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Individual Difference in Self and Social Attributions of Facial Appearances: Behavioural Correlates of Depression

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Individual Difference in Self and Social Attributions of Facial Appearances: Behavioural Correlates of Depression

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This thesis is submitted to the School of Medical Sciences, Bangor University, Wales, in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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Acknowledgements

ഞാൻ ഈ തീസിസ് എൻറെ പ്രിയപ്പെട്ട അച്ചനും, ശ്രീനിവാസൻ നാനാടത്, അമ്മക്കും, ഹൈമാവതി എം. കെ., സമർപ്പിക്കുന്നു

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Thesis Summary

Human faces are naturally captivating and display a variety of facial cues that can be accurately identified as mood state or inherent traits. This process of giving meaning to behaviours or signals that we observe is called attribution. When this is directed to self, we make self-attributions and when directed at others, we make social-attributions. Previous research demonstrates that attributions are affected by mood and wellbeing states, and personality traits, and in the initial chapter I discuss how wellbeing state and neuroticism trait predict depressive mood-state. I further aimed to develop an attribution task using self and others' face. Studies so far have used self-face to understand perceptions of attractiveness, self-esteem and depression, but not specifically to investigate self-attributions relating to changes in mood state, wellbeing and neuroticism.

Measuring attributions of facial appearance using self and others' face is a new approach. It was important that the self and social attributions were meaningfully measured and easily comparable. I piloted the stimuli and the novel task; the latter is discussed in this thesis. I compared three 19-point face scales created using face composites of neuroticism, depression and agreeableness. The Neurotic Face Scale was chosen for the self and social attribution tasks on the basis of the results from the pilot study. I also demonstrate the different positive and negative attributions that are systematically made to neurotic facial cues.

In the main experimental chapters, I investigate the association of self and social attributions of facial appearances with individual's mood, wellbeing and neuroticism. Participants' own photograph is used for the self-attribution task, while

selected portraits of 'other' individuals were used for the social-attribution task. I also compare the participant's self and social attributions with independent observers' attributions (of the participants). I demonstrate that participant's increasing severity of depressive symptoms, decreasing hedonic wellbeing and increasing neuroticism relate to misattributions of self and others, but does not affect independent observers' attributions. I discuss participants displaying classic social projection based on the similarities between their self and social attributions. Finally, I triangulate self, social and observer attributions to demonstrate that misattributions displayed by participants experiencing depression were specifically for positive attributions, whilst maintaining consistent negative attributions as the independent observers. Self-attributions, however, are more sensitive to mood, wellbeing and inherent traits than social attributions. I further calculate discrepancies between basic self-attributions to demonstrate increasing self-negativity with increasing severity of depressive symptoms, neuroticism and decreasing hedonic wellbeing, as well as increasing self-discrepancy with decreasing hedonic wellbeing.

I further investigate the longitudinal changes (11 weeks) of self-attributions in participants who are clinically depressed. I demonstrate decreasing severity of depressive symptoms overlapping with decreasing self-negativity and self-discrepancy, and increasing self-positivity. I further demonstrate that an increase in self-positivity and decrease in self-negativity in the first week predicts depressive symptoms at week 11. Finally in a pilot study, I demonstrate increase in self-positivity after eight weeks of mindfulness practice; a practice that focuses on non-judgemental self-referential processing to increase self-positivity. This pilot study is included in the final chapter for general discussion, to demonstrate the future research potential for the self-attribution task.

CHAPTER 1 – Introduction

മുഖം മനസ്സിന്റെ കണ്ണാടി
(Face, the mirror of mind)

- Unknown (ancient folk saying in Malayalam, a native regional language of Kerala, a southern state of India)

Ut imago est animi voltus sic indices oculi
(The face is a picture of the mind as the eyes are its interpreter)

- Marcus Tillius Cicero (106 – 44 B.C.)

Faces are arguably the most entrancing stimuli around us. Our fascination for faces and reading information from faces is part of our social behaviour as human beings. Even as new-borns, we track face-like stimuli more consistently than non-face like stimuli (Easterbrook, Kisilevsky, Muir, & Laplante, 1999). These face-processing capabilities rapidly advance, and the new-borns make preference for their mother's face compared to a paired female face (Bushnell, 1982; Pascalis, de Schonen, Morton, Deruelle, & Fabre-Grenet, 1995; Walton, Bower, & Bower, 1992) and even preference for attractive faces over unattractive faces (Slater et al., 1998; Slater et al., 2000). Thus, the inherent pursuit of faces help the new-borns to learn to differentiate, understand and imitate the facial cues they see and thus develop their social skills (Meltzoff & Moore, 2002; Reissland, 1988).

Even as adults, we are prone to seeing faces in vaguely face-like random patterns in the clouds, on the moon or on a burnt toast (Bainbridge, Isola, & Oliva, 2013). Despite faces having a general composition and layout, they also have subjective differences (Little, Jones, & DeBruine, 2011). From our experiences we know that some faces are remembered better than others. For example, attractive faces can capture more attention and studies have shown that they have greater face-symmetry (Mealey, Bridgstock, & Townsend, 1999), but interestingly they are also

associated with individual's health (Fink, Neave, Manning, & Grammer, 2006; Jones et al., 2001). Such subjective displays of facial cues, therefore, forms the basic social networking tools and trigger automatic social processes of mentalizing of others (Frith & Frith, 2008). Mentalizing (Theory of mind) refers to the ability to read other's state of mind (Frith & Frith, 2006a; Frith & Frith, 2006b; Frith & Frith, 2003). In this manner social alliances are made or unmade, stressing the importance of face processing in social functioning (Frith & Frith, 2010; Frith & Frith, 2008). Thus, a face is more than what meets the eye. So what are the different signals that we read from faces?

