td>
<td>42.12 (17.29)</td>
<td>53.64 (23.22)</td>
<td>47.88 (20.83)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>hostility fairness</td>
<td>52.42 (18.02)</td>
<td>60.00 (15.63)</td>
<td>56.21 (16.91)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>trdec sub</td>
<td>-5.23 (6.49)</td>
<td>1.14 (8.63)</td>
<td>-2.05 (8.13)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>fadec sub</td>
<td>5.57 (8.05)</td>
<td>3.18 (16.44)</td>
<td>4.38 (12.69)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>overall score</td>
<td>1606 (29.20)</td>
<td>1625 (33.62)</td>
<td>1615 (32.19)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Partners with emotion cues

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>fair of high return</td>
<td>70.91 (16.08)</td>
<td>71.67 (18.07)</td>
<td>71.29 (16.70)</td>
<td>40e4 (21e4)</td>
<td>42e4 (20e4)</td>
<td>41e4 (20e4)</td>
</tr>
<tr>
<td>fair of mod return</td>
<td>43.64 (16.07)</td>
<td>45.76 (9.58)</td>
<td>44.70 (12.96)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>fair of low return</td>
<td>25.00 (16.67)</td>
<td>25.15 (13.99)</td>
<td>25.08 (15.02)</td>
<td>1.33 (0.26)</td>
<td>1.34 (0.22)</td>
<td>1.34 (0.23)</td>
</tr>
<tr>
<td>hostility transfers</td>
<td>34.70 (15.29)</td>
<td>38.33 (17.29)</td>
<td>36.52 (16.03)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>hostility fairness</td>
<td>46.67 (14.18)</td>
<td>48.79 (11.33)</td>
<td>47.73 (12.57)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>trdec sub</td>
<td>3.79 (6.96)</td>
<td>1.36 (7.63)</td>
<td>2.58 (7.23)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>fadec sub</td>
<td>-0.76 (6.88)</td>
<td>-0.15 (9.02)</td>
<td>-0.45 (7.83)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>overall score</td>
<td>1185 (65.78)</td>
<td>1147 (84.96)</td>
<td>1166 (76.63)</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes
Values in bold report significant differences; ovr fair fair = overall fairness rating of fair partners; ovr unfair fair = overall fairness rating of unfair partners; ovr self fair to fair = self rating of fairness to fair partners; ovr self fair to unfair = self rating of fairness to unfair partners; fair of high return = fairness of high partner returns; fair of mod return = fairness of moderate partner returns; fair of low return = fairness of low partner returns; hostility transfers = transfer values of participants within the first halves of the task; hostility fairness = fairness ratings of partners in the first halves of the task; trdec sub = change in transfers between first and second halves of the task; fadec sub = change in fairness ratings between first and second halves of the task; congruency weight = congruency values in the first 4 presentations of each partner; congruency weight 2 = congruency values in the first 5 presentations of each partner.

Seen in Table 7.4, although there seemed to be a trend whereby controls seemed to modify their transfers to partners without emotional cues overtime after learning of partner trustworthiness, there were no significant results.
7.5 Trust task: EEG source localisation results

7.5.1 Data screening

The data screening protocol has been presented in previous sections (Section 4.5.1). Post-moment decisions can be argued to affect the EEG epoch, as no participants responded within 500 milliseconds of the fairness decision and only 3 participants responded within 800 milliseconds; being 4, 3, and 1, respectively. Regarding the missing value analyses, all the psychometric and brain activity data were entered into the analysis, in absence of the non-significant trust task behavioural data. For the partners without emotional cues and fairness decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1301) = 377.980, p = 1.000$), alpha ($\chi^2 (1215) < 0.001, p = 1.000$), and beta 1 ($\chi^2 (1058) < 0.001, p = 1.000$), respectively. The highest amount of missing data was 40.9% with one case for theta, 40.9% with one case for alpha, and 40.9% with six cases for beta 1 frequency. For the transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1297) < 0.001, p = 1.000$), alpha ($\chi^2 (1370) < 0.001, p = 1.000$), and beta 1 ($\chi^2 (1317) < 0.001, p = 1.000$), respectively. The highest amount of missing data was 36.4% with one case for theta, 40.9% with one case for alpha, and 40.9% with two cases for beta 1 frequency. For the fairness minus transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (899) = 3088.162, p = 1.000$), alpha ($\chi^2 (978) = 48.550, p = 1.000$), and beta 1 ($\chi^2 (949) < 0.001, p = 1.000$), respectively. The highest amount of missing data was 40.9% with six cases for theta, 40.9% with three cases for alpha, and 40.9% with two cases for beta 1 frequency.

For the partners with emotional cues and fairness decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1136) < 0.001, p = 1.000$), alpha ($\chi^2 (1138) < 0.001, p = 1.000$), and beta 1 ($\chi^2 (1138) < 0.001, p = 1.000$), respectively. The highest amount of missing data was 36.4% with two cases for theta, 40.9% with one case for alpha, and 40.9% with 7 cases for beta 1 frequency. For the transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta ($\chi^2 (1290) < 0.001, p = 1.000$), alpha ($\chi^2 (748) < 0.001, p = 1.000$), and beta 1 ($\chi^2 (748) < 0.001, p = 1.000$), respectively.
and beta 1 (\(\chi^2 (950) < 0.001, p = 1.000\)), respectively. The highest amount of missing data was 40.9% with one case for theta, 40.9% with one case for alpha, and 40.9% with 4 cases for beta 1 frequency. For the fairness minus transfer decisions, the data was reported to be missing completely at random according to Little’s MCAR test for theta (\(\chi^2 (1066) = 795.157, p = 1.000\)), alpha (\(\chi^2 (1160) = 12.234, p = 1.000\)), and beta 1 (\(\chi^2 (902) = 10127.586, p = 1.000\)), respectively. The highest amount of missing data was 40.9% with six cases for theta, 40.9% with 5 cases for alpha, and 40.9% with one case for beta 1 frequency.

7.5.2 Decisions for partners without emotional cues

In order to investigate whether any differences in brain activity existed between those with and without BPD when participants made transfer and fairness decisions for the partners without emotional cues, 9 main effects only, MANOVA’s were conducted. The significant results from these MANOVA’s are collated into Figure 7.2 below.
Figure 7.2. Source localisation significances between a BPD and control sample by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

<table>
<thead>
<tr>
<th>COND</th>
<th>FREQ</th>
<th>LAT</th>
<th>FRONTAL</th>
<th>TEMPORAL</th>
<th>PARIETAL</th>
<th>OCCIPITAL</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>fad</td>
<td>THETA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>ALPHA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>BETA 1</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td>trd</td>
<td>THETA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>ALPHA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>BETA 1</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td>fad-trd</td>
<td>THETA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>ALPHA</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
<tr>
<td></td>
<td>BETA 1</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
<td>LEFT</td>
<td>RIGHT</td>
<td>RIGHT</td>
</tr>
</tbody>
</table>

| BPD > C | BPD < C, but sig levenes | BPD > C, but sig levenes |

Figure 7.2. Source localisation significances between a BPD and control sample by Brodmann area (6...39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners without emotional cues.

Seen in Figure 7.2, when making fairness decisions, those with BPD reported to have increased theta oscillations in right premotor, ventral anterior cingulate, posterior cingulate, lateral temporal, parietal occipital dorsolateral prefrontal, middle frontal, left middle frontal, Broca, and bilateral dorsal lateral prefrontal, orbitofrontal and temporo-polar regions. The same trends were found in the alpha frequency range in left orbitofrontal, ventral anterior cingulate, Broca, and right lateral temporal and temporo-polar, anterior parietal, posterior cingulate, insula and angular regions. Beta 1 frequency showed the same trends in left dorsal anterior cingulate, and right Broca, lateral and medial temporal, temporo-polar, parietal, posterior cingulate, occipital, insula and angular regions. When
making transfer decisions, those with BPD reported to have increased theta oscillations in left ventral anterior cingulate, medial temporal regions, right orbitofrontal temporo-polar, and bilateral anterior parietal regions. These same trends were found in the alpha frequency in right posterior lateral parietal regions and bilateral posterior cingulate regions. Beta 1 frequency on the other hand, reported the same trends in left dorsolateral, and right middle and orbitofrontal as well as in right medial temporal regions. In the fairness minus transfer condition, those with BPD reported to have decreased left temporo-polar activity in the theta frequency range, increased alpha oscillations in left medial temporal and occipital regions and increased beta 1 oscillations in right middle frontal, occipital and posterior cingulate regions.

7.5.3 Decisions for partners with emotional cues

In order to investigate whether any differences in brain activity existed between those with and without BPD when participants made transfer and fairness decisions for the partners with emotional cues, 9 main effects only, MANOVA’s were conducted. The significant results from these MANOVA’s are collated into Figure 7.3 below.
Figure 7.3. Source localisation significances between a BPD and control sample by Brodmann area (6… 39), frequency (theta, alpha, beta 1) and lateralisation (left, right) in and between making transfer (trd) and fairness (fad) decisions for partners with emotional cues.

Seen in Figure 7.3, when making fairness decisions, those with BPD reported to have increased theta activity in right parietal, lateral temporal, temporo-polar, posterior cingulate regions, left dorsolateral prefrontal, as well as bilateral orbito and middle frontal, ventral anterior cingulate, Broca, medial temporal regions. The same trends were found with alpha oscillations in right orbitofrontal, dorsolateral prefrontal, Broca, lateral temporal, anterior parietal, occipital, left anterior cingulate and bilateral middle frontal, posterior cingulate and...
posterior parietal regions. Beta 1 on the other hand, only reported differences in right ventral anterior cingulate, Broca, dorsolateral prefrontal, temporo-polar, posterior cingulate and parietal regions, which showed the same trends whereby greater activity was found for those with BPD. In the fairness minus transfer decision condition, those with BPD reported to have decreased theta oscillations in right medial temporal, and increases in right posterior cingulate and bilateral middle frontal regions. Those with BPD reported to have greater alpha oscillations in left medial temporal and right occipital regions.
Chapter 8: Discussion of study 2

8.1 Aims and support for the hypotheses

This study intended to investigate the cognitive and emotional processes associated with BPD by comparing a clinical sample to healthy controls. Specifically, measures on dissociation, emotion dysregulation, perceptions of self and others, childhood abuse and neglect, and post-traumatic stress would allow the researchers to investigate their impact on behaviour and underlying brain activity in an emotional recognition and Franzen et al.’s (2011) trust task.

8.1.1 Psychosocial

Hypothesis 1: As expected, those with BPD reported to have higher levels of negative states of themselves and others, emotion dysregulation, dissociation, childhood abuse and neglect, as well as post-traumatic symptoms.

8.1.2 Emotional recognition task

Hypothesis 2: By comparing between those that present with BPD and healthy controls, it was expected that those with BPD would have more negative perceptions of ambiguous facial stimuli as expressed through difficulties reading ambiguous stimuli and negative bias. Therefore, it was expected that those with BPD would rate an angry face as more angry, a neutral face as more angry, and happy face as less happy when compared to those with less BPD traits. This hypothesis was not supported.

Hypothesis 3: It was expected that those with BPD would have a negative bias when judging the strength of physical facial characteristics, particularly with neutral facial expressions. In particular, a neutral face would be rated as having a stronger frown compared to healthy controls. This hypothesis was not supported.

Hypothesis 4: It was further anticipated that those with BPD would have different brain activity processing, reflected in brain regions involved in attention to and memory
retrieval associated with facial recognition. Therefore, ACC, hippocampus, extra-striate cortex, fusiform gyrus, and the superior temporal gyrus are expected to be different between those with BPD and healthy controls. This hypothesis was supported.

Hypothesis 5: As expected, those with BPD will have increased activity in OFC and sensory regions (i.e., parietal regions).

8.1.3 Trust task

Hypothesis 6: It was expected that those with BPD will perform better at the trust task by identifying that emotional cues relate to high and low monetary responses, compared to healthy controls. Therefore, overtime, those individuals with BPD and negative perceptions will transfer more money over to a partner that is smiling, and transfer less to the frowning faces when compared to healthy controls. This hypothesis was not supported.

Hypothesis 7: Those with BPD and controls would reveal no differences in transfer amounts between partners that do not have emotional cues. This hypothesis was supported.

Hypothesis 8: It is expected that those with BPD would have differences in activity in mentalisation-related regions (i.e., ACC, posterior cingulate, temporal, and angular areas) when compared healthy controls. This hypothesis was supported.

Hypothesis 9: Episodic memory processes between those with and without BPD are expected to be represented by posterior cingulate cortex, retrosplenial region differences when compared to healthy controls. This hypothesis was supported.

Hypothesis 10: Autobiographical memory processes between those with and without BPD are expected to be represented by right prefrontal region differences when compared to healthy controls, particularly in partners with emotion cues. This hypothesis was supported.
Hypothesis 11: Increased activity in the OFC and parietal regions were anticipated to present between those with BPD as a results of a greater emotional sensitivity. This hypothesis was supported.

8.2 Psychometric interpretations

Those with BPD reported to have increased maladaptive levels of dissociation, all facets of emotion dysregulation, positive and negative views of themselves and others, and post-traumatic stress symptoms regarding their increased experiences of all facets of childhood abuse. These results are expected because those with BPD report to experience quick and rapid (i.e., an instability) regarding their emotions, and seem to be more sensitive to experiencing emotions (Linehan, 1993). Furthermore, a lack of adaptive emotion regulation strategies from difficulties in managing those sensitive and instable emotions or/and insufficient coaching and discouragement of expressing emotions relate to poorer emotion dysregulation (Linehan, 1993). Therefore, for example, instead of utilising strategies that either attempt to change or reattribute a situation that is causing distress to remove or lessen the impact of emotions in the long term, those with BPD will implement quicker acting, more harmful strategies that have negative consequences (e.g., self-harm, over eating, drug taking, reckless driving, violence, etc.) and do not address the situation (Carpenter & Trull, 2013), and even through attempts to avoid negative emotions in general (Linehan, 1993).

Greater negative and less positive views of the self can be explained using attachment insecurities whereby prolonged periods of separation or loss of a caregiver can lead to feelings of being abandoned, unwanted, and unloved. Alternatively, in an overprotective childhood (Bowlby, 1998a), it can be difficult for a child to gain a self of self (Fonagy & Luyten, 2009) and internalise a caregiver as part of themselves (Fonagy & Bateman, 2007; Young et al., 2003), such as by failing to develop confidence in spending time away from caregivers and gaining security around making decisions themselves. Because these expectations carry over as a ‘template’ on how should behave with a
significant dating partner, it could be speculated that if a partner does not fulfil the ‘take command’ role, relationship issues could surmount and create confusion and frustration because anxiety from having to make decisions. This anxiety in making decisions could make ones emotions and insecurities more salient and therefore ideas that there is something wrong with them. However, less speculatively, the more common experience from internalising a caregiver as part of oneself is one in which childhood abuse is involved, whereby abuse can lead someone believing that they are ‘bad’, ‘dirty’, and rotten to the core (Fonagy & Bateman, 2007; Young et al., 2003), which is made evident by the increased levels of post-traumatic stress that those with BPD still thought about and reacted to in the week leading up to this study. Notably then, the increased levels of childhood abuse and post-traumatic stress relating to their childhood abuse experiences are explained by the increased incidence of all facets of childhood abuse and neglect experiences that those with BPD report (Barnow et al., 2010; Herman et al., 1989; Zanarini et al., 1997).

Greater negative and less positive views of others can also be explained by attachment insecurities as well as abuse too. Although separation and loss experiences are projected towards the attachment figure, it can also be directed at every other person as well (Bowlby, 1998d). Perhaps this is best exemplified in a money exchange task whereby those with BPD responded more aggressive in both a anger provoked and non-provoked condition (New et al., 2009). Nevertheless, needless to say, the experiences of abuse itself could be viewed as a large contributor to negative views of others, which is also found in PTSD (APA., 2013).

8.3 Emotion recognition task interpretations

Due to the lack of behavioural results, only the EEG data will be discussed. For neutral faces, those with BPD reported to have increased activity in right orbitofrontal, middle frontal, dorsolateral prefrontal, Broca, and bilateral ventral anterior cingulate regions, with sporadic activity in right posterior cingulate, left occipital, dorsolateral prefrontal, insula, and Broca regions across theta, alpha and beta 1 oscillations. Generally
speaking, this activity pattern was also found for happy and angry faces, but happy faces were associated with left lateral temporal activity; angry faces with right lateral and also bilateral dorsal anterior cingulate, dorsolateral prefrontal, and angular region activity. As a general comment for each facial expression, expected brain regions were activated based on emotion recognition (Domes et al., 2009).

More specifically, based on the areas involved and the direction of that activity, it could be said that those with BPD were more engaged in the task. Arguably, this could be related to the increased emotion sensitivity that has been previously reported (Donegan et al., 2003). Previous comparisons between neutral and happy faces implicate the role of temporal hemispheres to be unique to happy faces (Esslen et al., 2004), suggesting that those with and without BPD have encoded happy faces differently in this current study. Furthermore, there were no reported source localisation evidence implicated the temporal hemispheres when comparing between angry and neutral faces (Esslen et al., 2004).

When drawing on previous evidence that, based on auditory probes when engaging in a hemisphere specific task, neutral memories seem to be stored in left temporal areas and emotional memories seem to be stored in right temporal areas (Teicher et al., 2003), perhaps this suggests that those with BPD categorise happy and angry faces accordingly. In some ways, this can also explain why only dorsal anterior cingulate regions were found to be different with angry faces between those with and without BPD in this study, due to the greater attention to negative thought processes (Bush et al., 2000; Rolls & Grabenhorst, 2008), which would be less related to the happy and neutral conditions. In place, perhaps neutral faces have an increase in occipital, visual engagement (Esslen et al., 2004), perhaps implicating uncertainty and confusion regarding interpreting the images ambiguity when tailored with the insula activity (Preuschoff et al., 2008) for those with BPD. Angry faces seem to have an increase in ventral anterior cingulate and angular region activity, perhaps further implicating a greater experience and attention to emotions (Bush et al., 2000; Rolls & Grabenhorst, 2008); angular regions implicating a greater sensitivity to social cognition regarding angry faces (Fonagy & Luyten, 2009). Of most importance, it is important to point
out that the claims above regard a neurobiological susceptibility to mentioned trends, as there was no behavioural evidence that could be drawn upon.

8.4 Trust task interpretations

8.4.1 Partners without emotional cues

Generally speaking, when making fairness decisions, those with BPD reported to have increased bilateral ventral anterior cingulate, left orbitofrontal, right Broca, lateral temporal and temporo-polar, insula, angular, parietal, occipital, and posterior cingulate region activity across all frequencies. Right premotor, left middle frontal and bilateral dorsolateral prefrontal regions were only paramount in the theta frequency range. Left dorsal anterior cingulate regions were only paramount in the beta 1 frequency range. When making transfer decisions, generally speaking, those with BPD reported to have a larger neural response in right lateral orbitofrontal, medial temporal across theta and beta 1 frequencies, and bilateral anterior parietal and posterior cingulate regions for theta and alpha frequencies, respectively. Beta 1 frequency reported increased activity for those with BPD in left dorsolateral and right middle frontal regions. In the fairness minus transfer decision condition, reported increases in right middle frontal regions, posterior cingulate in the beta 1 frequency, and occipital regions across the beta 1 and alpha frequency ranges. Alpha frequency also reported the same trends for those with BPD in medial temporal areas, but a decrease was found in left temporo-polar areas for those with BPD in the theta frequency range.

Overall, the greater activity when making fairness and transfer decisions for those with BPD, suggest that those with BPD are more sensitive and/or have more difficulty in processes mentalisation-related stimuli, as indicated by the increases in brain activity. Similar perspectives have been used when explaining a greater brain activity in males when compared to females in another mentalisation task, also yielding no differences in behaviour (Krach et al., 2009). More specifically, when making fairness decisions, it appears that this difference is of both a cognitive and emotional, ACC responding type (Bush et al.,
2000). In particular, perhaps it could be said that those with BPD processed pain more strongly than controls (Nielsen et al., 2005) when we also consider the increased emotional gut feelings (Cabeza & St Jacques, 2007), or emotional response in OFC regions (New et al., 2009). Also interesting, is that it appears that lateral temporal regions, relating to negative memories (Teicher et al., 2003) were processed during fairness decisions. Because these same trends were found in the emotional recognition task, it is believed that this response is a direct result of the encoding of the ambiguous (i.e., neutral) faces, whereby the increases in insula response is a representation of negative emotion perception (Phan et al., 2002). An alternative perspective is that the insula activity could be related to uncertainty of decision outcomes (Preuschoff et al., 2008), because of the unpredictability that the neutral faces create during the task, in comparison to the emotional cues.

Regarding transfer decisions, it appears that those with BPD have enhanced episodic, pain, or emotion-perception strategies to guide decision making. In particular, this can explain the activity in right middle frontal regions, left lateral orbitofrontal and dorsolateral pre-frontal regions, but also those in parietal and ventral and posterior cingulate regions. Interestingly, these data trends seem to align with the bio-psychosocial model theorised for BPD, when under minimal to moderate stress (see Section 2.3). For instance, when making transfer decisions for partners without emotional cues, those with BPD seem to be using orbitofrontal regions to establish an emotion response/‘gut instinct’ and left dorsolateral prefrontal regions are involved in visual searches of memory, mediating a hippocampal recollection (Cabeza & St Jacques, 2007), posterior cingulate episodic memory and pain processing (Nielsen et al., 2005), parietal visualisation and attention towards those recollections (Cabeza & St Jacques, 2007). The right middle frontal region (Cabeza & St Jacques, 2007) is then guiding decision making in terms of a negative autobiographical expectation (Young et al., 2003) or uncertainty and decision making (Volz et al., 2005).

However, in this trust tasks case, these processes are occurring outside of a dissociative response, based on the lack of ACC differences (Sierra & Berrios, 1998; Wingenfeld et al., 2009). These aforementioned trends become more supported when mentioning that the fairness minus transfer condition also reported to have differences in right middle frontal, left hippocampal, parietal and even occipital regions differences.
8.4.2 Partners with emotional cues

Generally speaking, when making fairness decisions, those with BPD reported to have increases in bilateral orbitofrontal, middle frontal, dorsolateral prefrontal, ventral anterior cingulate, Broca, medial temporal, posterior cingulate, posterior parietal, and right lateral temporal, temporo-polar, and anterior parietal regions. In the alpha frequency, there was also left dorsal anterior cingulate increases for those with BPD. During transfer decisions, those with BPD reported to have increased bilateral activity in Broca, posterior cingulate and right insula regions across all frequencies. Left dorsolateral prefrontal, insula, right middle frontal, ventral anterior cingulate, lateral temporal, posterior parietal, bilateral orbitofrontal, temporo-polar, and anterior parietal regions reflected greater activation in the theta range for those with BPD. Left premotor, dorsal anterior cingulate, and right medial temporal regions were also increased for those with BPD in the beta 1 frequency. In the fairness minus transfer decision condition, those with BPD reported to have increased activity in bilateral middle frontal and right posterior cingulate, and decreased right medial temporal activity in the theta frequency, whereas left medial temporal and right occipital regions were increased for those with BPD in the alpha frequency.