1.1 Face, the mirror of mind

When you are in a room full of strangers, with whom do you choose to start a conversation? Although it could be any one in the room, you will probably end up starting a conversation with somebody who looks friendly, approachable and less intimidating. Despite having limited information on any of the individuals, your judgement would have been heavily influenced on the basis of facial cues. It does appear that our faces, even with neutral expressions, can reflect some of our characteristics. Personality is considered a stable characteristic with 25 – 50% heritability (Henderson, 1982; Kendler & Baker, 2007; Martin et al., 1986), despite differential familial and environmental factors (Bouchard, 1994; Bouchard & Loehlin, 2001; Rushton, Bons, & Hur, 2008). The stable personality of an individual is also associated with their transient mental and physical health (Barnhofer & Chittka, 2010; Goodwin & Friedman, 2006; Hooker, 2002; Weiss, Bates, & Luciano, 2008), and such characteristics are reflected on individual's faces. Previous research shows that faces display a wealth of information including age (Porcheron, Mauger, & Russell,

2013; Rhodes, 2009), sex (Cellerino, Borghetti, & Sartucci, 2004; Killgore, 2000), race (Carroo, 1986; Golby, Gabrieli, Chiao, & Eberhardt, 2001; Malpass & Kravitz, 1969), emotions (Ekman, Rolls, Perrett, & Ellis, 1992), dominance (Mueller & Mazur, 1997), attractiveness (Jones, Kramer, & Ward, 2014; Kramer, Jones, & Sharma, 2013), mental health (Scott, Kramer, Jones, & Ward, 2013), physical health (Kramer & Ward, 2010) and personality traits (Kramer & Ward, 2010). By nature, some of these characteristics including age, attractiveness, physical-health and mental-health can change with time, environmental factors and biological factors (Fox & Davidson, 2010; McKinlay, McKinlay, & Brambilla, 1987b; Singh-Manoux et al., 2010; Williams, Cunich, & Byles, 2013). More recently researchers have viewed facial cues and facial adaptations from an anthropological perspective (Schmidt & Cohn, 2001). Facial cues are reported to reflect the changes in individual's circumstances, including mood (Girard, Cohn, Mahoor, Mavadati, & Rosenwald, 2013) and physical-health (VanSwearingen, 2008). In this light, face characteristics are considered as phenotypical variants (Chinthapalli et al., 2012; Hammond et al., 2012; Schmidt & Cohn, 2001).

So far we looked at how individual's facial cues reflect their mind. There is also evidence of individual differences in how those facial cues are perceived. Perceptions have been associated to individual's age, sex, transient mental-state and stable personality traits (Frith & Frith, 2008). This adds another level of complexity to social interactions. Subjective differences are therefore not limited to the observed faces, but also to the 'eyes' that perceive. Recent studies have reported genetic basis of face recognition, indicating the heritability of these mechanisms (Shakeshaft & Plomin, 2015). Face processing deficits and social dysfunction are also associated with heritable factors such as personality (Andric et al., 2016; Doty, Japee, Ingvar, &

Ungerleider, 2013; Saito, Nakamura, & Endo, 2005), mood disorders (Leppänen, Milders, Bell, Terriere, & Hietanen, 2004; Leppänen & Nelson, 2006), anxiety disorders (McClure, Pope, Hoberman, Pine, & Leibenluft, 2003), psychotic disorders (Brennan, Harris, & Williams, 2014; Li, Chan, Zhao, Hong, & Gong, 2010) and developmental disorders (Golarai, Grill-Spector, & Reiss, 2006). Although this opens up a wide scope for discussing face-processing deficits, in this thesis I will focus on the ability to make attributions to faces of self and others in relation to individuals' mood and wellbeing states, and personality traits.

1.2 What the eye perceives

Perception is quite subjective and reflective of your mood-state, traits and experiences. Looking through dark glasses is a common but evocative description for individual's experience of depressive symptoms and how it distorts perception. A wide range of research supports this anecdotal evidence. Depressive mood-state is found to elicit attention bias for negative cues (Gollan, Pane, McCloskey, & Coccaro, 2008; Liu, Huang, Wang, Gong, & Chan, 2012), and improved accuracy for negative facial expressions such as sad (Linden, Jackson, Subramanian, Healy, & Linden, 2011; Lopez-Duran, Kuhlman, George, & Kovacs, 2012) and fearful (Yang, Zald, & Blake, 2007). Isaac et al. (2014) reported shorter gaze duration whilst processing happy facial cues in currently depressed individuals, unlike in remitted or non-depressed individuals. This could explain the extensive tendency to attend to negative more than positive cues, whilst experiencing sad mood (Isaac, Vrijsen, Rinck, Speckens, & Becker, 2014; Liu et al., 2012). Due to this tendency for negative perception, individuals experiencing depressive symptoms misattribute neutral facial expression as more negative (Leppänen et al., 2004). In contradiction, research has

also reported individual's accuracy for happy facial expression when experiencing sad mood (Surguladze et al., 2004), suggesting wider misreading of facial cues relating to depression.

Attributions of facial cues is affected not only by depression but also factors associated with it, such as early life stress or abuse (Heim & Binder, 2012; Pollak, 2008), neuroticism (Canli, 2004; Kehoe, Toomey, Balsters, & Bokde, 2011; Perlman, Hein, & Stepp, 2014) and wellbeing (Heller et al., 2013; van Reekum et al., 2007; Vittersø & Dahl, 2013). Research so far suggests not just excessive negative perception but also altered processing of positive cues relating to neuroticism trait (Andric et al., 2016) and depressive state (Fox, Ridgewell, & Ashwin, 2009; Surguladze et al., 2004). It therefore seems that the underlying neural mechanisms that are associated with stress and affective state also affects the processing of facial cues and influence social behaviours.

1.3 The underlying neural mechanisms

Face processing is complex, and the required neural mechanisms comprise diverse and sometimes specialised regions, including the fusiform face area, inferior temporal lobe and superior temporal sulcus (Tsao & Livingstone, 2008). Furthermore, the main focus of this thesis are the attributions made to self and to others on the basis of facial cues, and these attributions are likely to recruit additional networks relating to the attributions of emotions (Ebner, Johnson & Fischer, 2012) and theory of mind (Schulte-Rüther, Markowitsch, Fink & Piefke, 2007).

Attributions of emotions to various facial cues activate prefrontal and anterior temporal cortex (Spunt, Ellsworth & Adolphs, 2016), while attributions to self and others' facial cues activate left lateral orbitofrontal, medial prefrontal (MPFC),

bilateral inferior frontal cortices, superior temporal sulci, temporal poles and right cerebellum (Schulte-Rüther et al., 2007). Attributions of self and others can trigger self-referential processes, which activate MPFC, the posterior cingulate cortex/precuneus and the temporo-parietal junction bilaterally (Schulte-Rüther et al., 2007). While recognition of neutral faces activate anterior cingulate cortex (ACC) and sad faces activate caudate (Hagan, Hoeft, Mackey, Mobbs and Reiss, 2008), nonconscious processing of sad versus happy faces activated amygdala and ACC (Killgore & Yurgelun-Todd, 2004). These evidences show some common networks being activated when making attributions to different types of facial cues of self or others, which are aberrant when experiencing depression.

As discussed previously, when individuals are experiencing depression their processing of facial cues is affected and so are the related cortico-limbic activations (Feng, et al., 2015). The negatively biased attributions relating to depression show reduced cortical activity in ACC, prefrontal and superior parietal cortices (Disner, Beevers, Haigh & Beck, 2011; Kaiser, Bledowski & Dietrich, 2014). This can overlap with increased activity in the subcortical areas such as subgenual cingulate, caudate, putamen, amygdala, thalamus and hippocampus (Disner et al. 2011; Kaiser, et al., 2014). Self-referential processing when experiencing depression shows hyperactivation in these subcortical areas along with differential activation in ACC and MPFC (Disner et al. 2011; Lemogne et al., 2012; Li et al., 2017). Similar activations and deactivations in the cortico-limbic networks are observed during the perception of facial cues in individuals with high neuroticism (Canli, 2004; Hooker, Verosky, Miyakawa, Knight & D'Esposito, 2008) and reduced wellbeing (Canli, 2004; Green & Malhi, 2006; Kong et al., 2015).

Although without our awareness, our transient mood state and more stable traits are modulated by our underlying mechanisms such as neurobiology and neural networks. These mechanisms are constantly responsive to various stimuli in our environment, and forming our behavioural responses. So, although we would like to believe in our autonomy as human beings, we are also part of nature's bio-mechanism. These concepts lead us to the biological theory of emotion processing.

1.4 Theories of emotion processing

James-Lang biological theory of emotion (James, 1884; Lange & Haupt, 1922) : According to this theory, a stimuli or an event produces arousal and physiological responses in the body, for example increased heartbeat or sweating when facing a group. We interpret these physiological responses as the emotions that we feel, for example as fear or anxiety when facing a group. Similarly, we feel sad because of some physical changes in response to some personal loss. This process is illustrated in Figure 1.1. This theory, however, was limited because of exclusive focus on bodily processes and interpretation of emotion as one entity, and not as cognitive processes.

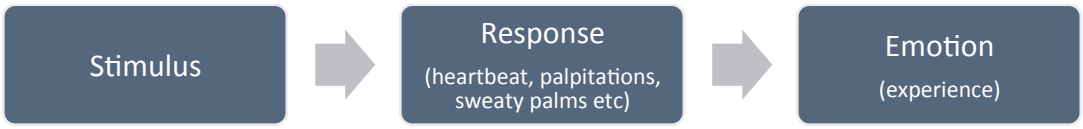


Figure 1.1. Illustration of the process of interpreting emotions according to James-Lange theory of emotion.

Schachter's cognitive theory of emotion (Schachter & Singer, 1962): Schachter further developed the biological theory of emotion by including the process of making attributions. In an experiment with two groups of participants, both injected with epinephrine to induce arousal, Schachter found differential emotional experience between the groups on the basis of their external situational experiences. This suggested that the groups made attributions to their physiological arousal on the basis

of what they perceived around them and hence experienced the respective emotion. On this basis, Schachter added the crucial component of attribution into the previous model (shown in Figure 1.2). Besides the external situational factors, attributions are also affected by internal factors such as personality traits (Seligman, Abramson, Semmel, & von Baeyer, 1979). Thus internal and external factors modulate attributions, and therefore the interpretation of the experienced emotion (Markus & Wurf, 1987).