Overall, the greater activity when making fairness and transfer decisions for those with BPD, suggest that those with BPD are more sensitive and/or have more difficulty in processes mentalisation-related stimuli, as indicated by the increases in brain activity. Similar perspectives have been used when explaining a greater brain activity in males when compared to females in another mentalisation task, also yielding no differences in behaviour (Krach et al., 2009). More specifically, when making fairness decisions, it appears that those with BPD are making both cognitive and emotional processing differences, as indicated by the ACC activity in ventral and dorsal areas (Bush et al., 2000). This therefore leaves the posterior cingulate regions being involved in processing episodic memory or emotional pain (Nielsen et al., 2005), however interestingly, there was no differences in insula activity that similarly reflects any negative emotion perceptions.
Therefore, perhaps the insula activity found in the partners without emotional cues was best represented by the uncertainty of decision outcomes as opposed to experience of pain itself; thereby also explaining the lack of insula activity in the partners with emotional cues. With reference to the previous results in the emotional recognition task, it is argued that the right lateral temporal region increases for those with BPD would relate to processing of emotional memory (Teicher et al., 2003). When considering that the happy and angry faces were in the analyses were merged, this emotional memory becomes more influential when the individual angry faces presented with a right temporal and happy faces presented with a left temporal region increase in the emotional recognition task. Apart from this, the vast frontal differences could be accounted to a broad range of processes including semantic, episodic, and autobiographical memory processing (Cabeza & Nyberg, 2000; Cabeza & St Jacques, 2007), which cannot be reasonably speculated. However, perhaps the transfer decision results can help provide some perspectives.

According to the results for the transfer decision, it appears that those with BPD have enhanced episodic, pain, or emotion-perception strategies to guide decision making. In particular, this can explain the activity in right middle frontal regions, left lateral orbitofrontal and dorsolateral pre-frontal regions, but also those in parietal and posterior cingulate regions. Interestingly, these data trends seem to link up with the bio-psychosocial model of BPD reported in the introduction, when under minimal to moderate stress (Section 2.3). For instance, when making transfer decisions for partners without emotional cues, those with BPD seem to be using orbitofrontal regions to establish an emotion response/’gut instinct’ and left dorsolateral prefrontal regions are involved in visual searches of memory, mediating a hippocampal recollection (Cabeza & St Jacques, 2007), posterior cingulate episodic and pain processing (Nielsen et al., 2005), occipital visualisation and attention towards those recollections (Cabeza & St Jacques, 2007). The right middle frontal region (Cabeza & St Jacques, 2007) is then perhaps guiding decision making in terms of a negative autobiographical expectation (Young et al., 2003), perhaps with the left involved in decision making (Fellows & Farah, 2007; Volz et al., 2005). Bearing in mind the lack of insula activity regarding uncertainty of decision outcomes with the partners without emotional cues, it is both argued that the insula activity with the partners with emotional
8.4.3 Emotional cues versus non-emotional cues

Both partners with and without emotional cues reported differences in right lateral temporal and middle frontal regions when comparing between those with and without BPD. It has been suggested that these may underlie emotional, categorical memory (Teicher et al., 2003) and autobiographical memory (Cabeza & St Jacques, 2007), respectively. Interestingly, because both of these processes are involved in both emotional and non-emotional cues, perhaps it can be argued that the left semantic memory processes, unique to the results of the partners with emotional cues are mediating the differences in performance between those with and without BPD in Franzen et al.’s (2011). Although speculative, perhaps individuals who have developed expectations that others will be unhelpful/untrusting or even abusive could encode parts of those experiences in autobiographical memory (e.g., such as specific visualisations and life defining moments from abuse and/or neglect) whereas other aspects could be encoded as semantic memory (e.g., people not being helpful/mistrusted in general). Arguably, this idea has been eluded to when discussing attachment difficulties and how anger towards an attachment figure can be directed to the individual and other people in general too (Bowlby, 1998d). Perhaps this could explain how semantic memory could undermine the greater performance for those with BPD in the trust task in Franzen et al. (2011), if facial or emotional encoding mechanism cannot explain it. With this said, it is difficult to ascertain exactly what is a greater mediator of activity in this study, because of a lack of behavioural differences. Furthermore, this
study’s results do not provide information on the strength of activity between those with and without BPD in both the partners with and without emotional cues.

8.5 Limitations

Generally speaking, the limitations for the study are identical to those mentioned in previous sections (section 5.5). Additional methodological limitations that pertain to this study include changes to the Diagnostic Statistical Manual of Mental Disorders (changing versions IV to V) which occurred within the time of this study. Although no differences were made regarding the diagnosis of BPD, there were changes made to other conditions such as Bipolar, Major Depressive Disorder, Panic Disorder with Agoraphobia, Social Anxiety Disorder (Social Phobia), Obsessive Compulsive Disorder, Body Dysmorphic Disorder, PTSD, Bulimia Nervosa, and Binge-Eating Disorder, amongst others (cf. APA., 2000, 2013). Based on these changes, the diagnoses made in this study comply with DSM-IV, not DSM V diagnoses, and therefore the co-morbidities mentioned for the participants in this study can only be presumed to be reliable. Furthermore, by dropping the diagnostic axis means that psychiatric conditions are no longer given independent axis I and axis II diagnoses (cf. APA., 2000, 2013), therefore it can only be presumed that differentials diagnosis methods would still diagnose participants with those same diagnoses.

A small sample size is argued to have significantly influenced the lack of significant behavioural results. When comparing to the 30 participants used in Franzen et al. (2011), it could be said that the randomness of the presentations in the trust task has a small effect size. Intentions that this study had to try and overcome this small effect size did not seem to be successful by introducing and implementing the congruency weights and a change in transfers overtime variable. Furthermore, this smaller sample means that it was not possible to properly delineate whether semantic (left middle frontal), autobiographical (right middle frontal), or temporal, emotional memory (right lateral temporal) best explained the processes used between those with and without BPD when deciphering emotional cues from non-emotional cues.
8.6 Implications

Overall, the results of the study imply that those with BPD seem to have an increased sensitivity when viewing facial expressions. A particular results between controls and those with BPD suggested that happy faces seemed to be associated with left temporal activity and angry faces seemed to be associated with right temporal activity, perhaps related to differences in emotional sensitivity, specifically related to the encoding of the faces. The emotional sensitivity also seemed to venture onto the trust task in both the partners with and without emotional cues too. Considering angry and happy faces were mixed in the trust task, it appears that an element of emotional, long-term categorical memory is associated with the performance of those with BPD in Franzen et al.’s (2011) trust task. With this said ACC, posterior cingulate and parietal-occipital regions were indicated to be activated for those with BPD in both partners with and without emotional cues reflecting a sensitivity differences and enhanced episodic processing. However, those regions were especially associated with making fairness decisions for the partners without emotional cues, and in the partners with emotional cues which also reported OFC and middle frontal regional activity, particularly. Overall, as implicated in this studies brain activity differences, the performance regarding emotional cues between those with and without BPD in Franzen et al. (2011) could be said to be related to mentalistion and sensitivity/emotional processing differences, which may relate to autobiographical or even semantic processing.
9.1 General discussion

Overall, when comparing between the two studies, the largest similarity is the activity in anterior cingulate, posterior cingulate, and OFC regions. These such regions have a major influence in behaviour correction and attention (Rolls & Grabenhorst, 2008) and therefore mentalisation (Fonagy & Luyten, 2009; Gallagher & Frith, 2003) and self-states; the states of others (Murray et al., 2015), episodic memory and pain perception (Nielsen et al., 2005); as well as emotional responses (Cabeza & St Jacques, 2007; New et al., 2009), respectively. Due to the overlap between brain processes in all of the concepts in this study as eluded to in the bio-psychosocial model (see section 2.3), it is difficult to ascertain the specific processes occurring for those with BPD, and therefore these interpretations of results should be read with that in mind. However, based on the rationale in the discussions of study 1 and 2, the bio-psychosocial model could not be completely discredited based on the results in the two studies. The model may also require an addition of a semantic memory component. Conservatively however, it can be said that most of the concepts related to BPD symptomatology (i.e., BPD traits, emotion dysregulation, dissociation, and, but less so, positive and negative views of self and others), reported brain-based mentalisation differences. Furthermore, [at least some of] the individual processes involved in better understanding this studies results can be examined individually in future studies.

9.2 Future directions

This study used a design whereby participants were asked to rate the physical characteristics of the people in the emotional recognition task (i.e., the size of the smile, frown, etc.) which are related to visual search patterns in recognising emotions (Calvo & Marrero, 2009). An interesting result of this study was that those with greater BPD traits reported to rate the frown more strongly than those with less BPD traits, and it is assumed that this lead to the beliefs that those images were therefore less happy. A study that teases this process out would be particularly interesting to conduct. Therefore, presenting more images and getting participants to rate the extent of the smile, frown, etc., and then the
strength of the emotion would be a way that this can be investigated and compared between those with and without BPD. Adding in a larger ‘gradient’ of emotional expressions (e.g., neutral, to smile, to larger smile) may be a way to better pin point at what point an ambiguity occurs for those with BPD, as has been reported for BPD with ambiguous faces (Domes et al., 2009).

Many studies have investigated emotional ratings when viewing facial expressions (Domes et al., 2008; Franzen et al., 2011; Unoka et al., 2011) but most have failed to consider what specifically is being perceived to make those individuals rate emotions of a person in an image more strongly to controls. Whilst correcting this missing information, it may also be interesting to collect data using eye tracking technology (Karatekin, 2007), to better read the visual scanning of participants. Analysing EEG or fMRI results whilst making facial characteristic and emotional rating decisions may provide better insight into the mechanisms related to perceiving the images over analysing the presentation of the faces themselves.

Those with BPD report to have impairments in establishing and developing a sense of self, such as from childhood upbringing and trauma (Crowell et al., 2009; Fonagy & Bateman, 2007). Given that research on BPD is generally in its infancy (Oldham, 2009), neurobiological results investigate self-referential processing in BPD would be helpful in interpreting the results of this study. For instance, some studies have investigated self-referential processing have found differences in brain activity when presenting participants with congruent and incongruent personality words that both do and do not relate to the participants; analysing the differences between creates a comparison of self-referential processing (Craik et al., 1999). Such designs and comparisons to healthy controls may provide insight into the intact or malnourished state that those with BPD have, in terms of their sense of self. With this said, it could be speculated that those with BPD, would use connotations of relationships, loss, and abandonment as a way that they define themselves, as some studies have hinted at, albeit not addressing identity in BPD (Berenson et al., 2011). Neuroscience results within these designs would provide insights into self-referential processing in BPD, and in this study.
9.3 Conclusions

In conclusion, it can be said that those with greater BPD traits had a negative bias when reading the emotions of neutral faces, and this seems to be underpinned by perceiving the frown to be stronger compared to those low in BPD traits. Those with BPD report to have an increased sensitivity when viewing facial expressions, and have tendencies of processing emotional faces in right temporal regions, with neutral faces being encoded in the left temporal regions. When making transfer and fairness decisions between partners with and without emotional cues, those with BPD report to have an increased sensitivity or greater difficulties, despite showing no behavioural differences. Transfer partners that had faces with emotional cues indicating how much participants should transfer to that partner (smile = transfer lots, frown = transfer the least) required a greater amount of processing for those with BPD, even considering emotional recognition, and partners without emotional cues. This may represent autobiographical or even semantic processing differences, but it is safest to conclude that it is related to differences in sensitivity and emotional memory or decision making difficulty required for those with BPD. Otherwise, sensory regions and episodic/pain perception regions were associated with both transfers and fairness ratings to partners with and without emotional cues. Further, fundamental research is necessary to better understand the results of this study.
Chapter 10: References


presentation borderline personality disorder. Psychiatry Research - Neuroimaging, 163(2), 116-125.


MacArthur Foundation Research. Nim Stim face stimulus set. from [http://www.macbrain.org/resources.htm](http://www.macbrain.org/resources.htm)


Appendix A. Task programming

A.1 Programming for the emotion recognition task

```matlab
sessiontime = clock;
pt = input('Participant number?: ');
pt2 = input('Confirm participant number: ');

if pt == pt2
else
pt = input('Participant number?: ');
end

stim = 12;
ISI = 1.5;
WISI = 0.5;

for i = 1:pt
order = randperm(stim);
end

order((stim + 1):stim*2) = randperm(stim);
order((stim*2 + 1):stim*3) = randperm(stim);
staticphysicorder = randperm(4);
kc_space = KbName('Space');
kc_esc = KbName('Esc');
imgfix = imread('fix.jpg');
img1 = imread('1.jpg');
img2 = imread('2.jpg');
img3 = imread('3.jpg');
```
img4 = imread('4.jpg');
img5 = imread('5.jpg');
img6 = imread('6.jpg');
img7 = imread('7.jpg');
img8 = imread('8.jpg');
img9 = imread('9.jpg');
img10 = imread('10.jpg');
img11 = imread('11.jpg');
img12 = imread('12.jpg');

imgp10 = imread('p10.jpg');
imgp20 = imread('p20.jpg');
imgp30 = imread('p30.jpg');
imgp40 = imread('p40.jpg');
imgp50 = imread('p50.jpg');
imgp60 = imread('p60.jpg');
imgp70 = imread('p70.jpg');
imgp80 = imread('p80.jpg');
imgp90 = imread('p90.jpg');

getimg = 1;
getdata = 1;
get = 1;

% set serial port
s = serial('COM3', 'Baudrate', 57600);
% open serial port
fopen(s);
% set display screen
screenNum = 0;
clrdepth = 32;

% get current screen resolution (SCREEN NEEDS TO BE 1440 by 900)
[width, height] = Screen ('WindowSize', 0);

% set display screen resolution
res(1) = width;
res(2) = height;

% open display
[wPtr, rect] = Screen('OpenWindow', screenNum, 0, [0 0 1440 900], clrdepth);

% hide the cursor
HideCursor;

% calculate the centre of the screen
xcentre = width/2;
ycentre = height/2;

% set text size
Screen('TextSize', wPtr, 16)

% draw text
Screen('DrawText', wPtr, 'In this task you will be shown a series of images of the 4 people that you will see', 190, 200, 255)
Screen('DrawText', wPtr, 'during both this emotional recognition task, and the trust task that you will do later.', 170, 250, 255)
Screen('DrawText', wPtr, 'During the start of this emotional recognition task, you will simply be shown images', 180, 300, 255)
Screen('DrawText', wPtr, 'of faces and not asked to make any decisions about them. Take a close look at the images', 160, 350, 255)
Screen('DrawText', wPtr, 'during this phase because they will help you later when you go through each image', 210, 400, 255)
Screen('DrawText', wPtr, 'one-at-a-time and rate what you think the physical characteristics of the person', 205, 450, 255)
Screen('DrawText', wPtr, 'is, and later how happy or angry they look. When prompted by a question, use the', 211, 500, 255)
Screen('DrawText', wPtr, 'left mouse button to press the number on the screen that matches the strength of your belief to record your response. Note that there are no right or wrong answers.', 170, 550, 255)
Screen('DrawText', wPtr, '< press the space bar when you are ready to begin >', 365, 700, 255)

% synch with screen refresh rate
Screen(wPtr, 'Flip');

% wait for space bar press to continue
while 1
    [keyIsDown secs keycodes] = KbCheck();
    if keycodes(kc_space)
        break
    elseif keycodes(kc_esc)
        ShowCursor;
        Screen('CloseAll');
    end
end

for i = 1:stim
    Screen('PutImage', wPtr, imgfix)
    Screen(wPtr, 'Flip');
    pause(ISI);
    if order(getimg) == 1
        Screen('PutImage', wPtr, img1)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AA');
    elseif order(getimg) == 2
        Screen('PutImage', wPtr, img2)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AB');
    end
end
elseif order(getimg) == 3
Screen('PutImage', wPtr, img3)
Screen(wPtr, 'Flip');
fprintf(s, 'AC');
elseif order(getimg) == 4
Screen('PutImage', wPtr, img4)
Screen(wPtr, 'Flip');
fprintf(s, 'AD');
elseif order(getimg) == 5
Screen('PutImage', wPtr, img5)
Screen(wPtr, 'Flip');
fprintf(s, 'AE');
elseif order(getimg) == 6
Screen('PutImage', wPtr, img6)
Screen(wPtr, 'Flip');
fprintf(s, 'AF');
elseif order(getimg) == 7
Screen('PutImage', wPtr, img7)
Screen(wPtr, 'Flip');
fprintf(s, 'AG');
elseif order(getimg) == 8
Screen('PutImage', wPtr, img8)
Screen(wPtr, 'Flip');
fprintf(s, 'AH');
elseif order(getimg) == 9
Screen('PutImage', wPtr, img9)
Screen(wPtr, 'Flip');
fprintf(s, 'AI');
elseif order(getimg) == 10
Screen('PutImage', wPtr, img10)
Screen(wPtr, 'Flip');
fprintf(s, 'AJ');
elseif order(getimg) == 11
Screen('PutImage', wPtr, img11)
Screen(wPtr, 'Flip');
fprintf(s, 'AK');
elseif order(getimg) == 12
Screen('PutImage', wPtr, img12)
Screen(wPtr, 'Flip');
fprintf(s, 'AL');
end
getimg = getimg + 1;

pause(ISI)
end

Screen('DrawText', wPtr, 'You will now be asked about the physical characteristics for each image one at a time.', 190, 400, 255)
Screen('DrawText', wPtr, '< press the space bar when you are ready to begin >', 400, 500, 255)
% synch with screen referesh rate
Screen(wPtr, 'Flip');
while 1
    [keyIsDown secs keycodes] = KbCheck();
    if keycodes(kc_space)
        break
    elseif keycodes(kc_esc)
        ShowCursor;
        Screen('CloseAll');
    end
for i = 1:4
    Screen('PutImage', wPtr, imgfix)
    Screen(wPtr, 'Flip');
    pause(ISI);
    if staticphysicorder(get) == 1
        Screen('PutImage', wPtr, img2)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AB');
    elseif staticphysicorder(get) == 2
        Screen('PutImage', wPtr, img5)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AE');
    elseif staticphysicorder(get) == 3
        Screen('PutImage', wPtr, img8)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AH');
    elseif staticphysicorder(get) == 4
        Screen('PutImage', wPtr, img11)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AK');
    end
    pause(ISI);
end

if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
dynamictrigger1 = 'AM';
dynamictrigger2 = 'AN';
dynamictrigger3 = 'AO';
dynamictrigger4 = 'AP';
dynamictrigger5 = 'AQ';
dynamictrigger6 = 'AR';
dynamictrigger7 = 'AS';
dynamictrigger8 = 'AT';
elseif staticphysicorder(get) == 2
  Screen('PutImage', wPtr, img5)
dynamictrigger1 = 'AU';
dynamictrigger2 = 'AV';
dynamictrigger3 = 'AW';
dynamictrigger4 = 'AX';
dynamictrigger5 = 'AY';
dynamictrigger6 = 'AZ';
dynamictrigger7 = 'BA';
dynamictrigger8 = 'BB';
elseif staticphysicorder(get) == 3
  Screen('PutImage', wPtr, img8)
dynamictrigger1 = 'BC';
dynamictrigger2 = 'BD';
dynamictrigger3 = 'BE';
dynamictrigger4 = 'BF';
dynamictrigger5 = 'BG';
dynamictrigger6 = 'BH';
dynamictrigger7 = 'BI';
dynamictrigger8 = 'BJ';
elseif staticphysicorder(get) == 4
  Screen('PutImage', wPtr, img11)

270
dynamictrigger1 = 'BK';
dynamictrigger2 = 'BL';
dynamictrigger3 = 'BM';
dynamictrigger4 = 'BN';
dynamictrigger5 = 'BO';
dynamictrigger6 = 'BP';
dynamictrigger7 = 'BQ';
dynamictrigger8 = 'BR';
end

Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen('DrawText', wPtr, 'What is the skin tone of this person?', 480, 700, 255)
Screen('DrawText', wPtr, '     Pale                               Dark', 400, 750, 255)
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
% If it is greater than zero, then one of them was one, and thus the
% mouse was pressed...

clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >=738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >=738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >=738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >=738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >=738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >=738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >=738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >=738 && y <= 763
    resp(getdata) = 80;

272
break

elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
resp(getdata) = 90;
break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end

fprintf(s, dynamictrigger1)

RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI)

Screen('DrawText', wPtr, 'Does this person have light or dark hair colour?', 420, 700, 255)
Screen('DrawText', wPtr, '   Light                              Dark', 420, 750, 255)
if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end

Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;

starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
% mouse was pressed...

clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );

if clicked == 0
    continue;
end

if x >= 549 & x <= 586 & y >= 738 & y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 & x <= 624 & y >= 738 & y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 & x <= 662 & y >= 738 & y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 & x <= 700 & y >= 738 & y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 & x <= 738 & y >= 738 & y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 & x <= 776 & y >= 738 & y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 & x <= 814 & y >= 738 & y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 & x <= 852 & y >= 738 & y <= 763
    resp(getdata) = 80;
    break

elseif x >= 853 && x <= 890 && y >=738 && y <= 763
    resp(getdata) = 90;
    break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    Screen('CloseAll');
end
end

fprintf(s, dynamictrigger2)

RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip);
pause(WISI)

Screen('DrawText', wPtr, 'To what extent does this person have short or long hair?', 350, 700, 255)
Screen('DrawText', wPtr, '        Short                               Long', 350, 750, 255)
if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end

Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
% If it is greater than zero, then one of them was one, and thus the
% mouse was pressed...

clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;

break

elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    resp(getdata) = 90;
    break
endif

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    Screen('CloseAll');
end

eprintf(s, dynamictrigger3)

RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI);

Screen('DrawText', wPtr, 'To what extent does this person have facial hair?', 400, 700, 255)
Screen('DrawText', wPtr, 'No facial hair                                A lot of facial hair', 325, 750, 255)
if staticphysicorder(get) == 1
Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
Screen('PutImage', wPtr, img11)
end
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
clicked = sum(buttons(1:length(buttons(1)),1));

if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;
    break
else if x >= 853 && x <= 890 && y >= 738 && y <= 763
    resp(getdata) = 90;
    break
end
resp(getdata) = 90;
break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
    Screen('CloseAll');
end
end
fprintf(s, dynamictrigger4)

RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI)

Screen('DrawText', wPtr, 'How full are the lips of this person?', 478, 700, 255)
Screen('DrawText', wPtr, 'Thin                             Full', 478, 750, 255)
if staticphysicorder(get) == 1
Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
Screen('PutImage', wPtr, img11)
end
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
    if clicked == 0
continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;
    break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    resp(getdata) = 90;
    break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end
fprintf(s, dynamictrigger5)
RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI)