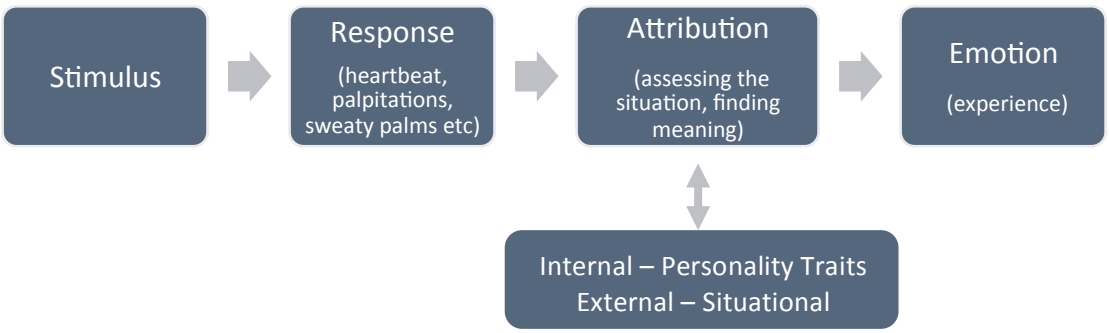


Figure 1.2. Illustration of the processing of emotions according to Schatcher's cogntive theory of emotion.

Attribution process has since been used to explain behaviours, such as learned helplessness, depressive attributions (Seligman et al., 1979) and negative cognitions relating to depressive state (Beck, Rush, Shaw, & Emery, 1979), p.11). Thus by including the aspect of attribution to the above theory, the role of cognitive processes in the experience of emotion became as prominent as the underlying neurobiology. It showed that the inherent neurobiological process might not be the only reason for maladaptation relating to depressive disorder, which is the focus of this thesis. Furthermore, the dynamic cognitive processes being responsive to both internal underlying mechanisms as well as the external situations added complexity to the theoretical basis of depressive disorders. This complexity is also observed in the actual experience or presentation of related symptoms of depression and the criteria for a clinical diagnosis.

1.5 Diagnostic criteria for depression

According to the Diagnostic and Statistical Manual of Mental Disorders - 4th edition (DSM-IV) (American Psychiatric Association, 2000; First, Spitzer, Gibbon, & Williams, 2002), the symptoms for a depressive episode include depressed or irritable mood (melancholia), decreased pleasure or interest (anhedonia), and reduced energy or activity (fatigue) as the core symptoms. Additional symptoms include low self-esteem or confidence, feelings of guilt/worthlessness, pessimistic thoughts, disturbed sleep and appetite, and self-harm or suicidal tendencies or thoughts. A diagnosis can be made when at least five of the above symptoms, including the three core symptoms are persistent nearly every day for at least two weeks. Besides, the diagnostic criteria for the severity of depression are gauged on the basis of how strongly the individual experience the above symptoms. A variety of models were proposed to explain the depressive disorder with its heterogeneous clusters of symptoms. To discuss all the models of depression will be outside the remit of this thesis, and therefore I will focus on those pertinent to the neurobiological and cognitive processes that overlap with the theories of emotions.

1.6 Neurocognitive models of depression

In 1937, Papez proposed the role of neural circuit (i.e. limbic system) in the processing of emotions (Rajmohan & Mohandas, 2007) and this has been the basis for the neurobiological model of emotion. Neurobiological model posits that early life stress or abuse, which is also strongly associated with depression (Cohen et al., 2006; Heim & Binder, 2012), contributes to neurobiological alterations (Felger & Lotrich, 2013). Sustained stress levels relate to hyperactive hypothalamic pituitary adrenal (HPA) axis, producing high levels of cortisol, which is further linked to cytokines

(cellular inflammation), hormones (epinephrine), and neurotransmitters (serotonin) that affect depressive mood-state (Haddad, Saadé, & Safieh-Garabedian, 2002; Pariante & Lightman, 2008; Tian, Hou, Li, & Yuan, 2014). Meanwhile, cognitive theorists posit negative self-evaluations, exaggerated negativity, systematic negative bias, negative schemata and misattributions as depressive cognitions (Beck, 2008). It was proposed that the affective state could be improved by correcting these cognitions (Beck & Bredemeier, 2016).

Reflecting on the theories of emotion, we can see that the above models of depression bilaterally feed into each other. The behavioural or cognitive implications of serotonin mechanisms have been widely researched using neuromodulators such as tryptophan, the precursor for serotonin (Crockett & Fehr, 2014). Tryptophan depletion (TD) studies artificially lowered the brain tryptophan levels, and depleted brain serotonin levels to mimic a depressive neurobiology (Harmer, Rogers, Tunbridge, Cowen, & Goodwin, 2003b; Ruhe, Mason, & Schene, 2007). Studies using face paradigms reported altered facial emotion processing with TD (Harmer, Hill, Taylor, Cowen, & Goodwin, 2003), while blocking serotonin 2A receptors in the prefrontal-amygdala networks specifically affected the processing of negative facial cues (Hornboll et al., 2013; Passamonti et al., 2012). The fronto-limbic networks are consistently found as aberrant in depressed patients (Anderson, Shippen et al., 2011; Harmer et al., 2003), emphasizing the role of this network in mood disorders and face perception.

The interesting finding from these studies was the effect of TD on face perception observed within five hours after depletion and before any experience of mood change, suggesting early changes of subtle behaviours (Harmer et al., 2003b;

Merens, Booij, Haffmans, & van der Does, 2008). Combining the findings from the TD studies to Schatcher's cognitive theory of emotions, we can add another process of early behavioural change prior to the experience of emotion, as illustrated in Figure 1.3. This is exciting because such early behavioural changes could be targeted to assess early intervention response for depression (illustrated in Figure 1.4). It could even be a behavioural marker of depression (Owens et al., 2014).

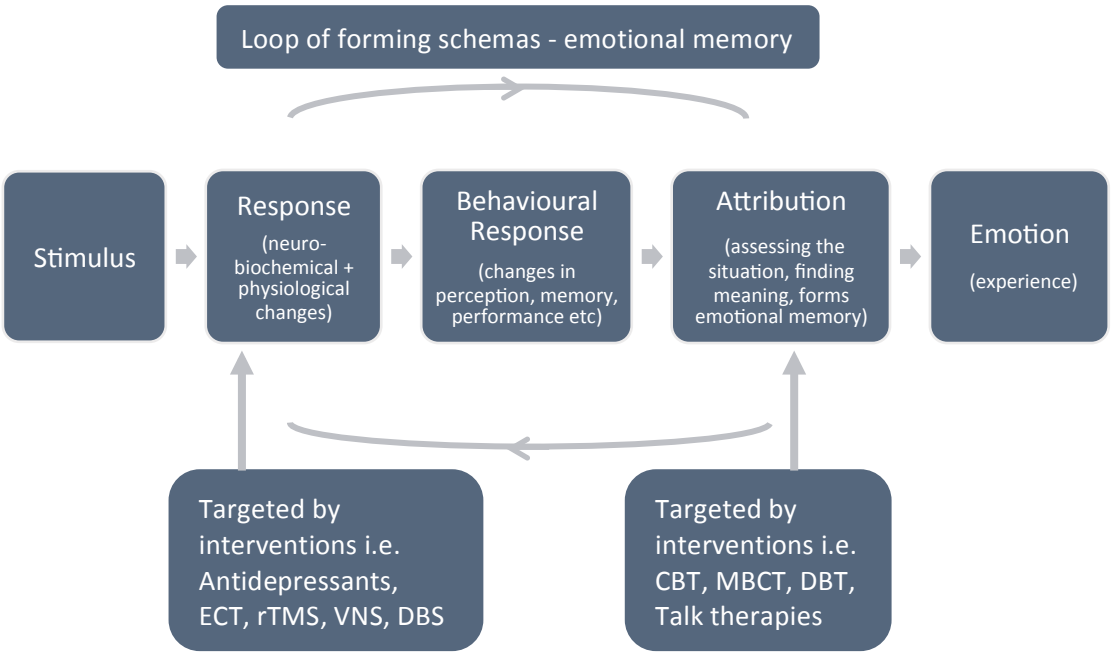


Figure 1.3. Illustration of the processing of emotions, after combining Schatcher's cogntive theory of emotion and early behavioural changes due to neurobiological changes as demonstrated by acute tryptophan depletion studies. ECT, Electroconvulsive therapy; rTMS, Repeated Transcranial magnetic sitmulation; VNS, Vegus nerve stimulation; DBS, Deep brain stimulation; CBT, Cognitive behavioural therapy; MBCT, Mindfulness based cognitive therapy; DBT, Dialectical behaviour therapy.

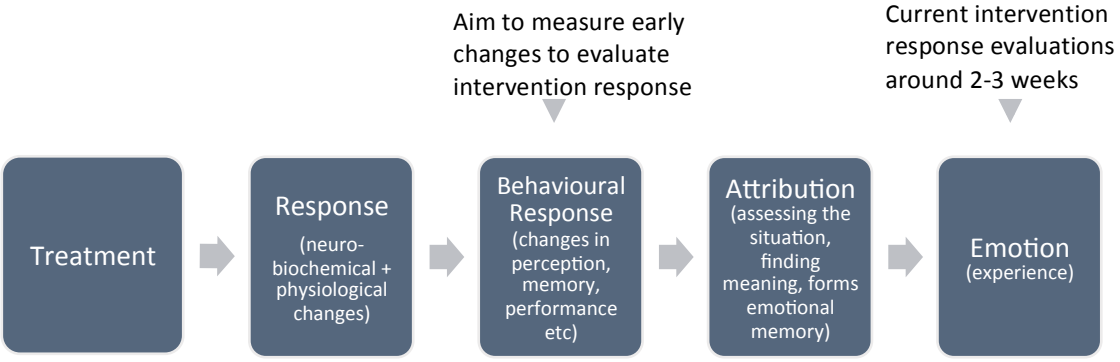


Figure 1.4. Illustration of the proposed process for identifying early behvaioural changes.

1.7 Implications of behavioural marker

The need for behavioural markers that can contribute to early prediction of intervention response directly relates to the complexity of depressive disorder, and the non-existence of a single effective intervention that works for all (Trivedi et al., 2013). Existing interventions include talk therapies, Cognitive Behavioural Therapy, mindfulness therapy, Dialectical Behavioral Therapy and antidepressants for mild to moderate depression, and Electroconvulsive Therapy, repeated Transcranial Magnetic Stimulation, Vegus Nerve Stimulation and Deep Brain Stimulation for severe depression (Wong & Licinio, 2001; Mayberg, 2003). Currently, the effective intervention for each individual is identified by administering series of monotherapies or combinations (Dunlop & Aaron, 2010; Dunlop et al., 2012). It can take at least two to three weeks to identify response to treatments through self-reports of improved mood (Thase, Shelton, & Khan, 2006; Tranter et al., 2009; Trivedi et al., 2006). Unfortunately, all the interventions require similar testing periods which prolong the overall trial and error period. This means the individual is in a depressive state for longer than optimal, impacting on prolonged disease burden. Disease burden is a measure of time lost on the basis of reduced quality of life or loss of life due to suicides (World Health Organization, 2007). By identifying early predictors, such as bio or behavioural markers, we can essentially reduce the trial and error period in identifying the effective intervention (Owens et al., 2014; Roiser, Elliott, & Sahakian, 2012; Thase, 2014). Effective interventions at an early stage of depressive disorder will naturally improve the outcome, quality of life and reduce disease burden (Schoenbaum et al., 2001; Unützer et al., 2002). National Health Service can thereby improve the cost effectiveness of interventions for depression, and society can further