Screen('DrawText', wPtr, 'How large is the nose of this person?', 480, 700, 255)
Screen('DrawText', wPtr, 'Small nose Large nose', 390, 750, 255)
if staticphysicorder(get) == 1
Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end

Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum(buttons(1:length(buttons(1)), 1));
    if clicked == 0
        continue;
    end
if x >= 549 && x <= 586 && y >=738 && y <= 763 
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >=738 && y <= 763 
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >=738 && y <= 763 
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >=738 && y <= 763 
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >=738 && y <= 763 
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >=738 && y <= 763 
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >=738 && y <= 763 
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >=738 && y <= 763 
    resp(getdata) = 80;
    break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    Screen('CloseAll');
fprintf(s, dynamictrigger6)

RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI)

Screen('DrawText', wPtr, 'How large are the ears of this person?', 490, 700, 255)
Screen('DrawText', wPtr, 'Small ears                                Large ears', 380, 750, 255)

if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI)
Screen('PutImage', wPtr, img11)
end
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >=738 && y <= 763
        resp(getdata) = 10;

        289
break

elseif x >= 587 && x <= 624 && y > 738 && y <= 763
resp(getdata) = 20;
break

elseif x >= 625 && x <= 662 && y > 738 && y <= 763
resp(getdata) = 30;
break

elseif x >= 663 && x <= 700 && y > 738 && y <= 763
resp(getdata) = 40;
break

elseif x >= 701 && x <= 738 && y > 738 && y <= 763
resp(getdata) = 50;
break

elseif x >= 739 && x <= 776 && y > 738 && y <= 763
resp(getdata) = 60;
break

elseif x >= 777 && x <= 814 && y > 738 && y <= 763
resp(getdata) = 70;
break

elseif x >= 815 && x <= 852 && y > 738 && y <= 763
resp(getdata) = 80;
break

elseif x >= 853 && x <= 890 && y > 738 && y <= 763
resp(getdata) = 90;
break

elseif x >= 1340 && x <= 1440 && y > 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end
fprintf(s, dynamictrigger7)

RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');
pause(WISI)

Screen('DrawText', wPtr, 'How thick are the eyebrows of this person?', 440, 700, 255)
Screen('DrawText', wPtr, '  Thin                               Thick', 440, 750, 255)
if staticphysicorder(get) == 1
    Screen('PutImage', wPtr, img2)
elseif staticphysicorder(get) == 2
    Screen('PutImage', wPtr, img5)
elseif staticphysicorder(get) == 3
    Screen('PutImage', wPtr, img8)
elseif staticphysicorder(get) == 4
    Screen('PutImage', wPtr, img11)
end
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >= 738 && y <= 763
        resp(getdata) = 10;
        break
    elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
        resp(getdata) = 20;
        break

    292
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;
    break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    resp(getdata) = 90;
    break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    Screen('CloseAll');
end
eprintf(s, dynamictrigger8);
RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
get = get + 1;
HideCursor;

end

for i = 1:stim
Screen('PutImage', wPtr, imgfix)
Screen(wPtr, 'Flip');
pause(ISI);
if order(getimg) == 1
Screen('PutImage', wPtr, img1)
Screen(wPtr, 'Flip');
fprintf(s, 'AA');
elseif order(getimg) == 2
Screen('PutImage', wPtr, img2)
Screen(wPtr, 'Flip');
fprintf(s, 'AB');
elseif order(getimg) == 3
Screen('PutImage', wPtr, img3)
Screen(wPtr, 'Flip');
fprintf(s, 'AC');
elseif order(getimg) == 4
Screen('PutImage', wPtr, img4)
Screen(wPtr, 'Flip');
fprintf(s, 'AD');
elseif order(getimg) == 5
Screen('PutImage', wPtr, img5)
Screen(wPtr, 'Flip');
fprintf(s, 'AE');
elseif order(getimg) == 6
Screen('PutImage', wPtr, img6)
Screen(wPtr, 'Flip');
fprintf(s, 'AF');
elseif order(getimg) == 7
Screen('PutImage', wPtr, img7)
Screen(wPtr, 'Flip');
fprintf(s, 'AG');
elseif order(getimg) == 8
Screen('PutImage', wPtr, img8)
Screen(wPtr, 'Flip');
fprintf(s, 'AH');
elseif order(getimg) == 9
Screen('PutImage', wPtr, img9)
Screen(wPtr, 'Flip');
fprintf(s, 'AI');
elseif order(getimg) == 10
Screen('PutImage', wPtr, img10)
Screen(wPtr, 'Flip');
fprintf(s, 'AJ');
elseif order(getimg) == 11
Screen('PutImage', wPtr, img11)
Screen(wPtr, 'Flip');
fprintf(s, 'AK');
elseif order(getimg) == 12
Screen('PutImage', wPtr, img12)
Screen(wPtr, 'Flip');
fprintf(s, 'AL');
end
pause(ISI);

Screen('DrawText', wPtr, 'How high does this person raise their cheeks?', 430, 700, 255)
Screen('DrawText', wPtr, 'Not at all                                A lot', 380, 750, 255)
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
if order(getimg) == 1
  Screen('PutImage', wPtr, img1)
dynamictrigger9 = 'BS';
dynamictrigger10 = 'BT';
dynamictrigger11 = 'BU';
elseif order(getimg) == 2
  Screen('PutImage', wPtr, img2)
dynamictrigger9 = 'BV';
dynamictrigger10 = 'BW';
dynamictrigger11 = 'BX';
elseif order(getimg) == 3
  Screen('PutImage', wPtr, img3)
dynamictrigger9 = 'BY';
dynamictrigger10 = 'BZ';
dynamictrigger11 = 'CA';
elseif order(getimg) == 4
   Screen('PutImage', wPtr, img4)
dynamictrigger9 = 'CB';
dynamictrigger10 = 'CC';
dynamictrigger11 = 'CD';
elseif order(getimg) == 5
   Screen('PutImage', wPtr, img5)
dynamictrigger9 = 'CE';
dynamictrigger10 = 'CF';
dynamictrigger11 = 'CG';
elseif order(getimg) == 6
   Screen('PutImage', wPtr, img6)
dynamictrigger9 = 'CH';
dynamictrigger10 = 'CI';
dynamictrigger11 = 'CJ';
elseif order(getimg) == 7
   Screen('PutImage', wPtr, img7)
dynamictrigger9 = 'CK';
dynamictrigger10 = 'CL';
dynamictrigger11 = 'CM';
elseif order(getimg) == 8
   Screen('PutImage', wPtr, img8)
dynamictrigger9 = 'CN';
dynamictrigger10 = 'CO';
dynamictrigger11 = 'CP';
elseif order(getimg) == 9
   Screen('PutImage', wPtr, img9)
dynamictrigger9 = 'CQ';
dynamictrigger10 = 'CR';
dynamictrigger11 = 'CS';
elseif order(getimg) == 10
    Screen('PutImage', wPtr, img10)
dynamictrigger9 = 'CT';
dynamictrigger10 = 'CU';
dynamictrigger11 = 'CV';
elseif order(getimg) == 11
    Screen('PutImage', wPtr, img11)
dynamictrigger9 = 'CW';
dynamictrigger10 = 'CX';
dynamictrigger11 = 'CY';
elseif order(getimg) == 12
    Screen('PutImage', wPtr, img12)
dynamictrigger9 = 'CZ';
dynamictrigger10 = 'DA';
dynamictrigger11 = 'DB';
end
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;
    break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    resp(getdata) = 90;
    break

299
break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    Screen('CloseAll');
end
end

fprintf(s, dynamictrigger9)

RT(getdata) = GetSecs() - starttime;

getdata = getdata + 1;

HideCursor;

if order(getimg) == 1
    Screen('PutImage', wPtr, img1)
elseif order(getimg) == 2
    Screen('PutImage', wPtr, img2)
elseif order(getimg) == 3
    Screen('PutImage', wPtr, img3)
elseif order(getimg) == 4
    Screen('PutImage', wPtr, img4)
elseif order(getimg) == 5
    Screen('PutImage', wPtr, img5)
elseif order(getimg) == 6
    Screen('PutImage', wPtr, img6)
elseif order(getimg) == 7
    Screen('PutImage', wPtr, img7)
elseif order(getimg) == 8
    Screen('PutImage', wPtr, img8)
elseif order(getimg) == 9
    Screen('PutImage', wPtr, img9)
Screen('PutImage', wPtr, img9)
elseif order(getimg) == 10
Screen('PutImage', wPtr, img10)
elseif order(getimg) == 11
Screen('PutImage', wPtr, img11)
elseif order(getimg) == 12
Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');

pause(WISI)

Screen('DrawText', wPtr, 'To what extent does this person show their teeth?', 400, 700, 255)
Screen('DrawText', wPtr, 'Not present                  Completely exposed', 380, 750, 255)
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
if order(getimg) == 1
Screen('PutImage', wPtr, img1)
elseif order(getimg) == 2
Screen('PutImage', wPtr, img2)
elseif order(getimg) == 3
Screen('PutImage', wPtr, img3)
elseif order(getimg) == 4
Screen('PutImage', wPtr, img4)
elseif order(getimg) == 5
  Screen('PutImage', wPtr, img5)
elseif order(getimg) == 6
  Screen('PutImage', wPtr, img6)
elseif order(getimg) == 7
  Screen('PutImage', wPtr, img7)
elseif order(getimg) == 8
  Screen('PutImage', wPtr, img8)
elseif order(getimg) == 9
  Screen('PutImage', wPtr, img9)
elseif order(getimg) == 10
  Screen('PutImage', wPtr, img10)
elseif order(getimg) == 11
  Screen('PutImage', wPtr, img11)
elseif order(getimg) == 12
  Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
  [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

  % Sum everything in the 1st row, from item 1-length
  % If it is greater than zero, then one of them was one, and thus the
  % mouse was pressed...
clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;
    break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
resp(getdata) = 90;
break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end
fprintf(s, dynamictrigger10)
RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
HideCursor;

if order(getimg) == 1
Screen('PutImage', wPtr, img1)
elseif order(getimg) == 2
Screen('PutImage', wPtr, img2)
elseif order(getimg) == 3
Screen('PutImage', wPtr, img3)
elseif order(getimg) == 4
Screen('PutImage', wPtr, img4)
elseif order(getimg) == 5
Screen('PutImage', wPtr, img5)
elseif order(getimg) == 6
Screen('PutImage', wPtr, img6)
elseif order(getimg) == 7
Screen('PutImage', wPtr, img7)
elseif order(getimg) == 8
Screen('PutImage', wPtr, img8)
elseif order(getimg) == 9
Screen('PutImage', wPtr, img9)
elseif order(getimg) == 10
Screen('PutImage', wPtr, img10)
elseif order(getimg) == 11
Screen('PutImage', wPtr, img11)
elseif order(getimg) == 12
Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');

pause(WISI)

Screen('DrawText', wPtr, 'To what extent is this person frowning?', 480, 700, 255)
Screen('DrawText', wPtr, 'Not at all                              A lot', 400, 750, 255)
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
if order(getimg) == 1
Screen('PutImage', wPtr, img1)
elseif order(getimg) == 2
Screen('PutImage', wPtr, img2)
elseif order(getimg) == 3
Screen('PutImage', wPtr, img3)
elseif order(getimg) == 4
Screen('PutImage', wPtr, img4)
elseif order(getimg) == 5
  Screen('PutImage', wPtr, img5)
elseif order(getimg) == 6
  Screen('PutImage', wPtr, img6)
elseif order(getimg) == 7
  Screen('PutImage', wPtr, img7)
elseif order(getimg) == 8
  Screen('PutImage', wPtr, img8)
elseif order(getimg) == 9
  Screen('PutImage', wPtr, img9)
elseif order(getimg) == 10
  Screen('PutImage', wPtr, img10)
elseif order(getimg) == 11
  Screen('PutImage', wPtr, img11)
elseif order(getimg) == 12
  Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
  [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

  % Sum everything in the 1st row, from item 1-length
  % If it is greater than zero, then one of them was one, and thus the
  % mouse was pressed...
  clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    resp(getdata) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    resp(getdata) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    resp(getdata) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    resp(getdata) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    resp(getdata) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    resp(getdata) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    resp(getdata) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    resp(getdata) = 80;
    break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    resp(getdata) = 90;
    break

break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
  fclose(s);
  Screen('CloseAll');
end
end
fprintf(s, dynamictrigger11)
RT(getdata) = GetSecs() - starttime;
getdata = getdata + 1;
getimg = getimg + 1;
HideCursor;
end

Screen('DrawText', wPtr, 'You will now be asked to rate how happy or angry someone is based on their facial expression', 120, 400, 255)

Screen('DrawText', wPtr, '< press the space bar when you are ready to begin >', 400, 500, 255)
% synch with screen referesh rate
Screen(wPtr, 'Flip');

while 1
  [keyIsDown secs keycodes] = KbCheck();
  if keycodes(kc_space)
    break
  elseif keycodes(kc_esc)
    ShowCursor;
    Screen('CloseAll');
  end
end
for i = 1:stim
    Screen('PutImage', wPtr, imgfix)
    Screen(wPtr, 'Flip');
    pause(ISI);
    if order(getimg) == 1
        Screen('PutImage', wPtr, img1)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AA');
    elseif order(getimg) == 2
        Screen('PutImage', wPtr, img2)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AB');
    elseif order(getimg) == 3
        Screen('PutImage', wPtr, img3)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AC');
    elseif order(getimg) == 4
        Screen('PutImage', wPtr, img4)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AD');
    elseif order(getimg) == 5
        Screen('PutImage', wPtr, img5)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AE');
    elseif order(getimg) == 6
        Screen('PutImage', wPtr, img6)
        Screen(wPtr, 'Flip');
        fprintf(s, 'AF');
elseif order(getimg) == 7
    Screen('PutImage', wPtr, img7)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AG');
elseif order(getimg) == 8
    Screen('PutImage', wPtr, img8)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AH');
elseif order(getimg) == 9
    Screen('PutImage', wPtr, img9)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AI');
elseif order(getimg) == 10
    Screen('PutImage', wPtr, img10)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AJ');
elseif order(getimg) == 11
    Screen('PutImage', wPtr, img11)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AK');
elseif order(getimg) == 12
    Screen('PutImage', wPtr, img12)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AL');
end
pause(ISI);
Screen('DrawText', wPtr, 'How happy does this person look?', 510, 700, 255)
Screen('DrawText', wPtr, 'Not happy at all                              Very happy', 320, 750, 255)
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
if order(getimg) == 1
    Screen('PutImage', wPtr, img1)
    dynamictrigger12 = 'DC';
dynamictrigger13 = 'DD';
elseif order(getimg) == 2
    Screen('PutImage', wPtr, img2)
    dynamictrigger12 = 'DE';
dynamictrigger13 = 'DF';
elseif order(getimg) == 3
    Screen('PutImage', wPtr, img3)
    dynamictrigger12 = 'DG';
dynamictrigger13 = 'DH';
elseif order(getimg) == 4
    Screen('PutImage', wPtr, img4)
    dynamictrigger12 = 'DI';
dynamictrigger13 = 'DJ';
elseif order(getimg) == 5
    Screen('PutImage', wPtr, img5)
    dynamictrigger12 = 'DK';
dynamictrigger13 = 'DL';
elseif order(getimg) == 6
    Screen('PutImage', wPtr, img6)
dynamictrigger12 = 'DM';
dynamictrigger13 = 'DN';
elseif order(getimg) == 7
    Screen('PutImage', wPtr, img7)
dynamictrigger12 = 'DO';
dynamictrigger13 = 'DP';
elseif order(getimg) == 8
    Screen('PutImage', wPtr, img8)
dynamictrigger12 = 'DQ';
dynamictrigger13 = 'DR';
elseif order(getimg) == 9
    Screen('PutImage', wPtr, img9)
dynamictrigger12 = 'DS';
dynamictrigger13 = 'DT';
elseif order(getimg) == 10
    Screen('PutImage', wPtr, img10)
dynamictrigger12 = 'DU';
dynamictrigger13 = 'DV';
elseif order(getimg) == 11
    Screen('PutImage', wPtr, img11)
dynamictrigger12 = 'DW';
dynamictrigger13 = 'DX';
elseif order(getimg) == 12
    Screen('PutImage', wPtr, img12)
dynamictrigger12 = 'DY';
dynamictrigger13 = 'DZ';
end
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons, focus, valuators, valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons(1:length(buttons(1)), 1));
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >= 738 && y <= 763
        resp(getdata) = 10;
        break
    elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
        resp(getdata) = 20;
        break
    elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
        resp(getdata) = 30;
        break
    elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
        resp(getdata) = 40;
        break
    elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
        resp(getdata) = 50;
        break
    else
        continue;
    end
resp(getdata) = 50;
break

elseif x >= 739 && x <= 776 && y >=738 && y <= 763
resp(getdata) = 60;
break

elseif x >= 777 && x <= 814 && y >=738 && y <= 763
resp(getdata) = 70;
break

elseif x >= 815 && x <= 852 && y >=738 && y <= 763
resp(getdata) = 80;
break

elseif x >= 853 && x <= 890 && y >=738 && y <= 763
resp(getdata) = 90;
break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end

fprintf(s, dynamictrigger12)

RT(getdata) = GetSecs() - starttime;

getdata = getdata + 1;
HideCursor;

if order(getimg) == 1
Screen('PutImage', wPtr, img1)
elseif order(getimg) == 2
Screen('PutImage', wPtr, img2)
elseif order(getimg) == 3
Screen('PutImage', wPtr, img3)
elseif order(getimg) == 4
    Screen('PutImage', wPtr, img4)
elseif order(getimg) == 5
    Screen('PutImage', wPtr, img5)
elseif order(getimg) == 6
    Screen('PutImage', wPtr, img6)
elseif order(getimg) == 7
    Screen('PutImage', wPtr, img7)
elseif order(getimg) == 8
    Screen('PutImage', wPtr, img8)
elseif order(getimg) == 9
    Screen('PutImage', wPtr, img9)
elseif order(getimg) == 10
    Screen('PutImage', wPtr, img10)
elseif order(getimg) == 11
    Screen('PutImage', wPtr, img11)
elseif order(getimg) == 12
    Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');

pause(WISI)

Screen('DrawText', wPtr, 'How angry does this person look?', 505, 700, 255)
Screen('DrawText', wPtr, 'Not angry at all                             Very angry', 320, 750, 255)
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
if order(getimg) == 1
    Screen('PutImage', wPtr, img1)
elseif order(getimg) == 2
    Screen('PutImage', wPtr, img2)
elseif order(getimg) == 3
    Screen('PutImage', wPtr, img3)
elseif order(getimg) == 4
    Screen('PutImage', wPtr, img4)
elseif order(getimg) == 5
    Screen('PutImage', wPtr, img5)
elseif order(getimg) == 6
    Screen('PutImage', wPtr, img6)
elseif order(getimg) == 7
    Screen('PutImage', wPtr, img7)
elseif order(getimg) == 8
    Screen('PutImage', wPtr, img8)
elseif order(getimg) == 9
    Screen('PutImage', wPtr, img9)
elseif order(getimg) == 10
    Screen('PutImage', wPtr, img10)
elseif order(getimg) == 11
    Screen('PutImage', wPtr, img11)
elseif order(getimg) == 12
    Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');

SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >=738 && y <= 763
        resp(getdata) = 10;
        break
    elseif x >= 587 && x <= 624 && y >=738 && y <= 763
        resp(getdata) = 20;
        break
    elseif x >= 625 && x <= 662 && y >=738 && y <= 763
        resp(getdata) = 30;
        break
    elseif x >= 663 && x <= 700 && y >=738 && y <= 763
        resp(getdata) = 40;
        break

    end

end
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
resp(getdata) = 50;
break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
resp(getdata) = 60;
break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
resp(getdata) = 70;
break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
resp(getdata) = 80;
break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
resp(getdata) = 90;
break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end
fprintf(s, dynamictrigger13)
RT(getdata) = GetSecs() - starttime;
getimg = getimg + 1;
getdata = getdata + 1;
HideCursor;

end

Screen('DrawText', wPtr, 'Thankyou! Please wait for the task to close.', 400, 500, 255)
Screen(wPtr, 'Flip');
getdata = 1;
pause(ISI)

logfile = sprintf('%s_ER.txt', num2str(pt));

fprintf('A log of this session will be saved to %s\n', logfile);

fid = fopen(logfile, 'a');
if fid < 1
    error('Could not open logfile!');
end

fprintf(fid, 'Date of session\n');
fprintf(fid, '%d ', sessiontime(3));
fprintf(fid, '%d ', sessiontime(2));
fprintf(fid, '%d ', sessiontime(1));
fprintf(fid, '\n');
fprintf(fid, 'Time of session\n');
fprintf(fid, '%d ', sessiontime(4));
fprintf(fid, '%d ', sessiontime(5));
fprintf(fid, '\n');
fprintf(fid, 'Participant number\n');
fprintf(fid, '%d', pt);
fprintf(fid, '\n');
fprintf(fid, 'Task presentation order\n');
for i = 1:stim*3
    fprintf(fid, '%d\', order(getdata));
    fprintf(fid, '\n');
getdata = getdata + 1;

end
getdata = 1;
fprintf(fid, 'Task static presentation order\n');
for i = 1:4
fprintf(fid, '%d\', staticphysicorder(getdata));
fprintf(fid, '\n');
getdata = getdata + 1;
end
getdata = 1;
fprintf(fid, 'Responses made\n');
fprintf(fid, 'Static characteristics\n');
for i = 1:32
fprintf(fid, '%d\', resp(getdata));
fprintf(fid, '\n');
getdata = getdata + 1;
end
fprintf(fid, 'Dynamic characteristics\n');
for i = 1:stim*3
fprintf(fid, '%d\', resp(getdata));
fprintf(fid, '\n');
getdata = getdata + 1;
end
fprintf(fid, 'Emotion ratings\n');
for i = 1:stim*2
fprintf(fid, '%d\', resp(getdata));
fprintf(fid, '\n');
getdata = getdata + 1;
end
getdata = 1;
fprintf(fid, 'RT\n');
for i = 1:92
    fprintf(fid, '%d\', RT(getdata));
    fprintf(fid, '\n');
    getdata = getdata + 1;
end

% Close file
fclose(fid);
% close serial port
fclose(s);
% Show cursor
ShowCursor;
%Close Screen/task
Screen('CloseAll');

% NOTE FOR RESULT DATA: COPY AND PASTE FROM THE .TXT TO EXCEL.
A.2 Programming for the trust task

```matlab
sessiontime = clock;
pt = input('Participant number?: ');
pt2 = input ('Confirm participant number: ');

if pt == pt2
else
pt = input('Participant number?: ');
end

imgset = input('Image set to be used (1 - 8)?: ');
imgset2 = input('Confirm image set: ');

if imgset == imgset2
else
imgset = input('Image set to be used (1 - 8)?: ');
end

mu = 90;
stim = 36;
overallratestim = 4;
ISI = 1.5;
WISI = 1;
overallscore = 0;

for i = 1:pt
    order = randperm(stim);
end
```
for i = 1:pt
    overallrateorder = randperm(4);
end

kc_space = KbName('Space');
kc_esc = KbName('Esc');
imgfix = imread('fix.jpg');
img1 = imread('1.jpg');
img2 = imread('2.jpg');
img3 = imread('3.jpg');
img4 = imread('4.jpg');
img5 = imread('5.jpg');
img6 = imread('6.jpg');
img7 = imread('7.jpg');
img8 = imread('8.jpg');
img9 = imread('9.jpg');
img10 = imread('10.jpg');
img11 = imread('11.jpg');
img12 = imread('12.jpg');

imgp10 = imread('p10.jpg');
imgp20 = imread('p20.jpg');
imgp30 = imread('p30.jpg');
imgp40 = imread('p40.jpg');
imgp50 = imread('p50.jpg');
imgp60 = imread('p60.jpg');
imgp70 = imread('p70.jpg');
imgp80 = imread('p80.jpg');
imgp90 = imread('p90.jpg');
get = 1; % used for getting images and saving transfer and fairness no.'s
get2 = 1; % used to get images in overall rate phase
dataget = 1; % used for getting RT

s = serial('COM3', 'Baudrate', 57600);
fopen(s);

% set display screen
screenNum = 0;
clrdepth = 32;
% get current screen resolution
[width, height] = Screen('WindowSize', 0);
% set display screen resolution (SCREEN NEEDS TO BE 1440 by 900)
res(1) = width;
res(2) = height;
[wPtr, rect] = Screen('OpenWindow', screenNum, 0, [0 0 1440 900], clrdepth);
% hide the cursor
HideCursor;
% calculate the centre of the screen
xcentre = width/2;
ycentre = height/2;
% set text size
Screen('TextSize', wPtr, 16)
% draw text
Screen('DrawText', wPtr, 'In this task, you will see the same 4 people that you saw in the previous emotional task. However, this task involves an exchange of money between yourself and each', 100, 100, 255)
partner. You will see each partner 9 times throughout the task, and you will have a credit of 90 from which to decide how much you will transfer to your partner each time.