benefit from the productivity of those with improved functioning following remission (Beddington et al., 2008; Wittchen et al., 2011).

1.8 A new behavioural task: face processing and depression

The next step is to identify the best behavioural task that can measure these early and subtle behavioural changes. A face paradigm seems an obvious choice since face processing shares the neural networks that are known to be aberrant in depression (Hall et al., 2014; Shi et al., 2015; Stuhrmann, Suslow, & Dannlowski, 2011) and involves visual stimuli processing that requires less cognitive load (Klingner, Tversky, & Hanrahan, 2011). Currently, the face paradigms used to investigate depression-related perceptions are limited to facial emotions (Harmer, Goodwin, & Cowen, 2009; Harmer, Mackay, Reid, Cowen, & Goodwin, 2006; Joormann, Gilbert, & Gotlib, 2010; Pagliaccio, Luby, Luking, Belden, & Barch, 2014). Some studies have used such emotional face-processing tasks longitudinally to track changes in perception with changes in mood over time, but used different emotions and paradigms (Johnstone et al., 2005; Münkler, Rothkirch, Dalati, Schmack, & Sterzer, 2015; Victor, Furey, Fromm, Öhman, & Drevets, 2010). However, the keynotes from the results of these studies were increased amygdala reactivity to fearful expressions (Johnstone et al., 2005); greater intensity of happy expression required for recognition (Münkler et al., 2015); negative perceptual bias relating to current clinical mood state (Münkler et al., 2015); and resolving negative bias coupled with developing positive bias after antidepressant treatment (Victor et al., 2010). Behavioural effects relating to depressive symptoms were also demonstrated as reduced accuracy for sad, angry, and fearful faces (Anderson et al., 2011).

Interestingly, greater misattribution of neutral expression compared to emotions has been demonstrated, when experiencing depression (Leppänen et al., 2004; Maniglio et al., 2014). Metaphorically, a neutral face could be described as a blank screen onto which individuals project their internal experience. The famous painting of Mona Lisa (La Gioconda) by Leonardo da Vinci is a timeless classic that still captivates people's imagination by the enigmatic 'smile'. Some people see the famous expression as a smile of contentment, while others see it as a hidden heartbreak; the opposite ends of the emotion spectrum. The American lyricist Ray Evans and songwriter Jay Harold Livingston queried in their classic song Mona Lisa, '*Do you smile to tempt a lover, Mona Lisa, Or is this your way to hide a broken heart',* trying to unravel this ambiguity (Bennett, 2013). Kontsevich and Tyler (2004) investigated the perception of the subtle facial expression by manipulating noise (grains) to the picture and location-specific features (areas of eyes and mouth), but found that only corners of the mouth related to sad-happy change of facial expression. This research overlooked the crucial influence of observer's transient mood state and inherent traits on their perceptions, which would have provided subjective meanings (Kontsevich & Tyler, 2004).

Research has shown evidence of mood-congruent misattributions of neutral faces as sad when experiencing depressive symptoms (Maniglio et al., 2014). Similar misattribution errors are identified when neutral and low-arousal facial expressions are perceived as emotions with greater arousal (Csukly, Czobor, Szily, Takács, & Simon, 2009; Maniglio et al., 2014). The potential to investigate similar misattributions relating to depression in self-context is more intriguing. There is evidence of increased self-descriptive negative memory (verbal) during depressive episode and increased positive memory with improved mood (Johnson, Joormann, &

Gotlib, 2007; Tranter et al., 2009; Warren, Pringle, & Harmer, 2015). It therefore seems reasonable to propose that with improved mood, neutral looking self-faces could be attributed as more positive. This shift in perception of a neutral self-face could be a better demonstration of mood-congruent face perception, and by measuring this change we could target the shift in the internal affective experience of individuals.

1.9 Self-attribution and depression

Prior studies have used neutral looking self-face to investigate self-recognition and individual's mental representation of self (Allen, Brady, & Tredoux, 2009; Felisberti & Musholt, 2014; Kircher et al., 2001). Allen et al. (2009) investigated individual's preference for the appearance of their actual face or caricatures (with exaggerated features that stand out) or anti-caricatures (with understated average features). The study reported anti-caricature bias for self and friend, and consistent with previous result (Rhodes & Moody, 1990), suggests that memory for a specific face is not a caricature but is more similar to an average face than the actual face. Average faces are typically judged to be attractive (Langlois & Roggman, 1990; Rhodes & Tremewan, 1996; Valentine, Darling, & & Donnelly, 2004) and because anti-caricature images are more similar to an average face than the actual face, the observed bias could be explained as the preference for more attractive faces.