The money that you decide to transfer over to your partner will be tripled, and then your partner will decide how much. Whereas the money that you decide to hold onto is guaranteed to be yours.

So, aim to get as much money as you can by giving a lot of money over to a partner that you trust, whilst also giving little to a partner that you do not trust. If you choose, you can transfer all 90 worth of your money, but you have to transfer a minimum of 10. When prompted, use the left mouse button to click on the number you want to transfer.

After this, and at the very end of the task, you will be asked to rate how fair you thought each partner was. Note that there are no right or wrong answers, and you do have the option of having break periods throughout the task.

< press the space bar when you are ready to begin >

% wait for space bar press to continue

while 1

[keyIsDown secs keycodes] = KbCheck();

if keycodes(kc_space)
    break
elseif keycodes(kc_esc)
fclose(s);
ShowCursor;
Screen('CloseAll');
end
end

pause(0.5)

for i = 1:stim

partnerlayout = randi(24);

Screen('DrawText', wPtr, '                                       Money you now own: 90', 141, 100, 255)

Screen('DrawText', wPtr, 'You will see the partner that you will be deciding how much to transfer your money to after', 141, 200, 255)

Screen('DrawText', wPtr, 'this screen - you will see both an image of your partner and numbers displayed under them.', 143, 250, 255)

Screen('DrawText', wPtr, 'When you decide how much of your money you would like to transfer to your partner, click on the', 136, 300, 255)

Screen('DrawText', wPtr, 'number that represents how much you would like to transfer (10 - 90).', 141, 350, 255)

if partnerlayout == 1

Screen('PutImage', wPtr2, img2, [382 500 551 704]);

Screen('PutImage', wPtr5, img5, [561 500 730 704]);

Screen('PutImage', wPtr8, img8, [740 500 909 704]);

Screen('PutImage', wPtr11, img11, [919 500 1088 704]);

elseif partnerlayout == 2

Screen('PutImage', wPtr2, img2, [382 500 551 704]);

Screen('PutImage', wPtr5, img5, [561 500 730 704]);

Screen('PutImage', wPtr11, img11, [740 500 909 704]);
Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 3
    Screen('PutImage', wPtr, img2, [382 500 551 704]);
    Screen('PutImage', wPtr, img8, [561 500 730 704]);
    Screen('PutImage', wPtr, img5, [740 500 909 704]);
    Screen('PutImage', wPtr, img11, [919 500 1088 704]);
elseif partnerlayout == 4
    Screen('PutImage', wPtr, img2, [382 500 551 704]);
    Screen('PutImage', wPtr, img8, [561 500 730 704]);
    Screen('PutImage', wPtr, img11, [740 500 909 704]);
    Screen('PutImage', wPtr, img5, [919 500 1088 704]);
elseif partnerlayout == 5
    Screen('PutImage', wPtr, img2, [382 500 551 704]);
    Screen('PutImage', wPtr, img11, [561 500 730 704]);
    Screen('PutImage', wPtr, img5, [740 500 909 704]);
    Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 6
    Screen('PutImage', wPtr, img2, [382 500 551 704]);
    Screen('PutImage', wPtr, img11, [561 500 730 704]);
    Screen('PutImage', wPtr, img8, [740 500 909 704]);
    Screen('PutImage', wPtr, img5, [919 500 1088 704]);
elseif partnerlayout == 7
    Screen('PutImage', wPtr, img5, [382 500 551 704]);
    Screen('PutImage', wPtr, img2, [561 500 730 704]);
    Screen('PutImage', wPtr, img8, [740 500 909 704]);
    Screen('PutImage', wPtr, img11, [919 500 1088 704]);
elseif partnerlayout == 8
    Screen('PutImage', wPtr, img5, [382 500 551 704]);
    Screen('PutImage', wPtr, img2, [561 500 730 704]);
    Screen('PutImage', wPtr, img11, [740 500 909 704]);

Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 9
Screen('PutImage', wPtr, img5, [382 500 551 704]);
Screen('PutImage', wPtr, img8, [561 500 730 704]);
Screen('PutImage', wPtr, img2, [740 500 909 704]);
Screen('PutImage', wPtr, img11, [919 500 1088 704]);
elseif partnerlayout == 10
Screen('PutImage', wPtr, img5, [382 500 551 704]);
Screen('PutImage', wPtr, img8, [561 500 730 704]);
Screen('PutImage', wPtr, img11, [740 500 909 704]);
Screen('PutImage', wPtr, img2, [919 500 1088 704]);
elseif partnerlayout == 11
Screen('PutImage', wPtr, img5, [382 500 551 704]);
Screen('PutImage', wPtr, img11, [561 500 730 704]);
Screen('PutImage', wPtr, img2, [740 500 909 704]);
Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 12
Screen('PutImage', wPtr, img5, [382 500 551 704]);
Screen('PutImage', wPtr, img11, [561 500 730 704]);
Screen('PutImage', wPtr, img2, [740 500 909 704]);
Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 13
Screen('PutImage', wPtr, img8, [382 500 551 704]);
Screen('PutImage', wPtr, img2, [561 500 730 704]);
Screen('PutImage', wPtr, img5, [740 500 909 704]);
Screen('PutImage', wPtr, img11, [919 500 1088 704]);
elseif partnerlayout == 14
Screen('PutImage', wPtr, img8, [382 500 551 704]);
Screen('PutImage', wPtr, img2, [561 500 730 704]);
Screen('PutImage', wPtr, img11, [740 500 909 704]);
Screen('PutImage', wPtr, img5, [919 500 1088 704]);
elseif partnerlayout == 15
    Screen('PutImage', wPtr, img8, [382 500 551 704]);
    Screen('PutImage', wPtr, img5, [561 500 730 704]);
    Screen('PutImage', wPtr, img2, [740 500 909 704]);
    Screen('PutImage', wPtr, img11, [919 500 1088 704]);
elseif partnerlayout == 16
    Screen('PutImage', wPtr, img8, [382 500 551 704]);
    Screen('PutImage', wPtr, img5, [561 500 730 704]);
    Screen('PutImage', wPtr, img11, [740 500 909 704]);
    Screen('PutImage', wPtr, img2, [919 500 1088 704]);
elseif partnerlayout == 17
    Screen('PutImage', wPtr, img8, [382 500 551 704]);
    Screen('PutImage', wPtr, img11, [561 500 730 704]);
    Screen('PutImage', wPtr, img2, [740 500 909 704]);
    Screen('PutImage', wPtr, img5, [919 500 1088 704]);
elseif partnerlayout == 18
    Screen('PutImage', wPtr, img8, [382 500 551 704]);
    Screen('PutImage', wPtr, img11, [561 500 730 704]);
    Screen('PutImage', wPtr, img5, [740 500 909 704]);
    Screen('PutImage', wPtr, img2, [919 500 1088 704]);
elseif partnerlayout == 19
    Screen('PutImage', wPtr, img11, [382 500 551 704]);
    Screen('PutImage', wPtr, img2, [561 500 730 704]);
    Screen('PutImage', wPtr, img5, [740 500 909 704]);
    Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 20
    Screen('PutImage', wPtr, img11, [382 500 551 704]);
    Screen('PutImage', wPtr, img2, [561 500 730 704]);
    Screen('PutImage', wPtr, img8, [740 500 909 704]);
elseif partnerlayout == 21
    Screen('PutImage', wPtr, img11, [382 500 551 704]);
    Screen('PutImage', wPtr, img5, [561 500 730 704]);
    Screen('PutImage', wPtr, img2, [740 500 909 704]);
    Screen('PutImage', wPtr, img8, [919 500 1088 704]);
elseif partnerlayout == 22
    Screen('PutImage', wPtr, img11, [382 500 551 704]);
    Screen('PutImage', wPtr, img5, [561 500 730 704]);
    Screen('PutImage', wPtr, img8, [740 500 909 704]);
    Screen('PutImage', wPtr, img2, [919 500 1088 704]);
elseif partnerlayout == 23
    Screen('PutImage', wPtr, img11, [382 500 551 704]);
    Screen('PutImage', wPtr, img8, [561 500 730 704]);
    Screen('PutImage', wPtr, img2, [740 500 909 704]);
    Screen('PutImage', wPtr, img5, [919 500 1088 704]);
elseif partnerlayout == 24
    Screen('PutImage', wPtr, img11, [382 500 551 704]);
    Screen('PutImage', wPtr, img8, [561 500 730 704]);
    Screen('PutImage', wPtr, img5, [740 500 909 704]);
    Screen('PutImage', wPtr, img2, [919 500 1088 704]);
end

Screen('DrawText', wPtr, '< Feel free to have a break here. Press the space bar when you are ready to continue >', 160, 750, 255)
Screen(wPtr, 'Flip');

starttime = GetSecs();

while 1
[keyIsDown secs keycodes] = KbCheck();
if keycodes(kc_space)
    break
elseif keycodes(kc_esc)
    fclose(s);
    ShowCursor;
    Screen('CloseAll');
end
end

rest(get) = GetSecs - starttime;
Screen('PutImage', wPtr, imgfix)
Screen(wPtr, 'Flip');
pause(ISI);
Screen('PutImage', wPtr, imgp10, [549 654 586 679])
Screen('PutImage', wPtr, imgp20, [587 654 624 679])
Screen('PutImage', wPtr, imgp30, [625 654 662 679])
Screen('PutImage', wPtr, imgp40, [663 654 700 679])
Screen('PutImage', wPtr, imgp50, [701 654 738 679])
Screen('PutImage', wPtr, imgp60, [739 654 776 679])
Screen('PutImage', wPtr, imgp70, [777 654 814 679])
Screen('PutImage', wPtr, imgp80, [815 654 852 679])
Screen('PutImage', wPtr, imgp90, [853 654 890 679])
if order(get) == 1
    picvalue = 0.66;
dynamictrigger1 = 'AM';
dynamictrigger2 = 'AN';
dynamictrigger3 = 'AO';
dynamictrigger4 = 'AP';
dynamictrigger5 = 'AQ';
dynamictrigger6 = 'AR';
Screen('PutImage', wPtr, img1)
Screen(wPtr, 'Flip');
fprintf(s, 'AA');
elseif order(get) == 2
picvalue = 0.5975;
dynamictrigger1 = 'AM';
dynamictrigger2 = 'AN';
dynamictrigger3 = 'AO';
dynamictrigger4 = 'AP';
dynamictrigger5 = 'AQ';
dynamictrigger6 = 'AR';
Screen('PutImage', wPtr, img1)
Screen(wPtr, 'Flip');
fprintf(s, 'AA');
elseif order(get) == 3
picvalue = 0.535;
dynamictrigger1 = 'AM';
dynamictrigger2 = 'AN';
dynamictrigger3 = 'AO';
dynamictrigger4 = 'AP';
dynamictrigger5 = 'AQ';
dynamictrigger6 = 'AR';
Screen('PutImage', wPtr, img1)
Screen(wPtr, 'Flip');
fprintf(s, 'AA');
elseif order(get) == 4
picvalue = 0.4725;
dynamictrigger1 = 'AS';
dynamictrigger2 = 'AT';
dynamictrigger3 = 'AU';
dynamictrigger4 = 'AV';
dynamictrigger5 = 'AW';
dynamictrigger6 = 'AX';
Screen('PutImage', wPtr, img2)
Screen(wPtr, 'Flip');
fprintf(s, 'AB');
elseif order(get) == 5
picvalue = 0.41;
dynamictrigger1 = 'AS';
dynamictrigger2 = 'AT';
dynamictrigger3 = 'AU';
dynamictrigger4 = 'AV';
dynamictrigger5 = 'AW';
dynamictrigger6 = 'AX';
Screen('PutImage', wPtr, img2)
Screen(wPtr, 'Flip');
fprintf(s, 'AB');
elseif order(get) == 6
picvalue = 0.3475;
dynamictrigger1 = 'AS';
dynamictrigger2 = 'AT';
dynamictrigger3 = 'AU';
dynamictrigger4 = 'AV';
dynamictrigger5 = 'AW';
dynamictrigger6 = 'AX';
Screen('PutImage', wPtr, img2)
Screen(wPtr, 'Flip');
fprintf(s, 'AB');
elseif order(get) == 7

picvalue = 0.285;
dynamictrigger1 = 'AY';
dynamictrigger2 = 'AZ';
dynamictrigger3 = 'BA';
dynamictrigger4 = 'BB';
dynamictrigger5 = 'BC';
dynamictrigger6 = 'BD';
Screen('PutImage', wPtr, img3)
Screen(wPtr, 'Flip');
fprintf(s, 'AC');
elseif order(get) == 8
    picvalue = 0.2225;
dynamictrigger1 = 'AY';
dynamictrigger2 = 'AZ';
dynamictrigger3 = 'BA';
dynamictrigger4 = 'BB';
dynamictrigger5 = 'BC';
dynamictrigger6 = 'BD';
Screen('PutImage', wPtr, img3)
Screen(wPtr, 'Flip');
fprintf(s, 'AC');
elseif order(get) == 9
    picvalue = 0.16;
dynamictrigger1 = 'AY';
dynamictrigger2 = 'AZ';
dynamictrigger3 = 'BA';
dynamictrigger4 = 'BB';
dynamictrigger5 = 'BC';
dynamictrigger6 = 'BD';
Screen('PutImage', wPtr, img3)
Screen(wPtr, 'Flip');
fprintf(s, 'AC');
Screen(wPtr, 'Flip');
fprintf(s, 'AC');
elseif order(get) == 10
picvalue = 0.66;
dynamictrigger1 = 'BE';
dynamictrigger2 = 'BF';
dynamictrigger3 = 'BG';
dynamictrigger4 = 'BH';
dynamictrigger5 = 'BI';
dynamictrigger6 = 'BJ';
Screen('PutImage', wPtr, img4)
Screen(wPtr, 'Flip');
fprintf(s, 'AD');
elseif order(get) == 11
picvalue = 0.5975;
dynamictrigger1 = 'BE';
dynamictrigger2 = 'BF';
dynamictrigger3 = 'BG';
dynamictrigger4 = 'BH';
dynamictrigger5 = 'BI';
dynamictrigger6 = 'BJ';
Screen('PutImage', wPtr, img4)
Screen(wPtr, 'Flip');
fprintf(s, 'AD');
elseif order(get) == 12
picvalue = 0.535;
dynamictrigger1 = 'BE';
dynamictrigger2 = 'BF';
dynamictrigger3 = 'BG';
dynamictrigger4 = 'BH';
dynamictrigger5 = 'BI';
dynamictrigger6 = 'BJ';
Screen('PutImage', wPtr, img4)
dynamictrigger5 = 'BI';
dynamictrigger6 = 'BJ';
Screen('PutImage', wPtr, img4)
Screen(wPtr, 'Flip');
fprintf(s, 'AD');
elseif order(get) == 13
    picvalue = 0.4725;
dynamictrigger1 = 'BK';
dynamictrigger2 = 'BL';
dynamictrigger3 = 'BM';
dynamictrigger4 = 'BN';
dynamictrigger5 = 'BO';
dynamictrigger6 = 'BP';
Screen('PutImage', wPtr, img5)
Screen(wPtr, 'Flip');
fprintf(s, 'AE');
elseif order(get) == 14
    picvalue = 0.41;
dynamictrigger1 = 'BK';
dynamictrigger2 = 'BL';
dynamictrigger3 = 'BM';
dynamictrigger4 = 'BN';
dynamictrigger5 = 'BO';
dynamictrigger6 = 'BP';
Screen('PutImage', wPtr, img5)
Screen(wPtr, 'Flip');
fprintf(s, 'AE');
elseif order(get) == 15
    picvalue = 0.3475;
dynamictrigger1 = 'BK';
dynamictrigger2 = 'BL';
dynamictrigger3 = 'BM';
dynamictrigger4 = 'BN';
dynamictrigger5 = 'BO';
dynamictrigger6 = 'BP';
Screen('PutImage', wPtr, img5)
Screen(wPtr, 'Flip');
fprintf(s, 'AE');
elseif order(get) == 16
    picvalue = 0.285;
    dynamictrigger1 = 'BQ';
    dynamictrigger2 = 'BR';
    dynamictrigger3 = 'BS';
    dynamictrigger4 = 'BT';
    dynamictrigger5 = 'BU';
    dynamictrigger6 = 'BV';
    Screen('PutImage', wPtr, img6)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AF');
elseif order(get) == 17
    picvalue = 0.2225;
    dynamictrigger1 = 'BQ';
    dynamictrigger2 = 'BR';
    dynamictrigger3 = 'BS';
    dynamictrigger4 = 'BT';
    dynamictrigger5 = 'BU';
    dynamictrigger6 = 'BV';
    Screen('PutImage', wPtr, img6)
    Screen(wPtr, 'Flip');
    fprintf(s, 'AF');
elseif order(get) == 18
picvalue = 0.16;
dynamictrigger1 = 'BQ';
dynamictrigger2 = 'BR';
dynamictrigger3 = 'BS';
dynamictrigger4 = 'BT';
dynamictrigger5 = 'BU';
dynamictrigger6 = 'BV';
Screen('PutImage', wPtr, img6)
Screen(wPtr, 'Flip');
fprintf(s, 'AF');
elseif order(get) == 19
picvalue = 0.50;
dynamictrigger1 = 'BW';
dynamictrigger2 = 'BX';
dynamictrigger3 = 'BY';
dynamictrigger4 = 'BZ';
dynamictrigger5 = 'CA';
dynamictrigger6 = 'CB';
Screen('PutImage', wPtr, img7)
Screen(wPtr, 'Flip');
fprintf(s, 'AG');
elseif order(get) == 20
picvalue = 0.4375;
dynamictrigger1 = 'BW';
dynamictrigger2 = 'BX';
dynamictrigger3 = 'BY';
dynamictrigger4 = 'BZ';
dynamictrigger5 = 'CA';
dynamictrigger6 = 'CB';
Screen('PutImage', wPtr, img7)
Screen('PutImage', wPtr, img7)
Screen(wPtr, 'Flip');
fprintf(s, 'AG');
elseif order(get) == 21
picvalue = 0.375;
dynamictrigger1 = 'BW';
dynamictrigger2 = 'BX';
dynamictrigger3 = 'BY';
dynamictrigger4 = 'BZ';
dynamictrigger5 = 'CA';
dynamictrigger6 = 'CB';
Screen('PutImage', wPtr, img7)
Screen(wPtr, 'Flip');
fprintf(s, 'AG');
elseif order(get) == 22
picvalue = 0.3125;
dynamictrigger1 = 'CC';
dynamictrigger2 = 'CD';
dynamictrigger3 = 'CE';
dynamictrigger4 = 'CF';
dynamictrigger5 = 'CG';
dynamictrigger6 = 'CH';
Screen('PutImage', wPtr, img8)
Screen(wPtr, 'Flip');
fprintf(s, 'AH');
elseif order(get) == 23
picvalue = 0.25;
dynamictrigger1 = 'CC';
dynamictrigger2 = 'CD';
dynamictrigger3 = 'CE';
dynamictrigger4 = 'CF';
dynamictrigger5 = 'CG';
dynamictrigger6 = 'CH';
Screen('PutImage', wPtr, img8)
Screen(wPtr, 'Flip');
fprintf(s, 'AH');
elseif order(get) == 24
    picvalue = 0.1875;
dynamictrigger1 = 'CC';
dynamictrigger2 = 'CD';
dynamictrigger3 = 'CE';
dynamictrigger4 = 'CF';
dynamictrigger5 = 'CG';
dynamictrigger6 = 'CH';
Screen('PutImage', wPtr, img8)
Screen(wPtr, 'Flip');
fprintf(s, 'AH');
elseif order(get) == 25
    picvalue = 0.125;
dynamictrigger1 = 'CI';
dynamictrigger2 = 'CJ';
dynamictrigger3 = 'CK';
dynamictrigger4 = 'CL';
dynamictrigger5 = 'CM';
dynamictrigger6 = 'CN';
Screen('PutImage', wPtr, img9)
Screen(wPtr, 'Flip');
fprintf(s, 'AI');
elseif order(get) == 26
    picvalue = 0.0625;
dynamictrigger1 = 'CI';
dynamictrigger2 = 'CJ';
dynamictrigger3 = 'CK';
dynamictrigger4 = 'CL';
dynamictrigger5 = 'CM';
dynamictrigger6 = 'CN';
Screen('PutImage', wPtr, img9)
Screen(wPtr, 'Flip');
fprintf(s, 'AI');
elseif order(get) == 27
    picvalue = 0;
dynamictrigger1 = 'CI';
dynamictrigger2 = 'CJ';
dynamictrigger3 = 'CK';
dynamictrigger4 = 'CL';
dynamictrigger5 = 'CM';
dynamictrigger6 = 'CN';
Screen('PutImage', wPtr, img9)
Screen(wPtr, 'Flip');
fprintf(s, 'AI');
elseif order(get) == 28
    picvalue = 0.50;
dynamictrigger1 = 'CO';
dynamictrigger2 = 'CP';
dynamictrigger3 = 'CQ';
dynamictrigger4 = 'CR';
dynamictrigger5 = 'CS';
dynamictrigger6 = 'CT';
Screen('PutImage', wPtr, img10)
Screen(wPtr, 'Flip');
fprintf(s, 'AJ');
elseif order(get) == 29
  picvalue = 0.4375;
dynamictrigger1 = 'CO';
dynamictrigger2 = 'CP';
dynamictrigger3 = 'CQ';
dynamictrigger4 = 'CR';
dynamictrigger5 = 'CS';
dynamictrigger6 = 'CT';
Screen('PutImage', wPtr, img10)
Screen(wPtr, 'Flip');
fprintf(s, 'AJ');
elseif order(get) == 30
  picvalue = 0.375;
dynamictrigger1 = 'CO';
dynamictrigger2 = 'CP';
dynamictrigger3 = 'CQ';
dynamictrigger4 = 'CR';
dynamictrigger5 = 'CS';
dynamictrigger6 = 'CT';
Screen('PutImage', wPtr, img10)
Screen(wPtr, 'Flip');
fprintf(s, 'AJ');
elseif order(get) == 31
  picvalue = 0.3125;
dynamictrigger1 = 'CU';
dynamictrigger2 = 'CV';
dynamictrigger3 = 'CW';
dynamictrigger4 = 'CX';
dynamictrigger5 = 'CY';
dynamictrigger6 = 'CZ';
Screen('PutImage', wPtr, img11)
Screen(wPtr, 'Flip');
fprintf(s, 'AK');
elseif order(get) == 32
picvalue = 0.25;
dynamictrigger1 = 'CU';
dynamictrigger2 = 'CV';
dynamictrigger3 = 'CW';
dynamictrigger4 = 'CX';
dynamictrigger5 = 'CY';
dynamictrigger6 = 'CZ';
Screen('PutImage', wPtr, img11)
Screen(wPtr, 'Flip');
fprintf(s, 'AK');
elseif order(get) == 33
picvalue = 0.1875;
dynamictrigger1 = 'CU';
dynamictrigger2 = 'CV';
dynamictrigger3 = 'CW';
dynamictrigger4 = 'CX';
dynamictrigger5 = 'CY';
dynamictrigger6 = 'CZ';
Screen('PutImage', wPtr, img11)
Screen(wPtr, 'Flip');
fprintf(s, 'AK');
elseif order(get) == 34
picvalue = 0.125;
dynamictrigger1 = 'DA';
dynamictrigger2 = 'DB';
dynamictrigger3 = 'DC';
dynamictrigger4 = 'DD';
dynamictrigger5 = 'DE';
dynamictrigger6 = 'DF';
Screen('PutImage', wPtr, img12)
Screen(wPtr, 'Flip');
fprintf(s, 'AL');
elseif order(get) == 35
  picvalue = 0.0625;
dynamictrigger1 = 'DA';
dynamictrigger2 = 'DB';
dynamictrigger3 = 'DC';
dynamictrigger4 = 'DD';
dynamictrigger5 = 'DE';
dynamictrigger6 = 'DF';
Screen('PutImage', wPtr, img12)
Screen(wPtr, 'Flip');
fprintf(s, 'AL');
elseif order(get) == 36
  picvalue = 0;
  dynamictrigger1 = 'DA';
dynamictrigger2 = 'DB';
dynamictrigger3 = 'DC';
dynamictrigger4 = 'DD';
dynamictrigger5 = 'DE';
dynamictrigger6 = 'DF';
Screen('PutImage', wPtr, img12)
Screen(wPtr, 'Flip');
fprintf(s, 'AL');
end
SetMouse(719, 700, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
    [x,y,buttons, focus, valuators, valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum(buttons(1:length(buttons(1)), 1));
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >= 654 && y <= 679
        nyt(get) = 10;
        npg = 30;
        break
    elseif x >= 587 && x <= 624 && y >= 654 && y <= 679
        nyt(get) = 20;
        npg = 60;
        break
    elseif x >= 625 && x <= 662 && y >= 654 && y <= 679
        nyt(get) = 30;
        npg = 90;
        break
    elseif x >= 663 && x <= 700 && y >= 654 && y <= 679
        nyt(get) = 40;
npg = 120;
break
elseif x >= 701 && x <= 738 && y >= 654 && y <= 679
nyt(get) = 50;
npg = 150;
break
elseif x >= 739 && x <= 776 && y >= 654 && y <= 679
nyt(get) = 60;
npg = 180;
break
elseif x >= 777 && x <= 814 && y >= 654 && y <= 679
nyt(get) = 70;
npg = 210;
break
elseif x >= 815 && x <= 852 && y >= 654 && y <= 679
nyt(get) = 80;
npg = 240;
break
elseif x >= 853 && x <= 890 && y >= 654 && y <= 679
nyt(get) = 90;
npg = 270;
break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
ShowCursor;
Screen('CloseAll');
end
end
fprintf(s, dynamictrigger1);
RT(dataget) = GetSecs - starttime;
dataget = dataget + 1;
HideCursor;