Allen et al. (2009) further demonstrated the advantage for quicker recognition of caricature due to exaggerated features, which concurs with previous result of greater memory for caricatures (Mauro & Kubovy, 1992). It appears that individuals experiencing depression require similarly exaggerated facial expression for accurate perception (LeMoult, Joormann, Sherdell, Wright, & Gotlib, 2009), because they are less able to discriminate between varying intensity of facial emotional expressions

(Anderson et al., 2011). Therefore, individuals experiencing depression rely on exaggerated appearances than ambiguous ones, which is contrary to the average anti-caricature bias demonstrated in the general population. Such individual differences in perception of facial expressions have also been associated with inherent personality traits relating to depression, such as alexithymia and neuroticism (Cremers et al., 2009; Suslow et al., 2016), and even genetic variance (Tamm, Kreegipuu, & Harro, 2016).

Additionally, Felisberti and Musholt (2014) reported individual differences in mental representation of self whilst perceiving self-face. Their results demonstrated accuracy for self-face. However, they also demonstrated the preference of individuals with lower self-esteem to manipulate their facial appearance in order to increase attractiveness. This indicates that individuals with lower self-esteem are unsatisfied by their actual appearance as is evidenced by previous research (Barker & Bornstein, 2010), and the opposing proposition would be increased self-esteem enhancing satisfaction with self-appearance (Tiwari, 2014). Increased self-esteem is associated with improved mood (Ikegami, 2002; Kim et al., 2015), and therefore supports the potential for paradigms with self-face to measure changes in self-attribution with improving mood.

The core depressive symptoms are strongly anchored as internalising negativity to self and contrastingly, mood improvements imply reducing self-negativity. It is quite intriguing how these self-perceptions change with a change in affective state, and this could be explained by the common underlying neural activations. Functional imaging studies have reported altered prefrontal, anterior cingulate and limbic activations with sad or depressive mood (Davidson, Pizzagalli,

Nitschke, & Putnam, 2002; Mayberg et al., 1999; F. C. Murphy, Nimmo-Smith, & Lawrence, 2003; Phan, Wager, Taylor, & Liberzon, 2002). Incidentally, the same neural networks including fronto-limbic networks are also involved in the processing of self-face and self-referential mental processes (Keenan, Wheeler, Gallup Jr, & Pascual-Leone, 2000; Kircher et al., 2000; Northoff et al., 2006; Northoff & Panksepp, 2008; Platek, Wathne, Tierney, & Thomson, 2008; Qin & Northoff, 2011; Uddin, Iacoboni, Lange, & Keenan, 2007), which could explain increasing self-negativity whilst experiencing depression. Thus, a neutral looking self-face seems to be the ideal stimuli to measure the early behavioural response to change in fronto-limbic networks that relate to depressive symptoms. This could provide measures of mood-sensitive self-attributions that change in response to effective interventions.

1.10 The current thesis

As discussed through this chapter, there is ample evidence for subjective signals of transient state and stable traits being displayed on neutral looking faces. Furthermore, the processing of facial cues relies heavily on perceivers' mood and personality traits, and shares neural networks that are altered when experiencing depression. Investigations of depression related misattribution of faces have so far used paradigms with facial emotions, whereas, the use of self-attributions have generally been limited to investigating self-recognition and attractiveness. There is simply inadequate knowledge about self-face processing in relation to subjective mood-state and stable traits, and we do not yet know whether or how attributions about one's own facial appearances relate to depressive symptoms. It will be useful to understand if general self-negativity relating to depressive state is also observed when processing self-face. I aim to develop a new paradigm using self-face that will be

sensitive to subtle behavioural changes associated with changes in severity of depression and wellbeing state, the process of which will be demonstrated through this thesis.

There is also the question, whether a construed self-perception when experiencing depression can affect one's perception of others. Projecting experiences of self onto others whilst making inferences or attributions is explained as social projection (Robbins & Krueger, 2005), and describes how misattributions occur and could lead to maladaptive social behaviours or dysfunctions (Van Boven & Loewenstein, 2003). More specifically, in the cognitive model of depression, Beck et al. (1979) proposed the dysfunctional belief system affecting dysfunctional behaviours using the negative cognitive triad; that is negativity of self, the world, and the future. I endeavour to measure such negative cognitions relating to self and other individuals using our proposed face paradigm. This will provide new insight into how current mood state can modulate more implicit cognitive processes relating to attributions of faces of self and others. Finally, I measure changes of such cognitive processes that relate to change in severity of depression and wellbeing state, which will provide evidence for potential behavioural markers to predict early intervention response.

This thesis contains four main parts. Part A is titled 'The Prelude', which presents a study that informs later studies that investigate mood congruent attributions. In Chapter 2, I investigate the behavioural composition of a representative population of Bangor University students. The aim is to investigate wellbeing and neuroticism as the predictors of depression in this population.

Part B has two chapters (i.e. Chapter 3 and 4) and is titled 'The Development', as it presents the process of developing our attribution task using face stimuli. In Chapter 3, I develop and pilot an attribution task with the aim to identify the best of three (agreeableness, neuroticism, and depression) implicit face scales. Based on the results thus far, the neurotic face scale is selected for the later attribution studies. In Chapter 4, there are two studies in which I aim to investigate the various positive and negative attributions as well as attributions of fear individuals make to neurotic facial cues, indicating related biases.