npt = round(picvalue*npg);
npo = round(npg - npt);
nyo = npt + mu - nyt(get);
overallscore = overallscore + nyo;
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen(wPtr, 'Flip');
fprintf(s, dynamictrigger2);
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen(wPtr, 'Flip');
Screen(wPtr, 'Flip');
fprintf(s, dynamictrigger3);
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen('DrawText', wPtr, num2str(nyo), 765, 550, 255)
Screen('DrawText', wPtr, 'Your partner owns:', 525, 600, 255)
Screen(wPtr, 'Flip');
pause(WISI)
Screen('DrawText', wPtr, 'You transferred:', 550, 400, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 765, 400, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 525, 450, 255)
Screen('DrawText', wPtr, num2str(npg), 765, 450, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 460, 500, 255)
Screen('DrawText', wPtr, num2str(npt), 765, 500, 255)
Screen('DrawText', wPtr, 'You own:', 654, 550, 255)
Screen('DrawText', wPtr, num2str(nyo), 765, 550, 255)
Screen('DrawText', wPtr, 'Your partner owns:', 525, 600, 255)
Screen(wPtr, 'Flip');
fprintf(s, dynamictrigger4);
pause(ISI)
Screen('PutImage', wPtr, imgfix)
Screen(wPtr, 'Flip');
pause(ISI)
if order(get) == 1
    Screen('PutImage', wPtr, img1)
elseif order(get) == 2
    Screen('PutImage', wPtr, img1)
elseif order(get) == 3
    Screen('PutImage', wPtr, img1)
elseif order(get) == 4
    Screen('PutImage', wPtr, img2)
elseif order(get) == 5
    Screen('PutImage', wPtr, img2)
elseif order(get) == 6
    Screen('PutImage', wPtr, img2)
elseif order(get) == 7
    Screen('PutImage', wPtr, img3)
elseif order(get) == 8
    Screen('PutImage', wPtr, img3)
elseif order(get) == 9
    Screen('PutImage', wPtr, img3)
elseif order(get) == 10
    Screen('PutImage', wPtr, img4)
elseif order(get) == 11
    Screen('PutImage', wPtr, img4)
elseif order(get) == 12
    Screen('PutImage', wPtr, img4)
elseif order(get) == 13
    Screen('PutImage', wPtr, img5)
elseif order(get) == 14
    Screen('PutImage', wPtr, img5)
elseif order(get) == 15
    Screen('PutImage', wPtr, img5)
elseif order(get) == 16
Screen('PutImage', wPtr, img6)
elseif order(get) == 17
Screen('PutImage', wPtr, img6)
elseif order(get) == 18
Screen('PutImage', wPtr, img6)
elseif order(get) == 19
Screen('PutImage', wPtr, img7)
elseif order(get) == 20
Screen('PutImage', wPtr, img7)
elseif order(get) == 21
Screen('PutImage', wPtr, img7)
elseif order(get) == 22
Screen('PutImage', wPtr, img8)
elseif order(get) == 23
Screen('PutImage', wPtr, img8)
elseif order(get) == 24
Screen('PutImage', wPtr, img8)
elseif order(get) == 25
Screen('PutImage', wPtr, img9)
elseif order(get) == 26
Screen('PutImage', wPtr, img9)
elseif order(get) == 27
Screen('PutImage', wPtr, img9)
elseif order(get) == 28
Screen('PutImage', wPtr, img10)
elseif order(get) == 29
Screen('PutImage', wPtr, img10)
elseif order(get) == 30
Screen('PutImage', wPtr, img10)
elseif order(get) == 31
Screen('PutImage', wPtr, img11)
elseif order(get) == 32
Screen('PutImage', wPtr, img11)
elseif order(get) == 33
Screen('PutImage', wPtr, img11)
elseif order(get) == 34
Screen('PutImage', wPtr, img12)
elseif order(get) == 35
Screen('PutImage', wPtr, img12)
elseif order(get) == 36
Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');
fprintf(s, dynamictrigger5);

pause(ISI)
Screen('DrawText', wPtr, 'Did your partner behave fair?', 530, 700, 255)
Screen('DrawText', wPtr, 'Very unfair                                 Very fair', 355, 750, 255)
Screen('DrawText', wPtr, 'You transferred:', 15, 800, 255)
Screen('DrawText', wPtr, num2str(nyt(get)), 225, 800, 255)
Screen('DrawText', wPtr, 'Your partner gets:', 295, 800, 255)
Screen('DrawText', wPtr, num2str(npg), 535, 800, 255)
Screen('DrawText', wPtr, 'Your partner transfers:', 595, 800, 255)
Screen('DrawText', wPtr, num2str(npt), 905, 800, 255)
Screen('DrawText', wPtr, 'You own:', 975, 800, 255)
Screen('DrawText', wPtr, num2str(nyo), 1080, 800, 255)
Screen('DrawText', wPtr, 'Your partner owns:', 1150, 800, 255)
Screen('DrawText', wPtr, num2str(npo), 1385, 800, 255)
if order(get) == 1
    Screen('PutImage', wPtr, img1)
elseif order(get) == 2
    Screen('PutImage', wPtr, img1)
elseif order(get) == 3
    Screen('PutImage', wPtr, img1)
elseif order(get) == 4
    Screen('PutImage', wPtr, img2)
elseif order(get) == 5
    Screen('PutImage', wPtr, img2)
elseif order(get) == 6
    Screen('PutImage', wPtr, img2)
elseif order(get) == 7
    Screen('PutImage', wPtr, img3)
elseif order(get) == 8
    Screen('PutImage', wPtr, img3)
elseif order(get) == 9
    Screen('PutImage', wPtr, img3)
elseif order(get) == 10
    Screen('PutImage', wPtr, img3)
else
    Screen('PutImage', wPtr, img1)
Screen('PutImage', wPtr, img4)
elseif order(get) == 11
Screen('PutImage', wPtr, img4)
elseif order(get) == 12
Screen('PutImage', wPtr, img4)
elseif order(get) == 13
Screen('PutImage', wPtr, img5)
elseif order(get) == 14
Screen('PutImage', wPtr, img5)
elseif order(get) == 15
Screen('PutImage', wPtr, img5)
elseif order(get) == 16
Screen('PutImage', wPtr, img6)
elseif order(get) == 17
Screen('PutImage', wPtr, img6)
elseif order(get) == 18
Screen('PutImage', wPtr, img6)
elseif order(get) == 19
Screen('PutImage', wPtr, img7)
elseif order(get) == 20
Screen('PutImage', wPtr, img7)
elseif order(get) == 21
Screen('PutImage', wPtr, img7)
elseif order(get) == 22
Screen('PutImage', wPtr, img8)
elseif order(get) == 23
Screen('PutImage', wPtr, img8)
elseif order(get) == 24
Screen('PutImage', wPtr, img8)
elseif order(get) == 25
Screen('PutImage', wPtr, img9)
elseif order(get) == 26
Screen('PutImage', wPtr, img9)
elseif order(get) == 27
Screen('PutImage', wPtr, img9)
elseif order(get) == 28
Screen('PutImage', wPtr, img10)
elseif order(get) == 29
Screen('PutImage', wPtr, img10)
elseif order(get) == 30
Screen('PutImage', wPtr, img10)
elseif order(get) == 31
Screen('PutImage', wPtr, img11)
elseif order(get) == 32
Screen('PutImage', wPtr, img11)
elseif order(get) == 33
Screen('PutImage', wPtr, img11)
elseif order(get) == 34
Screen('PutImage', wPtr, img12)
elseif order(get) == 35
Screen('PutImage', wPtr, img12)
elseif order(get) == 36
Screen('PutImage', wPtr, img12)
end
Screen(wPtr, 'Flip');
SetMouse(719, 775, wPtr);
ShowCursor;
starttime = GetSecs();

while 1
[x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
if clicked == 0
    continue;
end

if x >= 549 && x <= 586 && y >= 738 && y <= 763
    fairrate(get) = 10;
    break
elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
    fairrate(get) = 20;
    break
elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
    fairrate(get) = 30;
    break
elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
    fairrate(get) = 40;
    break
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    fairrate(get) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    fairrate(get) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    fairrate(get) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    fairrate(get) = 80;

break

elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    fairrate(get) = 90;
    break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    Screen('CloseAll');
end
dataget = dataget + 1;

HideCursor;
mu = 90;
get = get + 1;

end

Screen('DrawText', wPtr, 'You will now be asked how fair you thought each partner was overall, and how fair you were to them overall.', 15, 400, 255)
Screen('DrawText', wPtr, 'You will only be shown one image of each partner, and we will do this one partner at a time.', 15, 450, 255)
Screen('DrawText', wPtr, 'There are no right or wrong answers.', 15, 500, 255)
Screen('DrawText', wPtr, '< press the space bar when you are ready to continue >', 15, 550, 255)
Screen(wPtr, 'Flip');

pause(2)
while 1

[keyIsDown secs keycodes] = KbCheck();

if keycodes(kc_space)
    break

elseif keycodes(kc_esc)
    fclose(s);
    ShowCursor;
    Screen('CloseAll');
end
end

for i = 1:overallratestim
    Screen('PutImage', wPtr, imgfix)
    Screen(wPtr, 'Flip');
    pause(ISI);
    if overallrateorder(get2) == 1
        dynamictrigger7 = 'DK';
        dynamictrigger8 = 'DL';
        Screen('PutImage', wPtr, img2)
        Screen(wPtr, 'Flip');
        fprintf(s, 'DG');
    elseif overallrateorder(get2) == 2
        dynamictrigger7 = 'DM';
        dynamictrigger8 = 'DN';
        Screen('PutImage', wPtr, img5)
        Screen(wPtr, 'Flip');
        fprintf(s, 'DH');
    elseif overallrateorder(get2) == 3
        Screen('PutImage', wPtr, img8)
        Screen(wPtr, 'Flip');
        fprintf(s, 'DH');
    end
end
dynamictrigger7 = 'DO';
dynamictrigger8 = 'DP';
Screen('PutImage', wPtr, img8)
Screen(wPtr, 'Flip');
fprintf(s, 'DI');
elseif overallrateorder(get2) == 4
    dynamictrigger7 = 'DQ';
dynamictrigger8 = 'DR';
Screen('PutImage', wPtr, img11)
Screen(wPtr, 'Flip');
fprintf(s, 'DJ');
end
pause(ISI)
if overallrateorder(get2) == 1
    Screen('PutImage', wPtr, img2)
elseif overallrateorder(get2) == 2
    Screen('PutImage', wPtr, img5)
elseif overallrateorder(get2) == 3
    Screen('PutImage', wPtr, img8)
elseif overallrateorder(get2) == 4
    Screen('PutImage', wPtr, img11)
end
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Overall, how fair do you think this partner was?

Very unfair                                 Very fair

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >= 738 && y <= 763
        fairrate(get) = 10;
        break
    elseif x >= 587 && x <= 624 && y >= 738 && y <= 763
        fairrate(get) = 20;
        break
    elseif x >= 625 && x <= 662 && y >= 738 && y <= 763
        fairrate(get) = 30;
        break
    elseif x >= 663 && x <= 700 && y >= 738 && y <= 763
        fairrate(get) = 40;
        break
    elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
        fairrate(get) = 50;
        break
    elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
        fairrate(get) = 60;
        break
    elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
        fairrate(get) = 70;
        break
    end
fairrate(get) = 40;
break

elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
fairrate(get) = 50;
break

elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
fairrate(get) = 60;
break

elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
fairrate(get) = 70;
break

elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
fairrate(get) = 80;
break

elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
fairrate(get) = 90;
break

elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
fclose(s);
Screen('CloseAll');
end
end

fprintf(s, dynamictrigger7)

RT(dataget) = GetSecs - starttime;
dataget = dataget + 1;
HideCursor;

if overallrateorder(get2) == 1
    Screen('PutImage', wPtr, img2)
elseif overallrateorder(get2) == 2
  Screen('PutImage', wPtr, img5)
elseif overallrateorder(get2) == 3
  Screen('PutImage', wPtr, img8)
elseif overallrateorder(get2) == 4
  Screen('PutImage', wPtr, img11)
end
Screen(wPtr, 'Flip');

pause(0.5)
get = get + 1;
SetMouse(719, 775, wPtr);
ShowCursor;
if overallrateorder(get2) == 1
  Screen('PutImage', wPtr, img2)
elseif overallrateorder(get2) == 2
  Screen('PutImage', wPtr, img5)
elseif overallrateorder(get2) == 3
  Screen('PutImage', wPtr, img8)
elseif overallrateorder(get2) == 4
  Screen('PutImage', wPtr, img11)
end
Screen('PutImage', wPtr, imgp10, [549 738 586 763])
Screen('PutImage', wPtr, imgp20, [587 738 624 763])
Screen('PutImage', wPtr, imgp30, [625 738 662 763])
Screen('PutImage', wPtr, imgp40, [663 738 700 763])
Screen('PutImage', wPtr, imgp50, [701 738 738 763])
Screen('PutImage', wPtr, imgp60, [739 738 776 763])
Screen('PutImage', wPtr, imgp70, [777 738 814 763])
Screen('PutImage', wPtr, imgp80, [815 738 852 763])
Screen('PutImage', wPtr, imgp90, [853 738 890 763])
Screen('DrawText', wPtr, 'How fair do you think you were to this partner?', 305, 700, 255)
Screen('DrawText', wPtr, 'Very unfair                                 Very fair', 355, 750, 255)
Screen(wPtr, 'Flip');

starttime = GetSecs();

while 1
    [x,y,buttons,focus,valuators,valinfo] = GetMouse(wPtr);

    % Sum everything in the 1st row, from item 1-length
    % If it is greater than zero, then one of them was one, and thus the
    % mouse was pressed...
    clicked = sum( buttons( 1:length( buttons( 1 ) ), 1 ) );
    if clicked == 0
        continue;
    end

    if x >= 549 && x <= 586 && y >=738 && y <= 763
        fairrate(get) = 10;
        break
    elseif x >= 587 && x <= 624 && y >=738 && y <= 763
        fairrate(get) = 20;
        break
    elseif x >= 625 && x <= 662 && y >=738 && y <= 763
        fairrate(get) = 30;
        break
    elseif x >= 663 && x <= 700 && y >=738 && y <= 763
        fairrate(get) = 40;
        break
    end
elseif x >= 701 && x <= 738 && y >= 738 && y <= 763
    fairrate(get) = 50;
    break
elseif x >= 739 && x <= 776 && y >= 738 && y <= 763
    fairrate(get) = 60;
    break
elseif x >= 777 && x <= 814 && y >= 738 && y <= 763
    fairrate(get) = 70;
    break
elseif x >= 815 && x <= 852 && y >= 738 && y <= 763
    fairrate(get) = 80;
    break
elseif x >= 853 && x <= 890 && y >= 738 && y <= 763
    fairrate(get) = 90;
    break
elseif x >= 1340 && x <= 1440 && y >= 0 && y <= 100
    fclose(s);
    ShowCursor;
    Screen('CloseAll');
end
end
fprintf(s, dynamictrigger8)
RT(dataget) = GetSecs - starttime;
dataget = dataget + 1;
HideCursor;
get = get + 1;
get2 = get2 + 1;
end
Screen('DrawText', wPtr, 'Thankyou! Please wait for the task to close.', 400, 450, 255)
Screen(wPtr, 'Flip');
get = 1;
pause(ISI)

logfile = sprintf('%s_trusttask.txt', num2str(pt));

% Operations status
fprintf('A log of this session will be saved to %s\n', logfile);
% Set file variable name and open/create file
fid = fopen(logfile, 'a');
if fid < 1
    error('Could not open logfile!');
end
% save results
fprintf(fid, 'Date of session\n')
fprintf(fid, '%d ', sessiontime(3));
fprintf(fid, '%d ', sessiontime(2));
fprintf(fid, '%d ', sessiontime(1));
fprintf(fid, '
');
fprintf(fid, 'Time of session
')
fprintf(fid, '%d ', sessiontime(4));
fprintf(fid, '%d ', sessiontime(5));
fprintf(fid, '
');
fprintf(fid, 'Participant number
')
fprintf(fid, '%d', pt);
fprintf(fid, '
');
fprintf(fid, 'Image set used
')
fprintf(fid, 'Task presentation order\n');
for i = 1:stim
    fprintf(fid, ' %d', order(get));
    fprintf(fid, '\n');
    get = get + 1;
end
get = 1;
fprintf(fid, 'Overall rate presentation order\n');
for i = 1:4
    fprintf(fid, ' %d', overallrateorder(get));
    fprintf(fid, '\n');
    get = get + 1;
end
get = 1;
fprintf(fid, 'Number participant transferred\n');
for i = 1:stim
    fprintf(fid, ' %d', nyt(get));
    fprintf(fid, '\n');
    get = get + 1;
end
get = 1;
fprintf(fid, 'Consecutive fairness ratings\n');
for i = 1:stim
    fprintf(fid, ' %d', fairrate(get));
    fprintf(fid, '\n');
    get = get + 1;
end
get = 1;
fprintf(fid, 'Overall fairness ratings\n');
for i = 1:overallratestim*2
    fprintf(fid, '%d\n', fairrate(get));
    fprintf(fid, '\n');
    get = get + 1;
end

get = 1;
 fprintf(fid, 'RT\n');

for i = 1:80
    fprintf(fid, '%d\n', RT(get));
    fprintf(fid, '\n');
    get = get + 1;
end

get = 1;
 fprintf(fid, 'rest time\n');

for i = 1:stim
    fprintf(fid, '%d\n', rest(get));
    fprintf(fid, '\n');
    get = get + 1;
end

fprintf(fid, 'Overall score\n');
 fprintf(fid, '%d\n', overallscore);
 fprintf(fid, '\n');

% Close file
 fclose(fid);
% close serial port
fclose(s);

% Show cursor
ShowCursor;

%Close Screen/task
Screen('CloseAll');

% NOTE FOR RESULT DATA: COPY AND PASTE FROM THE .TXT TO EXCEL.
Appendix B. Task analysis programming

B.1 Trust task analysis code

% data is the variable name that holds the data from the trust task:
% column 1 = order of presentation
% column 2 = transferred amount
% column 3 = reaction time of transferred amount
% column 4 = cumulative fairness ratings
% column 5 = reaction time of fairness rating
% column 6 = overall order presentation
% column 7 = overall fairness ratings
% column 8 = reaction time for overall fairness ratings

% condition count vars
p1h = 0;
p4h = 0;
p1a = 0;
p4a = 0;
p1n = 0;
p4n = 0;

Tp2 = 0;
Tp3 = 0;

% imputation vars and ANCOVA calcs
p1_1h = 0;
ToM_hostility_trans = 0;
ToM_hostility_fair = 0;
nToM_hostility_trans = 0;
nToM_hostility_fair = 0;
Overallscore_emotions = 0;
Overallscore_non_emotions = 0;
Sup_emotions_score = 0;
ovr_calc_tool = 0;

count123 = 0;
count789 = 0;
count282930 = 0;
count343536 = 0;
count456 = 0;
count313233 = 0;
hstart = 0;
astart = 0;
nstart = 0;

g = 1;

% before data extraction, go into the data and work out which partner is
% randomised to present their happy, neutral and angry faces twice,
% first. Whichever one presents their images (for each of h, n, and a)
% twice first, the data from those images are placed in the 'first half'
% of the task analyses.

for i = 1:36
data(get, 1)
if ans == 1 || ans == 2 || ans == 3
    count123 = count123 + 1;
elseif ans == 28 || ans == 29 || ans == 30
    count282930 = count282930 + 1;
end
if count123 == 2
    hstart = 1;
    break
elseif count282930 == 2
    hstart = 2;
    break
end
get = get + 1;
end
get = 1;

for i = 1:36
    data(get, 1)
    if ans == 7 || ans == 8 || ans == 9
        count789 = count789 + 1;
    elseif ans == 34 || ans == 35 || ans == 36
        count343536 = count343536 + 1;
    end
    if count789 == 2
        astart = 1;
        break
    elseif count343536 == 2
        astart = 2;
        break
    end
end
astart = 2;
break
end
get = get + 1;
end

get = 1;
for i = 1:36
data(get, 1)
    if ans == 4 || ans == 5 || ans == 6
        count456 = count456 + 1;
    elseif ans == 31 || ans == 32 || ans == 33
        count313233 = count313233 + 1;
    end

    if count456 == 2
        nstart = 1;
        break
    elseif count313233 == 2
        nstart = 2;
        break
    end
    get = get + 1;
end

get = 1;

% data extraction from the raw data for happy, neutral and angry
% presentations (ToM), as well as partners without emotions (nToM)
for i = 1:36
    data(get, 1)

%ToM_calcs
if ans == 1 || ans == 2 || ans == 3
    p1h = p1h + 1;

if hstart == 1
    if p1h == 3
        p1_2h(1, 1) = p1_2h(1, 1) + 1;
        p1_2h(1, (length(p1_2h) + 1)) = data(get, 2);
        p1_2h(1, (length(p1_2h) + 1)) = data(get, 3);
        p1_2h(1, (length(p1_2h) + 1)) = data(get, 4);
        p1_2h(1, (length(p1_2h) + 1)) = data(get, 5);
    else
        p1_1h(1, 1) = p1_1h(1, 1) + 1;
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 2);
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 3);
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 4);
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 5);
        ToM_hostility_trans = ToM_hostility_trans + data(get, 2);
        ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
    end
elseif hstart == 2
    if p1h == 1
        p1_1h(1, 1) = p1_1h(1, 1) + 1;
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 2);
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 3);
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 4);
        p1_1h(1, (length(p1_1h) + 1)) = data(get, 5);
    end
end
p1_1h(1, (length(p1_1h) + 1)) = data(get, 5);
ToM_hostility_trans = ToM_hostility_trans + data(get, 2);
ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
else
  p1_2h(1, 1) = p1_2h(1, 1) + 1;
p1_2h(1, (length(p1_2h) + 1)) = data(get, 2);
p1_2h(1, (length(p1_2h) + 1)) = data(get, 3);
p1_2h(1, (length(p1_2h) + 1)) = data(get, 4);
p1_2h(1, (length(p1_2h) + 1)) = data(get, 5);
end
end

elseif ans == 4 || ans == 5 || ans == 6
  p1n = p1n + 1;

if nstart == 1
  if p1n == 3
    p1_2n(1, (length(p1_2n) + 1)) = data(get, 2);
p1_2n(1, (length(p1_2n) + 1)) = data(get, 3);
p1_2n(1, (length(p1_2n) + 1)) = data(get, 4);
p1_2n(1, (length(p1_2n) + 1)) = data(get, 5);
  else
    p1_1n(1, (length(p1_1n) + 1)) = data(get, 2);
p1_1n(1, (length(p1_1n) + 1)) = data(get, 3);
p1_1n(1, (length(p1_1n) + 1)) = data(get, 4);
p1_1n(1, (length(p1_1n) + 1)) = data(get, 5);
  end
endif nstart == 2
  if p1n == 1
    p1_1n(1, (length(p1_1n) + 1)) = data(get, 2);
  end
endif
p1_1n(1, (length(p1_1n) + 1)) = data(get, 3);
p1_1n(1, (length(p1_1n) + 1)) = data(get, 4);
p1_1n(1, (length(p1_1n) + 1)) = data(get, 5);
else
    p1_2n(1, (length(p1_2n) + 1)) = data(get, 2);
p1_2n(1, (length(p1_2n) + 1)) = data(get, 3);
p1_2n(1, (length(p1_2n) + 1)) = data(get, 4);
p1_2n(1, (length(p1_2n) + 1)) = data(get, 5);
end
end

elseif ans == 7 || ans == 8 || ans == 9
    p1a = p1a + 1;

    if astart == 1
        if p1a == 3
            p1_2a(1, 1) = p1_2a(1, 1) - 1;
p1_2a(1, (length(p1_2a) + 1)) = (data(get, 2) - 100)* -1;
p1_2a(1, (length(p1_2a) + 1)) = data(get, 3);
p1_2a(1, (length(p1_2a) + 1)) = (data(get, 4) - 100)* -1;
p1_2a(1, (length(p1_2a) + 1)) = data(get, 5);
        else
            p1_1a(1, 1) = p1_1a(1, 1) - 1;
p1_1a(1, (length(p1_1a) + 1)) = (data(get, 2) - 100)* -1;
p1_1a(1, (length(p1_1a) + 1)) = data(get, 3);
p1_1a(1, (length(p1_1a) + 1)) = (data(get, 4) - 100)* -1;
p1_1a(1, (length(p1_1a) + 1)) = data(get, 5);
            ToM_hostility_trans = ToM_hostility_trans + data(get, 2);

            376
ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
end

elseif astart == 2
    if p1a == 1
        p1_1a(1, 1) = p1_1a(1, 1) - 1;
p1_1a(1, (length(p1_1a) + 1)) = (data(get, 2) - 100)* -1;
p1_1a(1, (length(p1_1a) + 1)) = data(get, 3);
p1_1a(1, (length(p1_1a) + 1)) = (data(get, 4) - 100)* -1;
p1_1a(1, (length(p1_1a) + 1)) = data(get, 5);
        ToM_hostility_trans = ToM_hostility_trans + data(get, 2);
        ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
    else
        p1_2a(1, 1) = p1_2a(1, 1) - 1;
p1_2a(1, (length(p1_2a) + 1)) = (data(get, 2) - 100)* -1;
p1_2a(1, (length(p1_2a) + 1)) = data(get, 3);
p1_2a(1, (length(p1_2a) + 1)) = (data(get, 4) - 100)* -1;
p1_2a(1, (length(p1_2a) + 1)) = data(get, 5);
    end
end

elseif ans == 28 || ans == 29 || ans == 30
    p4h = p4h + 1;

if hstart == 1
    if p4h == 1
        p4_1h(1, 1) = p4_1h(1, 1) + 1;
p4_1h(1, (length(p4_1h) + 1)) = data(get, 2);
p4_1h(1, (length(p4_1h) + 1)) = data(get, 3);
p4_1h(1, (length(p4_1h) + 1)) = data(get, 4);
p4_1h(1, (length(p4_1h) + 1)) = data(get, 5);
ToM_hostility_trans = ToM_hostility_trans + data(get, 2);
ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
else
p4_2h(1, 1) = p4_2h(1, 1) + 1;
p4_2h(1, (length(p4_2h) + 1)) = data(get, 2);
p4_2h(1, (length(p4_2h) + 1)) = data(get, 3);
p4_2h(1, (length(p4_2h) + 1)) = data(get, 4);
p4_2h(1, (length(p4_2h) + 1)) = data(get, 5);
end

elseif hstart == 2
if p4h == 3
p4_2h(1, 1) = p4_2h(1, 1) + 1;
p4_2h(1, (length(p4_2h) + 1)) = data(get, 2);
p4_2h(1, (length(p4_2h) + 1)) = data(get, 3);
p4_2h(1, (length(p4_2h) + 1)) = data(get, 4);
p4_2h(1, (length(p4_2h) + 1)) = data(get, 5);
else
p4_1h(1, 1) = p4_1h(1, 1) + 1;
p4_1h(1, (length(p4_1h) + 1)) = data(get, 2);
p4_1h(1, (length(p4_1h) + 1)) = data(get, 3);
p4_1h(1, (length(p4_1h) + 1)) = data(get, 4);
p4_1h(1, (length(p4_1h) + 1)) = data(get, 5);
ToM_hostility_trans = ToM_hostility_trans + data(get, 2);
ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
end
end
```matlab
elseif ans == 31 || ans == 32 || ans == 33
p4n = p4n + 1;

if nstart == 1
    if p4n == 1
        p4_1n(1, (length(p4_1n) + 1)) = data(get, 2);
p4_1n(1, (length(p4_1n) + 1)) = data(get, 3);
p4_1n(1, (length(p4_1n) + 1)) = data(get, 4);
p4_1n(1, (length(p4_1n) + 1)) = data(get, 5);
    else
        p4_2n(1, (length(p4_2n) + 1)) = data(get, 2);
p4_2n(1, (length(p4_2n) + 1)) = data(get, 3);
p4_2n(1, (length(p4_2n) + 1)) = data(get, 4);
p4_2n(1, (length(p4_2n) + 1)) = data(get, 5);
    end
elseif nstart == 2
    if p4n == 3
        p4_2n(1, (length(p4_2n) + 1)) = data(get, 2);
p4_2n(1, (length(p4_2n) + 1)) = data(get, 3);
p4_2n(1, (length(p4_2n) + 1)) = data(get, 4);
p4_2n(1, (length(p4_2n) + 1)) = data(get, 5);
    else
        p4_1n(1, (length(p4_1n) + 1)) = data(get, 2);
p4_1n(1, (length(p4_1n) + 1)) = data(get, 3);
p4_1n(1, (length(p4_1n) + 1)) = data(get, 4);
p4_1n(1, (length(p4_1n) + 1)) = data(get, 5);
    end
end
```
elseif ans == 34 || ans == 35 || ans == 36
    p4a = p4a + 1;

if astart == 1
    if p4a == 1
        p4_1a(1, 1) = p4_1a(1, 1) - 1;
        p4_1a(1, (length(p4_1a) + 1)) = (data(get, 2) - 100)* -1;
        p4_1a(1, (length(p4_1a) + 1)) = data(get, 3);
        p4_1a(1, (length(p4_1a) + 1)) = (data(get, 4) - 100)* -1;
        p4_1a(1, (length(p4_1a) + 1)) = data(get, 5);
        ToM_hostility_trans = ToM_hostility_trans + data(get, 2);
        ToM_hostility_fair = ToM_hostility_fair + data(get, 4);
    else
        p4_2a(1, 1) = p4_2a(1, 1) - 1;
        p4_2a(1, (length(p4_2a) + 1)) = (data(get, 2) - 100)* -1;
        p4_2a(1, (length(p4_2a) + 1)) = data(get, 3);
        p4_2a(1, (length(p4_2a) + 1)) = (data(get, 4) - 100)* -1;
        p4_2a(1, (length(p4_2a) + 1)) = data(get, 5);
        end
    elseif astart == 2
        if p4a == 3
            p4_2a(1, 1) = p4_2a(1, 1) - 1;
            p4_2a(1, (length(p4_2a) + 1)) = (data(get, 2) - 100)* -1;
            p4_2a(1, (length(p4_2a) + 1)) = data(get, 3);
            p4_2a(1, (length(p4_2a) + 1)) = (data(get, 4) - 100)* -1;
            p4_2a(1, (length(p4_2a) + 1)) = data(get, 5);
            end
    end
p4_2a(1, (length(p4_2a) + 1)) = data(get, 3);
p4_2a(1, (length(p4_2a) + 1)) = (data(get, 4) - 100)* -1;
p4_2a(1, (length(p4_2a) + 1)) = data(get, 5);
else
    p4_1a(1, 1) = p4_1a(1, 1) - 1;
p4_1a(1, (length(p4_1a) + 1)) = (data(get, 2) - 100)* -1;
p4_1a(1, (length(p4_1a) + 1)) = data(get, 3);
p4_1a(1, (length(p4_1a) + 1)) = (data(get, 4) - 100)* -1;
p4_1a(1, (length(p4_1a) + 1)) = data(get, 5);
end
end

elseif ans == 10 || ans == 11 || ans == 12
    Tp2 = Tp2 + 1;
    if Tp2 <= 4
        p2_1h(1, 1) = p2_1h(1, 1) + 1;
p2_1h(1, (length(p2_1h) + 1)) = data(get, 2);
p2_1h(1, (length(p2_1h) + 1)) = data(get, 3);
p2_1h(1, (length(p2_1h) + 1)) = data(get, 4);
p2_1h(1, (length(p2_1h) + 1)) = data(get, 5);
        nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
    end
    end

% nToM ANCOVA calcs

eelseif ans == 10 || ans == 11 || ans == 12
    Tp2 = Tp2 + 1;
    if Tp2 <= 4
        p2_1h(1, 1) = p2_1h(1, 1) + 1;
p2_1h(1, (length(p2_1h) + 1)) = data(get, 2);
p2_1h(1, (length(p2_1h) + 1)) = data(get, 3);
p2_1h(1, (length(p2_1h) + 1)) = data(get, 4);
p2_1h(1, (length(p2_1h) + 1)) = data(get, 5);
        nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
nToM_hostility_fair = nToM_hostility_fair + data(get, 4);

elseif Tp2 >= 6
    p2_2h(1, 1) = p2_2h(1, 1) + 1;
p2_2h(1, (length(p2_2h) + 1)) = data(get, 2);
p2_2h(1, (length(p2_2h) + 1)) = data(get, 3);
p2_2h(1, (length(p2_2h) + 1)) = data(get, 4);
p2_2h(1, (length(p2_2h) + 1)) = data(get, 5);
end

elseif ans == 16 || ans == 17 || ans == 18
    Tp2 = Tp2 + 1;
    if Tp2 <= 4
        p2_1l(1, 1) = p2_1l(1, 1) - 1;
p2_1l(1, (length(p2_1l) + 1)) = data(get, 2);
p2_1l(1, (length(p2_1l) + 1)) = data(get, 3);
p2_1l(1, (length(p2_1l) + 1)) = data(get, 4);
p2_1l(1, (length(p2_1l) + 1)) = data(get, 5);
        nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
        nToM_hostility_fair = nToM_hostility_fair + data(get, 4);
    elseif Tp2 >= 6
        p2_2l(1, 1) = p2_2l(1, 1) - 1;
p2_2l(1, (length(p2_2l) + 1)) = data(get, 2);
p2_2l(1, (length(p2_2l) + 1)) = data(get, 3);
p2_2l(1, (length(p2_2l) + 1)) = data(get, 4);
p2_2l(1, (length(p2_2l) + 1)) = data(get, 5);
    end

382
elseif ans == 13 || ans == 14 || ans == 15
Tp2 = Tp2 + 1;
if Tp2 <= 4
   p2_1m(1, (length(p2_1m) + 1)) = data(get, 2);
p2_1m(1, (length(p2_1m) + 1)) = data(get, 3);
p2_1m(1, (length(p2_1m) + 1)) = data(get, 4);
p2_1m(1, (length(p2_1m) + 1)) = data(get, 5);
nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
nToM_hostility_fair = nToM_hostility_fair + data(get, 4);
elseif Tp2 >= 6
   p2_2m(1, (length(p2_2m) + 1)) = data(get, 2);
p2_2m(1, (length(p2_2m) + 1)) = data(get, 3);
p2_2m(1, (length(p2_2m) + 1)) = data(get, 4);
p2_2m(1, (length(p2_2m) + 1)) = data(get, 5);
end

elseif ans == 19 || ans == 20 || ans == 21
Tp3 = Tp3 + 1;
if Tp3 <= 4
   p3_1h(1, 1) = p3_1h(1, 1) - 1;
p3_1h(1, (length(p3_1h) + 1)) = data(get, 2);
p3_1h(1, (length(p3_1h) + 1)) = data(get, 3);
p3_1h(1, (length(p3_1h) + 1)) = data(get, 4);
p3_1h(1, (length(p3_1h) + 1)) = data(get, 5);
nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
nToM_hostility_fair = nToM_hostility_fair + data(get, 4);
elseif Tp3 >= 6
end
p3_2h(1, 1) = p3_2h(1, 1) - 1;
p3_2h(1, (length(p3_2h) + 1)) = data(get, 2);
p3_2h(1, (length(p3_2h) + 1)) = data(get, 3);
p3_2h(1, (length(p3_2h) + 1)) = data(get, 4);
p3_2h(1, (length(p3_2h) + 1)) = data(get, 5);
end

elseif ans == 22 || ans == 23 || ans == 24
    Tp3 = Tp3 + 1;
    if Tp3 <= 4
        p3_1m(1, (length(p3_1m) + 1)) = data(get, 2);
p3_1m(1, (length(p3_1m) + 1)) = data(get, 3);
p3_1m(1, (length(p3_1m) + 1)) = data(get, 4);
p3_1m(1, (length(p3_1m) + 1)) = data(get, 5);
        nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
        nToM_hostility_fair = nToM_hostility_fair + data(get, 4);
    elseif Tp3 >= 6
        p3_2m(1, (length(p3_2m) + 1)) = data(get, 2);
p3_2m(1, (length(p3_2m) + 1)) = data(get, 3);
p3_2m(1, (length(p3_2m) + 1)) = data(get, 4);
p3_2m(1, (length(p3_2m) + 1)) = data(get, 5);
    end

elseif ans == 25 || ans == 26 || ans == 27

Tp3 =Tp3+1;
if Tp3 <= 4
p3_1l(1, 1) = p3_1l(1, 1) + 1;
p3_1l(1, (length(p3_1l) + 1)) = data(get, 2);
p3_1l(1, (length(p3_1l) + 1)) = data(get, 3);
p3_1l(1, (length(p3_1l) + 1)) = data(get, 4);
p3_1l(1, (length(p3_1l) + 1)) = data(get, 5);
end
nToM_hostility_trans = nToM_hostility_trans + data(get, 2);
nToM_hostility_fair = nToM_hostility_fair + data(get, 4);
elseif Tp3 >= 6
p3_2l(1, 1) = p3_2l(1, 1) + 1;
p3_2l(1, (length(p3_2l) + 1)) = data(get, 2);
p3_2l(1, (length(p3_2l) + 1)) = data(get, 3);
p3_2l(1, (length(p3_2l) + 1)) = data(get, 4);
p3_2l(1, (length(p3_2l) + 1)) = data(get, 5);
end
end

ovr_calc_tool = 90 - data(get, 2);

if ans == 1
Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.66) + ovr_calc_tool;
elseif ans == 2
Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.5975) + ovr_calc_tool;
elseif ans == 3
Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.535) + ovr_calc_tool;
elseif ans == 4
Sup_emotions_score = Sup_emotions_score + round((data(get, 2)*3)*0.4725) + ovr_calc_tool;
elseif ans == 5
    Sup_emotions_score = Sup_emotions_score + round((data(get, 2)*3)*0.41) + ovr_calc_tool;
elseif ans == 6
    Sup_emotions_score = Sup_emotions_score + round((data(get, 2)*3)*0.3475) + ovr_calc_tool;
elseif ans == 7
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.285) + ovr_calc_tool;
elseif ans == 8
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.2225) + ovr_calc_tool;
elseif ans == 9
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.16) + ovr_calc_tool;
elseif ans == 28
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.50) + ovr_calc_tool;
elseif ans == 29
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.4375) + ovr_calc_tool;
elseif ans == 30
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.375) + ovr_calc_tool;
elseif ans == 31
    Sup_emotions_score = Sup_emotions_score + round((data(get, 2)*3)*0.3125) + ovr_calc_tool;
elseif ans == 32
    Sup_emotions_score = Sup_emotions_score + round((data(get, 2)*3)*0.25) + ovr_calc_tool;
elseif ans == 33
    Sup_emotions_score = Sup_emotions_score + round((data(get, 2)*3)*0.1875) + ovr_calc_tool;
elseif ans == 34
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.125) + ovr_calc_tool;
elseif ans == 35
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0.0625) + ovr_calc_tool;
elseif ans == 36
    Overallscore_emotions = Overallscore_emotions + round((data(get, 2)*3)*0) + ovr_calc_tool;
elseif ans == 10

Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.66) + ovr_calc_tool);
elseif ans == 11
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.5975) + ovr_calc_tool;
elseif ans == 12
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.535) + ovr_calc_tool;
elseif ans == 13
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.4725) + ovr_calc_tool;
elseif ans == 14
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.41) + ovr_calc_tool;
elseif ans == 15
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.3475) + ovr_calc_tool;
elseif ans == 16
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.285) + ovr_calc_tool;
elseif ans == 17
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.2225) + ovr_calc_tool;
elseif ans == 18
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.16) + ovr_calc_tool;
elseif ans == 19
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.5) + ovr_calc_tool;
elseif ans == 20
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.4375) + ovr_calc_tool;
elseif ans == 21
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.375) + ovr_calc_tool;
elseif ans == 22
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.3125) + ovr_calc_tool;
elseif ans == 23
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.25) + ovr_calc_tool;
elseif ans == 24
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.1875) + ovr_calc_tool;
elseif ans == 25
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.125) + ovr_calc_tool;
elseif ans == 26
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.0625) + ovr_calc_tool;
elseif ans == 27
    Overallscore_non_emotions = Overallscore_non_emotions + round((data(get, 2)*3)*0.0) + ovr_calc_tool;
end

if Tp2 == 5
    Tp2 = Tp2 + 1;
    data(get, 1)
    if ans == 10 || ans == 11 || ans == 12
        p2_5th_ANCOVA = 1;
    elseif ans == 13 || ans == 14 || ans == 15
        p2_5th_ANCOVA = 0;
    elseif ans == 16 || ans == 17 || ans == 18
        p2_5th_ANCOVA = -1;
    end
elseif Tp3 == 5
    Tp3 = Tp3 + 1;

data(get, 1)
    if ans == 19 || ans == 20 || ans == 21
        p3_5th_ANCOVA = -1;
    elseif ans == 22 || ans == 23 || ans == 24
        p3_5th_ANCOVA = 0;
    elseif ans == 25 || ans == 26 || ans == 27
        p3_5th_ANCOVA = 1;
    end
end
get = get + 1;
end

%Final variable preparation for variables that have an odd amount of data

%ToM

p1_1a((length(p1_1a) + 1): (length(p1_1a) + 4)) = 0;
p1_1h((length(p1_1h) + 1): (length(p1_1h) + 4)) = 0;
p4_1a((length(p4_1a) + 1): (length(p4_1a) + 4)) = 0;
p4_1h((length(p4_1h) + 1): (length(p4_1h) + 4)) = 0;
p1_2a((length(p1_2a) + 1): (length(p1_2a) + 4)) = 0;
p1_2h((length(p1_2h) + 1): (length(p1_2h) + 4)) = 0;
p4_2a((length(p4_2a) + 1): (length(p4_2a) + 4)) = 0;
p4_2h((length(p4_2h) + 1): (length(p4_2h) + 4)) = 0;
\[ p_{1\_n}((\text{length}(p_{1\_n}) + 1): (\text{length}(p_{1\_n}) + 4)) = 0; \]
\[ p_{1\_n}((\text{length}(p_{1\_n}) + 1): (\text{length}(p_{1\_n}) + 4)) = 0; \]
\[ p_{4\_n}((\text{length}(p_{4\_n}) + 1): (\text{length}(p_{4\_n}) + 4)) = 0; \]
\[ p_{4\_n}((\text{length}(p_{4\_n}) + 1): (\text{length}(p_{4\_n}) + 4)) = 0; \]

\% nToM

\[ p_{2\_l}((\text{length}(p_{2\_l}) + 1): (\text{length}(p_{2\_l}) + 12)) = 0; \]
\[ p_{2\_h}((\text{length}(p_{2\_h}) + 1): (\text{length}(p_{2\_h}) + 12)) = 0; \]
\[ p_{3\_l}((\text{length}(p_{3\_l}) + 1): (\text{length}(p_{3\_l}) + 12)) = 0; \]
\[ p_{3\_h}((\text{length}(p_{3\_h}) + 1): (\text{length}(p_{3\_h}) + 12)) = 0; \]
\[ p_{2\_l}((\text{length}(p_{2\_l}) + 1): (\text{length}(p_{2\_l}) + 12)) = 0; \]
\[ p_{2\_h}((\text{length}(p_{2\_h}) + 1): (\text{length}(p_{2\_h}) + 12)) = 0; \]
\[ p_{3\_l}((\text{length}(p_{3\_l}) + 1): (\text{length}(p_{3\_l}) + 12)) = 0; \]
\[ p_{3\_h}((\text{length}(p_{3\_h}) + 1): (\text{length}(p_{3\_h}) + 12)) = 0; \]

\%Final variable Computations

\%ToM (emotional cue ToM's)

\[ \text{ToM\_trdec} = (p_{1\_a}(2) + p_{1\_a}(6) + p_{1\_h}(2) + p_{1\_h}(6) + p_{4\_a}(2) + p_{4\_a}(6) + p_{4\_h}(2) + p_{4\_h}(6))/6; \]
ToM1_trdec_RT = (p1_1a(3) + p1_1a(7) + p1_1h(3) + p1_1h(7) + p4_1a(3) + p4_1a(7) + p4_1h(3) + p4_1h(7))/6;
ToM1_fadec = (p1_1a(4) + p1_1a(8) + p1_1h(4) + p1_1h(8) + p4_1a(4) + p4_1a(8) + p4_1h(4) + p4_1h(8))/6;
ToM1_fadec_RT = (p1_1a(5) + p1_1a(9) + p1_1h(5) + p1_1h(9) + p4_1a(5) + p4_1a(9) + p4_1h(5) + p4_1h(9))/6;
ToM2_trdec = (p1_2a(2) + p1_2a(6) + p1_2h(2) + p1_2h(6) + p4_2a(2) + p4_2a(6) + p4_2h(2) + p4_2h(6))/6;
ToM2_trdec_RT = (p1_2a(3) + p1_2a(7) + p1_2h(3) + p1_2h(7) + p4_2a(3) + p4_2a(7) + p4_2h(3) + p4_2h(7))/6;
ToM2_fadec = (p1_2a(4) + p1_2a(8) + p1_2h(4) + p1_2h(8) + p4_2a(4) + p4_2a(8) + p4_2h(4) + p4_2h(8))/6;
ToM2_fadec_RT = (p1_2a(5) + p1_2a(9) + p1_2h(5) + p1_2h(9) + p4_2a(5) + p4_2a(9) + p4_2h(5) + p4_2h(9))/6;

ToM_trdec_sub = ToM2_trdec - ToM1_trdec;
ToM_trdec_RT_sub = ToM2_trdec_RT - ToM1_trdec_RT;
ToM_fadec_sub = ToM2_fadec - ToM1_fadec;
ToM_fadec_RT_sub = ToM2_fadec_RT - ToM1_fadec_RT;

ToM_trdec_ratio = ToM2_trdec/ToM1_trdec;
ToM_trdec_RT_ratio = ToM2_trdec_RT/ToM1_trdec_RT;
ToM_fadec_ratio = ToM2_fadec/ToM1_fadec;
ToM_fadec_RT_ratio = ToM2_fadec_RT/ToM1_fadec_RT;

ToM_hostility_trans = ToM_hostility_trans/6;
ToM_hostility_fair = ToM_hostility_fair/6;

%cTOM (comparison to emotional cue ToM's)
cToM1_trdec = (p1_1n(2) + p1_1n(6) + p4_1n(2) + p4_1n(6))/3;
cToM1_trdec_RT = (p1_1n(3) + p1_1n(7) + p4_1n(3) + p4_1n(7))/3;
cToM1_fadec = (p1_1n(4) + p1_1n(8) + p4_1n(4) + p4_1n(8))/3;
cToM1_fadec_RT = (p1_1n(5) + p1_1n(9) + p4_1n(5) + p4_1n(9))/3;

cToM2_trdec = (p1_2n(2) + p1_2n(6) + p4_2n(2) + p4_2n(6))/3;
cToM2_trdec_RT = (p1_2n(3) + p1_2n(7) + p4_2n(3) + p4_2n(7))/3;
cToM2_fadec = (p1_2n(4) + p1_2n(8) + p4_2n(4) + p4_2n(8))/3;
cToM2_fadec_RT = (p1_2n(5) + p1_2n(9) + p4_2n(5) + p4_2n(9))/3;

cToM_trdec_sub = cToM2_trdec - cToM1_trdec;
cToM_trdec_RT_sub = cToM2_trdec_RT - cToM1_trdec_RT;
cToM_fadec_sub = cToM2_fadec - cToM1_fadec;
cToM_fadec_RT_sub = cToM2_fadec_RT - cToM1_fadec_RT;

cToM_trdec_ratio = cToM2_trdec/cToM1_trdec;
cToM_trdec_RT_ratio = cToM2_trdec_RT/cToM1_trdec_RT;
cToM_fadec_ratio = cToM2_fadec/cToM1_fadec;
cToM_fadec_RT_ratio = cToM2_fadec_RT/cToM1_fadec_RT;

%nTOM (no emotional cue ToM's)

nToM1_ANCOVA_p2 = p2_1h(1) + p2_1l(1) + 3;
nToM1_ANCOVA_p3 = p3_1h(1) + p3_1l(1) + 3;
nToM2_ANCOVA_p2 = nToM1_ANCOVA_p2 + p2_5th_ANCOVA;
nToM2_ANCOVA_p3 = nToM1_ANCOVA_p3 + p3_5th_ANCOVA;
\[ \text{nToM1\_ANCOVA\_combo} = \text{nToM1\_ANCOVA\_p2} - \text{nToM1\_ANCOVA\_p3}; \]
\[ \text{nToM2\_ANCOVA\_combo} = \text{nToM2\_ANCOVA\_p2} - \text{nToM2\_ANCOVA\_p3}; \]

%*** REJECTED***
\[ \text{nToM2\_ANCOVA\_p2} = p2\_2h(1) + p2\_2l(1); \]
\[ \text{nToM2\_ANCOVA\_p3} = p3\_2h(1) + p3\_2l(1); \]

\[ \text{nToM1\_ANCOVA\_ave} = (\text{nToM1\_ANCOVA\_p2} + \text{nToM1\_ANCOVA\_p3})/2; \]
\[ \text{nToM2\_ANCOVA\_ave} = (\text{nToM2\_ANCOVA\_p2} + \text{nToM2\_ANCOVA\_p3})/2; \]

\[ \text{nToM\_ANCOVA\_ave\_ratio} = \text{nToM2\_ANCOVA\_ave}/\text{nToM1\_ANCOVA\_ave}; \]

%***************
\[ \text{nToM1\_trdec} = (p2\_1h(2) + p2\_1h(6) + p2\_1h(10) + p2\_1m(2) + p2\_1m(6) + p2\_1m(10) + p2\_1l(2) + p2\_1l(6) + p2\_1l(10) + p3\_1h(2) + p3\_1h(6) + p3\_1h(10) + p3\_1m(2) + p3\_1m(6) + p3\_1m(10) + p3\_1l(2) + p3\_1l(6) + p3\_1l(10))/8; \]
\[ \text{nToM1\_trdec\_RT} = (p2\_1h(3) + p2\_1h(7) + p2\_1h(11) + p2\_1m(3) + p2\_1m(7) + p2\_1m(11) + p2\_1l(3) + p2\_1l(7) + p2\_1l(11) + p3\_1h(3) + p3\_1h(7) + p3\_1h(11) + p3\_1m(3) + p3\_1m(7) + p3\_1m(11) + p3\_1l(3) + p3\_1l(7) + p3\_1l(11))/8; \]
\[ \text{nToM1\_fadec} = (p2\_1h(4) + p2\_1h(8) + p2\_1h(12) + p2\_1m(4) + p2\_1m(8) + p2\_1m(12) + p2\_1l(4) + p2\_1l(8) + p2\_1l(12) + p3\_1h(4) + p3\_1h(8) + p3\_1h(12) + p3\_1m(4) + p3\_1m(8) + p3\_1m(12) + p3\_1l(4) + p3\_1l(8) + p3\_1l(12))/8; \]
\[ \text{nToM1\_fadec\_RT} = (p2\_1h(5) + p2\_1h(9) + p2\_1h(13) + p2\_1m(5) + p2\_1m(9) + p2\_1m(13) + p2\_1l(5) + p2\_1l(9) + p2\_1l(13) + p3\_1h(5) + p3\_1h(9) + p3\_1h(13) + p3\_1m(5) + p3\_1m(9) + p3\_1m(13) + p3\_1l(5) + p3\_1l(9) + p3\_1l(13))/8; \]
\[ \text{nToM2\_trdec} = (p2\_2h(2) + p2\_2h(6) + p2\_2h(10) + p2\_2m(2) + p2\_2m(6) + p2\_2m(10) + p2\_2l(2) + p2\_2l(6) + p2\_2l(10) + p3\_2h(2) + p3\_2h(6) + p3\_2h(10) + p3\_2m(2) + p3\_2m(6) + p3\_2m(10) + p3\_2l(2) + p3\_2l(6) + p3\_2l(10))/8; \]

393
nToM2_trdec_RT = (p2_2h(3) + p2_2h(7) + p2_2h(11) + p2_2m(3) + p2_2m(7) + p2_2m(11) + p2_2l(3) + p2_2l(7) + p2_2l(11) + p3_2h(3) + p3_2h(7) + p3_2h(11) + p3_2m(3) + p3_2m(7) + p3_2m(11) + p3_2l(3) + p3_2l(7) + p3_2l(11))/8;

nToM2_fadec = (p2_2h(4) + p2_2h(8) + p2_2h(12) + p2_2m(4) + p2_2m(8) + p2_2m(12) + p2_2l(4) + p2_2l(8) + p2_2l(12) + p3_2h(4) + p3_2h(8) + p3_2h(12) + p3_2m(4) + p3_2m(8) + p3_2m(12) + p3_2l(4) + p3_2l(8) + p3_2l(12))/8;

nToM2_fadec_RT = (p2_2h(5) + p2_2h(9) + p2_2h(13) + p2_2m(5) + p2_2m(9) + p2_2m(13) + p2_2l(5) + p2_2l(9) + p2_2l(13) + p3_2h(5) + p3_2h(9) + p3_2h(13) + p3_2m(5) + p3_2m(9) + p3_2m(13) + p3_2l(5) + p3_2l(9) + p3_2l(13))/8;

nToM_trdec_sub = nToM2_trdec - nToM1_trdec;
nToM_trdec_RT_sub = nToM2_trdec_RT - nToM1_trdec_RT;
nToM_fadec_sub = nToM2_fadec - nToM1_fadec;
nToM_fadec_RT_sub = nToM2_fadec_RT - nToM1_fadec_RT;

nToM_trdec_ratio = nToM2_trdec/nToM1_trdec;
nToM_trdec_RT_ratio = nToM2_trdec_RT/nToM1_trdec_RT;
nToM_fadec_ratio = nToM2_fadec/nToM1_fadec;
nToM_fadec_RT_ratio = nToM2_fadec_RT/nToM1_fadec_RT;

nToM_hostility_trans = nToM_hostility_trans/6;
nToM_hostility_fair = nToM_hostility_fair/6;

% emotion fairness ratings for ToM by reciprocity, plus flipping back of fairness ratings to have
% a more intuitive direction for the answers. emotion fairness ratings for
% nToM by reciprocity

% ToM

ToM1emofa_high = (p1_1h(4) + p1_1h(8) + p4_1h(4) + p4_1h(8))/3;
ToM1emofa_mod = (p1_1n(4) + p1_1n(8) + p4_1n(4) + p4_1n(8))/3;
ToM1emofa_low_inverse = (p1_1a(4) + p1_1a(8) + p4_1a(4) + p4_1a(8))/3;
ToM1emofa_low = (ToM1emofa_low_inverse - 100)* -1;

ToM2emofa_high = (p1_2h(4) + p1_2h(8) + p4_2h(4) + p4_2h(8))/3;
ToM2emofa_mod = (p1_2n(4) + p1_2n(8) + p4_2n(4) + p4_2n(8))/3;
ToM2emofa_low_inverse = (p1_2a(4) + p1_2a(8) + p4_2a(4) + p4_2a(8))/3;
ToM2emofa_low = (ToM2emofa_low_inverse - 100)* -1;

ToMemofa_high = (p1_1h(4) + p1_1h(8) + p4_1h(4) + p4_1h(8) + p1_2h(4) + p1_2h(8) + p4_2h(4) +
                  p4_2h(8))/6;
ToMemofa_mod = (p1_1n(4) + p1_1n(8) + p4_1n(4) + p4_1n(8) + p1_2n(4) + p1_2n(8) + p4_2n(4) +
                  p4_2n(8))/6;
ToMemofa_low_inverse = (p1_1a(4) + p1_1a(8) + p4_1a(4) + p4_1a(8) + p1_2a(4) + p1_2a(8) +
                         p4_2a(4) + p4_2a(8))/6;
ToMemofa_low = (ToMemofa_low_inverse - 100)* -1;

% nToM

varhigh1 = 0;

p2_1h(4)
if ans ~= 0
    varhigh1((length(varhigh1) + 1)) = p2_1h(4);
end

p2_1h(8)
if ans ~= 0
    varhigh1((length(varhigh1) + 1)) = p2_1h(8);
end

p2_1h(12)

if ans ~= 0
    varhigh1((length(varhigh1) + 1)) = p2_1h(12);
end

p3_1h(4)

if ans ~= 0
    varhigh1((length(varhigh1) + 1)) = p3_1h(4);
end

p3_1h(8)

if ans ~= 0
    varhigh1((length(varhigh1) + 1)) = p3_1h(8);
end

p3_1h(12)

if ans ~= 0
    varhigh1((length(varhigh1) + 1)) = p3_1h(12);
end

get = 2;
when = length(varhigh1) - 1;
nToM1emofa_high = 0;
for i = 1:when
    nToM1emofa_high = nToM1emofa_high + varhigh1(get);
    get = get + 1;
end

nToM1emofa_high = nToM1emofa_high/when;

whenhigh1 = when + 2;

varmod1 = 0;

p2_1m(4)

if ans ~= 0
    varmod1((length(varmod1) + 1)) = p2_1m(4);
end

p2_1m(8)

if ans ~= 0
    varmod1((length(varmod1) + 1)) = p2_1m(8);
end

p2_1m(12)
if ans ~= 0
    varmod1((length(varmod1) + 1)) = p2_1m(12);
end

p3_1m(4)
if ans ~= 0
    varmod1((length(varmod1) + 1)) = p3_1m(4);
end

p3_1m(8)
if ans ~= 0
    varmod1((length(varmod1) + 1)) = p3_1m(8);
end

p3_1m(12)
if ans ~= 0
    varmod1((length(varmod1) + 1)) = p3_1m(12);
end

get = 2;
when = length(varmod1) - 1;
nToM1emofa_mod = 0;

for i = 1:when
    nToM1emofa_mod = nToM1emofa_mod + varmod1(get);
    get = get + 1;
end

nToM1emofa_mod = nToM1emofa_mod/when;

whenmod1 = when + 2;

varlow1 = 0;

p2_1l(4)
if ans ~= 0
    varlow1((length(varlow1) + 1)) = p2_1l(4);
end

p2_1l(8)
if ans ~= 0
    varlow1((length(varlow1) + 1)) = p2_1l(8);
end

p2_1l(12)
if ans ~= 0
    varlow1((length(varlow1) + 1)) = p2_1l(12);
end
if ans ~= 0
    varlow1((length(varlow1) + 1)) = p3_1l(4);
end

if ans ~= 0
    varlow1((length(varlow1) + 1)) = p3_1l(8);
end

if ans ~= 0
    varlow1((length(varlow1) + 1)) = p3_1l(12);
end

get = 2;
when = length(varlow1) - 1;
nToM1emofa_low = 0;

for i = 1:when
    nToM1emofa_low = nToM1emofa_low + varlow1(get);
    get = get + 1;
end

nToM1emofa_low = nToM1emofa_low/when;

whenlow1 = when + 2;
varhigh2 = 0;

p2_2h(4)

if ans ~= 0
    varhigh2((length(varhigh2) + 1)) = p2_2h(4);
end

p2_2h(8)

if ans ~= 0
    varhigh2((length(varhigh2) + 1)) = p2_2h(8);
end

p2_2h(12)

if ans ~= 0
    varhigh2((length(varhigh2) + 1)) = p2_2h(12);
end

p3_2h(4)
if ans ~= 0
    varhigh2((length(varhigh2) + 1)) = p3_2h(4);
end

p3_2h(8)

if ans ~= 0
    varhigh2((length(varhigh2) + 1)) = p3_2h(8);
end

p3_2h(12)

if ans ~= 0
    varhigh2((length(varhigh2) + 1)) = p3_2h(12);
end

get = 2;
when = length(varhigh2) - 1;
nToM2emofa_high = 0;

for i = 1:when
    nToM2emofa_high = nToM2emofa_high + varhigh2(get);
    get = get + 1;
end

nToM2emofa_high = nToM2emofa_high/when;

whenhigh2 = when;
varmod2 = 0;

p2_2m(4)

if ans ~= 0
    varmod2((length(varmod2) + 1)) = p2_2m(4);
end

p2_2m(8)

if ans ~= 0
    varmod2((length(varmod2) + 1)) = p2_2m(8);
end

p2_2m(12)

if ans ~= 0
    varmod2((length(varmod2) + 1)) = p2_2m(12);
end

p3_2m(4)

if ans ~= 0
    varmod2((length(varmod2) + 1)) = p3_2m(4);
end
p3_2m(8)

if ans ~= 0
    varmod2((length(varmod2) + 1)) = p3_2m(8);
end

p3_2m(12)

if ans ~= 0
    varmod2((length(varmod2) + 1)) = p3_2m(12);
end

get = 2;
when = length(varmod2) - 1;
nToM2emofa_mod = 0;

for i = 1:when
    nToM2emofa_mod = nToM2emofa_mod + varmod2(get);
    get = get + 1;
end

nToM2emofa_mod = nToM2emofa_mod/when;

whenmod2 = when;
varlow2 = 0;

p2_2l(4)

if ans ~= 0
    varlow2((length(varlow2) + 1)) = p2_2l(4);
end

p2_2l(8)

if ans ~= 0
    varlow2((length(varlow2) + 1)) = p2_2l(8);
end

p2_2l(12)

if ans ~= 0
    varlow2((length(varlow2) + 1)) = p2_2l(12);
end

p3_2l(4)

if ans ~= 0
    varlow2((length(varlow2) + 1)) = p3_2l(4);
end

p3_2l(8)
if ans ~= 0
    varlow2((length(varlow2) + 1)) = p3_2l(8);
end

p3_2l(12)

if ans ~= 0
    varlow2((length(varlow2) + 1)) = p3_2l(12);
end

g = 2;
when = length(varlow2) - 1;
nToM2emofa_low = 0;

for i = 1:when
    nToM2emofa_low = nToM2emofa_low + varlow2(get);
    get = get + 1;
end

nToM2emofa_low = nToM2emofa_low/when;

whenever2 = when;

% overall fairness ratings for each reciprocity level
varhighA = varhigh1;
varhighA(whenhigh1:whenhigh1 + whenhigh2) = varhigh2;

varwhenhighA = length(varhighA) - 1;
get = 2;
nToMemofa_high = 0;

for i = 1:varwhenhighA
    nToMemofa_high = nToMemofa_high + varhighA(get);
    get = get + 1;
end

nToMemofa_high = nToMemofa_high/varwhenhighA;

varmodA = varmod1;
varmodA(whenmod1:whenmod1 + whenmod2) = varmod2;

varwhenmodA = length(varmodA) - 1;
get = 2;
nToMemofa_mod = 0;

for i = 1:varwhenmodA
    nToMemofa_mod = nToMemofa_mod + varmodA(get);
    get = get + 1;
end

nToMemofa_mod = nToMemofa_mod/varwhenmodA;

varlowA = varlow1;
varlowA(whenlow1:whenlow1 + whenlow2) = varlow2;

varwhenlowA = length(varlowA) - 1;
get = 2;
nToMemofa_low = 0;

for i = 1:varwhenlowA
    nToMemofa_low = nToMemofa_low + varlowA(get);
    get = get + 1;
end
nToMemofa_low = nToMemofa_low/varwhenlowA;

% overall ratings calculations

get = 1;
when = 1;

for i = 1:4
    data(get, 6)
    if ans == 1
        if get == 1
            p1ovfair = data(1, 7);
p1ovfairRT = data(1, 8);
p1selffair = data(2, 7);
p1selffairRT = data(2, 8);
        elseif get == 2
            p1ovfair = data(3, 7);
p1ovfairRT = data(3, 8);
p1selffair = data(4, 7);
p1selffairRT = data(4, 8);
        elseif get == 3
            p1ovfair = data(5, 7);
p1ovfairRT = data(5, 8);
p1selffair = data(6, 7);
elseif get == 4
    p1ovfair = data(7, 7);
    p1ovfairRT = data(7, 8);
    p1selffair = data(8, 7);
    p1selffairRT = data(8, 8);
end

elseif ans == 2
    if get == 1
        p2ovfair = data(1, 7);
        p2ovfairRT = data(1, 8);
        p2selffair = data(2, 7);
        p2selffairRT = data(2, 8);
    elseif get == 2
        p2ovfair = data(3, 7);
        p2ovfairRT = data(3, 8);
        p2selffair = data(4, 7);
        p2selffairRT = data(4, 8);
    elseif get == 3
        p2ovfair = data(5, 7);
        p2ovfairRT = data(5, 8);
        p2selffair = data(6, 7);
        p2selffairRT = data(6, 8);
    elseif get == 4
        p2ovfair = data(7, 7);
        p2ovfairRT = data(7, 8);
        p2selffair = data(8, 7);
        p2selffairRT = data(8, 8);
    end
elseif ans == 3
    if get == 1
        p3ovfair = data(1, 7);
        p3ovfairRT = data(1, 8);
        p3selffair = data(2, 7);
        p3selffairRT = data(2, 8);
    elseif get == 2
        p3ovfair = data(3, 7);
        p3ovfairRT = data(3, 8);
        p3selffair = data(4, 7);
        p3selffairRT = data(4, 8);
    elseif get == 3
        p3ovfair = data(5, 7);
        p3ovfairRT = data(5, 8);
        p3selffair = data(6, 7);
        p3selffairRT = data(6, 8);
    elseif get == 4
        p3ovfair = data(7, 7);
        p3ovfairRT = data(7, 8);
        p3selffair = data(8, 7);
        p3selffairRT = data(8, 8);
    end

elseif ans == 4
    if get == 1
        p4ovfair = data(1, 7);
        p4ovfairRT = data(1, 8);
        p4selffair = data(2, 7);
        p4selffairRT = data(2, 8);
    end
elseif get == 2
    p4ovfair = data(3, 7);
    p4ovfairRT = data(3, 8);
    p4selffair = data(4, 7);
    p4selffairRT = data(4, 8);
elseif get == 3
    p4ovfair = data(5, 7);
    p4ovfairRT = data(5, 8);
    p4selffair = data(6, 7);
    p4selffairRT = data(6, 8);
elseif get == 4
    p4ovfair = data(7, 7);
    p4ovfairRT = data(7, 8);
    p4selffair = data(8, 7);
    p4selffairRT = data(8, 8);
end
end
get = get + 1;
end

ovfairptfair = (p1ovfair + p2ovfair)/2;
ovfairptfairRT = (p1ovfairRT + p2ovfairRT)/2;
ovunfairptfair = (p3ovfair + p4ovfair)/2;
ovunfairptfairRT = (p3ovfairRT + p4ovfairRT)/2;

ovselffairtofair = (p1selffair + p2selffair)/2;
ovselffairtofairRT = (p1selffairRT + p2selffairRT)/2;
ovselffairtounfair = (p3selffair + p4selffair)/2;
ovselffairtounfairRT = (p3selffairRT + p4selffairRT)/2;
Overall_score = Overall_score_emotions + Overall_score_non_emotions + Sup_emotions_score;
Overall_score_emotions_w_including_sup = Overall_score_emotions + Sup_emotions_score;

xlswrite('testdata.xls', ToM1_fadec, 1, 'A1')
xlswrite('testdata.xls', ToM1_fadec_RT, 1, 'B1')
xlswrite('testdata.xls', ToM1_trdec, 1, 'C1')
xlswrite('testdata.xls', ToM1_trdec_RT, 1, 'D1')
xlswrite('testdata.xls', ToM1emofa_high, 1, 'E1')
xlswrite('testdata.xls', ToM1emofa_low, 1, 'F1')
xlswrite('testdata.xls', ToM1emofa_mod, 1, 'G1')
xlswrite('testdata.xls', ToM2_fadec, 1, 'H1')
xlswrite('testdata.xls', ToM2_fadec_RT, 1, 'I1')
xlswrite('testdata.xls', ToM2_trdec, 1, 'J1')
xlswrite('testdata.xls', ToM2_trdec_RT, 1, 'K1')
xlswrite('testdata.xls', ToM2emofa_high, 1, 'L1')
xlswrite('testdata.xls', ToM2emofa_low, 1, 'M1')
xlswrite('testdata.xls', ToM2emofa_mod, 1, 'N1')
xlswrite('testdata.xls', ToM_fadec_RT_ratio, 1, 'O1')
xlswrite('testdata.xls', ToM_fadec_RT_sub, 1, 'P1')
xlswrite('testdata.xls', ToM_fadec_ratio, 1, 'Q1')
xlswrite('testdata.xls', ToM_fadec_sub, 1, 'R1')
xlswrite('testdata.xls', ToM_hostility_fair, 1, 'S1')
xlswrite('testdata.xls', ToM_hostility_trans, 1, 'T1')
xlswrite('testdata.xls', ToM_trdec_RT_ratio, 1, 'U1')
Appendix C. Manipulation of Nimstim images

C.1 Exampled differences of original and manipulated Nimstim images

Original

Manipulated
Appendix D. Ethical approvals and declaration

D.1 EH ethical approval

Human Research Ethics Committee - Scientific and Ethical Review

Ethical Approval – Granted

Commencement of Research at Eastern Health has been authorised

30 May 2012

Dr Kathryn Thompson
Research Program Leader
Spectrum
PO Box 135
Ringwood Vic 3135

Dear Dr Thompson

E54/1112 Cognitive and Emotional Processing in Borderline Personality Disorder

Principal Investigators: Dr Katherine Thompson

Associate Investigators: Dr Joseph Ciocciari, Prof Susan Rossell, Prof Michael Kyrios,

Other Approved Personnel: Student Researcher Ms Lee Lawrence

Eastern Health Site: Spectrum

External Sites: Swinburne University (Commencement of Research at these sites require
authorisation by the Senior Management of these sites)

Approval Period: On-going - subject to a satisfactory progress report being submitted
annually.

The above study was considered by the Eastern Health Research and Ethics Committee at
its meeting on 19 April 2012 and was approved subject to amendments and clarifications.
Following receipt of amended documents and additional Information (received on 19 May
2012), final approval can now be given for the study to proceed.

Please note following condition of final approval:

- This study also involves the use of data collected from participants in E30/0910 The
recent approval of amendment for E30/0910 dated 24 April 2012 will require the re-
consenting of all participants in the Spectrum service-wide evaluation before
recruitment can commence in this proposed study.
List of documents approved:
- Module 1 revised section 1.3, 1.19.
- Participant Information and Consent Form version 2 dated 16 May 2012
- Research Plan included in Module 1.14(b)
- Difficulties in Emotion Regulation Scale
- Brief Core Schema Scale
- Impact of Life Events Scale

Additionally the following documents have been submitted:
- Spectrum Service Wide Evaluation Assessment Booklet 2012
- CV’s Prof Susan Rosell, Prof Michael Kyrios, Dr Joseph Cioclari, Mr Lee Lawrence

Reporting Requirements:

Please note, an annual progress report is due June 2013 – continuing approval is subject to the timely submission of a satisfactory progress report. Progress report template can be downloaded from our web-page: http://www.easternhealth.org.au/research/ethics/progressreports.aspx

Please ensure you notify the Ethics Committee of all personnel changes and any serious adverse events that may affect study conduct. Any changes to the approved Protocol or other approved documents must be submitted for ethical review and approval prior to use.

Eastern Health Research and Ethics Committee

The Eastern Health Research and Ethics Committee is constituted and functions in accordance with the National Health and Medical Research Council Guidelines (National Statement on Ethical Conduct in Human Research 2007). No member of the Committee adjudicates on research in which that member has any conflict of interest including any personal involvement or participation in the research, any financial interest in the outcome or any involvement in competing research.


N:\02-03\current\Ethics - Eastern Health\All Correspondence\1112 studies\E54-1112\E54-1112 Correspondence from EH\E54-1112 Final\Approval 30 May 2012.docx  Page 2 of 3

419
Please quote our reference number E54/1112 in all future correspondence.

Yours sincerely,

[Signature]

Prof David Taylor
Director
Eastern Health Research and Ethics

Encl: Committee Composition letter

Cc: [All above listed personnel]

Confidentiality, Privacy & Research

Research data stored on personal computers, USBs and other portable electronic devices must not be identifiable. No patients’ names or UR numbers must be stored on these devices.

Electronic storage devices must be password protected or encrypted.

The conduct of research must be compliant with the conditions of ethics approval and Eastern Health policies.

Publications

Whilst the Eastern Health Research and Ethics Committee is an independent committee, the committee and Eastern Health management encourage the publication of the results of research in a discipline appropriate manner. Publications should provide evidence of the contribution that participants, researchers and funding sources make.

It is very important that the role of Eastern Health is acknowledged in publications.
13 July 2012

Dr Kathryn Thompson  
Research Program Leader  
Spectrum  
PO Box 135  
Ringwood Vic 3135

Dear Dr Thompson

**E54/1112** Cognitive and Emotional Processing in Borderline Personality Disorder

**Principal Investigators:** Dr Katherine Thompson

**Associate Investigators:** Dr Joseph Ciorciari, Prof Susan Rossell, Prof Michael Kyrios

**Other Approved Personnel:** Student Researcher Ms Lee Lawrence

**Eastern Health Site:** Spectrum

**External Sites:** Swinburne University (Commencement of Research at these sites require authorisation by the Senior Management of these sites)

**Approval Period:** On-going - subject to a satisfactory progress report being submitted annually.

Thank you for your reply dated 6 July 2012 in response to the ethics letter dated 4 July 2012. The amendment and clarification have now been fully reviewed and approved.

Yours sincerely

Gavin Davies  
Administrative Assistant  
Eastern Health Research and Ethics
D.3 SUHREC ethical approval

From: Keith Wilkins <kwilkins@swin.edu.au>
Date: 16 August 2012 5:34:30 PM AEST
To: Joseph Ciorciari <jciorciari@swin.edu.au>, Lee Lawrence <lmlawrence@swin.edu.au>
Cc: RES Ethics <resethics@swin.edu.au>, FLSS Research <lssresearch@swin.edu.au>
Subject: SUHREC Project 2012/207 Swinburne Ethics Clearance (EH HREC Project E54/1112)

To: Dr Joseph Ciorciari/Mr Lee Lawrence, FLSS

Dear Joe and Lee

**SUHREC Project 2012/207 Cognitive and Emotional Processing in Borderline Personality Disorder**

Dr J Ciorciari, FLSS; Mr L Lawrence et al

(Spectrum CI: Dr Katherine Thompson. EH HREC Project E54/112)

Approved Duration: 14/08/2012 to 14/08/2014 [Adjusted]

I refer to your application for Swinburne ethics clearance for a supervised Swinburne student project being conducted in conjunction with Spectrum/Eastern Health (EH) and given ethics clearance by EH HREC (Project E54/1112).

Relevant documentation pertaining to your application was emailed by you on 20 and 25 July and 10 August 2012 with attachments. The request documentation was given expedited ethical review on behalf of Swinburne's Human Research Ethics Committee (SUHREC) by a SUHREC delegate, significantly on the basis of the ethical review conducted by EH HREC. I acknowledge receipt of a revised Version 2 of the PICF emailed on 14 August 2012 which accords with positive feedback from the SUHREC delegate.

I am pleased to advise that, as submitted to date, Swinburne ethics clearance has been given for the project to proceed in line with standard on-going ethics clearance conditions here outlined (as applicable) and on the understanding that appropriate insurance arrangements are in place to cover the Swinburne-sanctioned research activity. (Nb EH HREC may need to be apprised of the Swinburne ethics clearance.)

- All human research activity undertaken under Swinburne auspices must conform to Swinburne and external regulatory standards, including the current *National Statement on Ethical Conduct in Human Research* and with respect to secure data use, retention and disposal.

- The named Swinburne Chief Investigator/Supervisor remains responsible for any personnel appointed to or associated with the project being made aware of ethics clearance conditions, including research and consent procedures or instruments approved. Any change in chief investigator/supervisor requires timely notification and SUHREC endorsement.
- The above project has been approved as submitted for ethical review by or on behalf of SUHREC. Amendments to approved procedures or instruments ordinarily require prior ethical appraisal/clearance. SUHREC must be notified immediately or as soon as possible thereafter of (a) any serious or unexpected adverse effects on participants and any redress measures; (b) proposed changes in protocols; and (c) unforeseen events which might affect continued ethical acceptability of the project.

- At a minimum, an annual report on the progress of the project is required as well as at the conclusion (or abandonment) of the project. (A copy of any progress, annual or final report submitted to Eastern Health also being submitted to my office should meet these requirements, all things being equal; similarly with any request to modify the approved protocol.)

- A duly authorised external or internal audit of the project may be undertaken at any time.

Please contact me if you have any queries about Swinburne on-going ethics clearance and if you need a signed Swinburne ethics clearance certificate, citing the SUHREC project number. Copies of clearance emails should be retained as part of project record-keeping.

Best wishes for the project.

Yours sincerely

Keith

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Keith Wilkins
Secretary, SUHREC & Research Ethics Officer
Swinburne Research (H68)
Swinburne University of Technology
P O Box 218
HAWTHORN VIC 3122
Tel +61 3 9214 5218
Fax +61 3 9214 5267
D.4 SUHREC ethical approval for study modification 2

From: Ann Gaeth
Sent: Wednesday, 28 August 2013 11:40 AM
To: Joseph Ciorciari; Lee Lawrence
Cc: RES Ethics; FLSS Research
Subject: RE: SUHREC Project 2012/207 (EH HREC Project E54/112) Swinburne Ethics Clearance Modification (1)

To: Dr Joseph Ciorciari/Mr Lee Lawrence, FLSS

Dear Joe and Lee,

SUHREC Project 2012/207 Cognitive and Emotional Processing in Borderline Personality Disorder (EH HREC Project E54/112)

Dr J Ciorciari, FLSS; Mr L Lawrence et al (EH HREC Project E54/112)

Approved Duration: 14/08/2012 to 14/08/2014 [Modified: August 2013]

I refer to your request, e-mailed 27 August 2013, requesting ethics clearance for modification to the existing approved protocol in regard to the amendments in the recruiting procedures for this project and informing the committee of the change in Dr Katherine Thompson’s status.

I am pleased to advise that, as modified to date, the project has approval to continue in line with the ethics clearance previously communicated. An additional condition is that any contractual matters regarding Dr Thompson’s employment arrangements are to be resolved in a timely fashion and the Research Ethics office is to be advised of the outcome.

Please contact the Research Ethics Office if you have any queries about on-going ethics clearance, citing the SUHREC project number. Copies of clearance e-mails should be retained as part of project recordkeeping.

As before, best wishes for the project.

Kind regards,

Ann

__________________________

Dr Ann Gaeth
Administration Officer (Research Ethics)
Swinburne Research (H68)
Swinburne University of Technology
P O Box 218
HAWTHORN VIC 3122
☎ +61 3 9214 8356
✉ +61 3 9214 5267
D.5 EH ethical approval for study modification 2

EASTERN HEALTH RESEARCH AND ETHICS SUB-COMMITTEE

Date: 17 December 2013

Acknowledgement

Meeting held Monday 11 November 2013

The following documents and further information provided has now been reviewed and approved:

E54/1112 Cognitive and Emotional Processing in Borderline Personality Disorder

- Request For Approval of Amendment form dated 8 October 2013
  - Participant Information and Consent Form Version 2 dated 12 August 2012

Please note this is the official acknowledgement from the Eastern Health Office of Research and Ethics. Please print or save for your file.

Eastern Health Research and Ethics
Ph: 03 9895 3398
Fax: 03 9094 9610
Email: ethics@easternhealth.org.au
D.6 SUHREC ethical approval for study modification 3

From: Ann Gaeth On Behalf Of RES Ethics
Sent: Tuesday, 7 January 2014 4:58 PM
To: Joseph Ciorciari; Lee Lawrence
Cc: RES Ethics
Subject: SUHREC Project 2012/207 (EH HREC Project E54/1112) Swinburne Ethics Clearance Modification (2)

To: Dr J Ciorciari/Mr L Lawrence, FLSS

Dear Joe and Lee,

SUHREC Project 2012/207 Cognitive and Emotional Processing in Borderline Personality Disorder (EH HREC Project E54/112)

Dr J Ciorciari, FLSS; Mr L Lawrence et al (EH HREC Project E54/112)

Approved Duration: 14/08/2012 to 14/08/2014 [Modified: Aug 2013; Jan 2014]

I refer to your request, e-mailed 29 November and 17 December 2013, requesting ethics clearance for modifications including the division of the study into two parts and revised consent instruments.

I am pleased to advise that, as modified to date, the project has approval to continue in line with the ethics clearance previously communicated.

Please contact the Research Ethics Office if you have any queries about on-going ethics clearance, citing the SUHREC project number. Copies of clearance e-mails should be retained as part of project recordkeeping.

As before, best wishes for the project.

Kind regards,

Ann

____________________________________
Dr Ann Gaeth
Executive Officer, Research
Swinburne Research (H68)
Swinburne University of Technology
P O Box 218
HAITHORN VIC 3122
☎️ +61 3 9214 8356
✍️ +61 3 9214 5267
D.7 EH ethical approval for study modification 3

EASTERN HEALTH RESEARCH AND ETHICS SUB-COMMITTEE

Date: 18 February 2014

Acknowledgement

The following documents now been reviewed and **approved**: 

E54/1112 Cognitive and Emotional Processing in Borderline Personality Disorder

- Request For Approval of Amendment form dated 8 January 2014
  - Updated Module 1 received January 2014
  - Participant Information and Consent Form 1 – Version 1 dated 8 January 2014
  - Participant Information and Consent Form 2 – Version 4 dated 8 January 2014
  - PAT-BOR Questionnaire

**Please note** this is the **official acknowledgement from the Eastern Health Office of Research and Ethics**. Please print or save for your file.

Eastern Health Research and Ethics
Ph: 03 9895 3390
Fax: 03 9094 9610
Email: ethics@easternhealth.org.au
D.8 SUHREC ethical approval for study modification 3

From: Ann Gaeth On Behalf Of RES Ethics
Sent: Wednesday, 19 March 2014 4:35 PM
To: Joseph Ciorciari; Lee Lawrence
Cc: RES Ethics
Subject: SUHREC Project 2012/207 (EH HREC Project E54/1112) Swinburne Ethics Clearance Modification (3)

To: Dr J Ciorciari/Mr L Lawrence, FLSS

Dear Joe and Lee,

SUHREC Project 2012/207 Cognitive and Emotional Processing in Borderline Personality Disorder (EH HREC Project E54/112)

Dr J Ciorciari, FLSS; Mr L Lawrence et al (EH HREC Project E54/112)

Approved Duration: 14/08/2012 to 14/08/2014 [Modified: Aug 2013; Jan, Mar 2014]

I refer to your request, e-mailed 18 February 2014, requesting ethics clearance for modification allowing the recruitment for the second study and revised consent instruments.

I am pleased to advise that, as modified to date, the project has approval to continue in line with the ethics clearance previously communicated.

Please contact the Research Ethics Office if you have any queries about on-going ethics clearance, citing the SUHREC project number. Copies of clearance e-mails should be retained as part of project recordkeeping.

As before, best wishes for the project.

Kind regards,

Ann

____________________________________
Dr Ann Gaeth
Executive Officer, Research
Swinburne Research (H68)
Swinburne University of Technology
P O Box 218
HAWTTHORN VIC 3122
D.9 SUHREC ethical approval for extension to continue recruitment protocols

From: Astrid Nordmann On Behalf Of RES Ethics
Sent: Thursday, 27 March 2014 11:21 AM
To: Joseph Ciorciari; Lee Lawrence
Cc: RES Ethics
Subject: RE: SUHREC Project 2012/207 (EH HREC Project E54/1112) Swinburne Ethics Clearance Modification (4)

To: Dr J Ciorciari/Mr L Lawrence, FLSS

Dear Joe and Lee,

SUHREC Project 2012/207 Cognitive and Emotional Processing in Borderline Personality Disorder (EH HREC Project E54/112)

Dr J Ciorciari, FLSS; Mr L Lawrence et al (EH HREC Project E54/112)

Approved Duration: 14/08/2012 to 14/08/2014; extended to 25/12/2014 [Modified: Aug 2013; Jan, Mar 2014; 27 March 2014]

I refer to your request for a simple extension of ethics clearance to complete the approved human research activity as per the report form received at Swinburne Research on 05/03/2014.

There being no change to the approved protocol as submitted to date, I am authorised to issue the clearance for the extension to 25/12/2014. The standard ethics clearance conditions previously communicated and reprinted below still apply.

Please contact the Research Ethics Office if you have any queries about on-going ethics clearance, citing the SUHREC project number. Copies of clearance emails should be retained as part of project record-keeping.

As before, best wishes for the project.

Yours sincerely,

Astrid Nordmann

Dr Astrid Nordmann

Research Ethics Executive Officer

Swinburne Research (H68)

Swinburne University of Technology

PO Box 218, Hawthorn, VIC 3122

Tel: +613 9214 3845

Fax: +613 9214 5267

Email: anordmann@swin.edu.au
D.9 Ethical declaration

I acknowledge that this study was conducted in line with ethical protocols approved by respective ethical research committees.

Abstract

Borderline Personality Disorder (BPD) is associated with various impulsive tendencies, difficulties interacting with others and controlling mood, as well as altered states of consciousness and perception, commonly from stressful childhood experiences. It is not uncommon for those with BPD to mistrust others' intentions, and dissociate. BPD has been suggested to be maintained by an overly sensitive amygdala reactivity, and an inability to suppress one's behaviour, initiated by frontal regions. Those with BPD report increased amygdala response when viewing faces, even when they have no emotional valence. Other reports suggest that BPD is associated with difficulties in cognitive empathy, yet are sensitive to reading non-verbal cues of threat or social rejection. Both of these processes can be properties of Theory of Mind, or 'placing oneself in someone else's shoes'. Participants will complete surveys on how well they can control their emotions, their dissociative experiences, how trustworthy other people are, their experiences when they were growing up, and how regularly they are reminded by those childhood experiences. Behavioural and EEG results of participants with and without BPD will be compared during an emotional recognition task, and a trust task that features four virtual partners, two with non-verbal cues indicating future reciprocity. It is expected that those with BPD will process emotional and neutral faces differently to those that do not have BPD. Also, it is expected that those with BPD will have a greater ability at detecting the non-verbal cues that indicate reciprocity, which could underlie activity within the anterior cingulate cortex using sLORETA. Differences are also expected during these tasks for those that tend to use dissociation.