Part C is titled 'Attributions Of Facial Appearance' and it presents the studies on self- (Chapter 5), social- (Chapter 6), and observer- attributions, and compares the three contexts (Chapter 7). In Chapter 5, I investigate our novel self-attribution task and the sensitivity of its individualised measures to subjective mood, wellbeing and neuroticism. This is the first of the main experimental chapters in this thesis in which I aim to measure changes in self-attribution, specifically increase in self-negativity, with increasing severity of depression, wellbeing and neuroticism. In Chapter 6, I investigate the sensitivity of our social attribution task to the subjective measures mentioned above and the process of social projection in visual modality. This is the second experimental chapter in which I aim to measure changes in social attribution relating to increasing severity of depression, wellbeing and neuroticism, and demonstrate evidence for social projection with social attribution being similar to self-attribution. In Chapter 7, I compare the attributions of observers with actor's self and social attributions as a triangulation study. I also investigate the association of observers' attributions with actor's mood, wellbeing and neuroticism. In this final experimental chapter in Part C, I aim to identify the similarities and dissimilarities

between actor's self-attribution and observers' attributions of the actors, and the relation of these attributions to actor's depression.

Part D is titled 'The Clinical Application Of Self-attribution' and it presents the clinical study (Chapter 8). In Chapter 8, I use our self and social attribution tasks in a longitudinal study with individuals experiencing clinical depression. The design has five time-points over a period of 11-12 weeks. I investigate the sensitivity of self-attributions to the changes in the severity of depressive symptoms and wellbeing, over the study period. In this experimental chapter, I aim to measure the changes in self and social attributions longitudinally over 11-12 weeks that overlaps with changes in depression. I also aim to measure the change in self-attribution in the first week to predict depression score at Week 11, as an attempt to identify potential early behavioural predictors of mood-state.

Finally in Chapter 9, I discuss the experimental findings, limitations, future implications and further research. Within this chapter, I briefly discuss the results from a small pilot study showing increase in self-positivity after mindfulness practice, to demonstrate the potential use of our self-attribution task in future research.

PART A – The prelude

In this section, I will discuss a study that forms the prelude to later studies. This study will provide evidence to support and rationalise later studies in this thesis relating to appearance, depression, and the associations among depression-related traits.

In Chapter 2, we investigate the composition of a sample student population at Bangor University with regard to their mood, wellbeing and personality traits. Besides giving a picture of the underlying behavioural composition of this population, the results of this study would inform later studies. For example, underlying sex difference in some personality traits in the population could skew the results of later studies; therefore exploring the population composition equips us to interpret later results meaningfully. It also provides a strong indication of the predictors of depression in our student population. This predictor model will be used in later studies to investigate its association with self and social attributions.

CHAPTER 2 – Neuroticism and wellbeing: Predictors of depression

Abstract

Depression is related to various factors including genetic, biological, behavioural and social factors. Although some predictors of depression such as trait neuroticism seem robust, depression is a heterogeneous disorder and we wished to better understand the variable structure that best described depression-related traits in our test population. We use behavioural and social factors to construct models that predict depression in our target population, the students at Bangor University. Prior studies have reported age, sex, personality traits and wellbeing as some of the factors associated with depression. We measured personality traits, eudemonic wellbeing and hedonic wellbeing to construct models that were tested using linear regression. The results indicate that neuroticism and wellbeing (eudemonic and hedonic) are predictors of depression. Neither age nor sex were significant predictors of depression in this sample. These findings suggest that the global constructs of neuroticism and wellbeing but not age or sex, as predictors of depression apply to our target population.

2.1 Introduction

In this chapter, I will discuss the characteristics of the target population that is relevant to later studies. My key interest was to explore the interplay of personality traits, wellbeing and mood state within the student population of Bangor University. The knowledge of causes and consequences of these characteristics will be informative of the group's behaviour and attribution within this social environment.

Previous research reported personality traits, especially neuroticism, as strongly associated with depression (Fergusson, Horwood, & Lawton, 1989; Lahey, 2009; Takano et al., 2007). Neurotic traits are described by the Mini International Personality Item Pool (MIPIP) as frequent experience of extreme emotions or anxiety (Donnellan et al., 2006). Neurotic individuals understandably experience negative emotions more frequently, and this can impact on subjective wellbeing (Steel, Schmidt, & Shultz, 2008b) and mood state (Lahey, 2009). Thus, combinations of different traits, internal and external factors also can mediate and moderate depression (Papakostas & Fava, 2008). Studies have found that being introvert and neurotic can decrease individual's happiness (Hotard, McFatter, McWhirter, & Stegall, 1989; Pavot, Diener, & Fujita, 1990), which is closely related to individual's subjective wellbeing.

Subjective wellbeing refers to a combination of eudemonic and hedonic wellbeing (Deci & Ryan, 2008; Vanhoutte, 2014), and has been identified as another moderator of mental health (Huppert, 2009). Previous studies have found low wellbeing as highly associated with incidence of depressive disorder (Grant, Guille, & Sen, 2013). Research on wellbeing has used a variety of subjective measures that may be relevant to the respective population. Eudemonic wellbeing refers to happiness within ones own control (Ryan, Huta, & Deci, 2008; Steel, Schmidt, & Shultz, 2008a), living a life of virtue and self-actualisation (Delle Fave, Massimini, & Bassi, 2011) , where as hedonic wellbeing refers to maximising ones pleasurable experiences (Delle Fave et al., 2011).

In this study, we investigate the associations between individuals' mood state, wellbeing (hedonic and eudemonic) state and personality traits in the population

targeted for further research. Wellbeing and neuroticism are proposed as significant predictors of depression in the target student population. Besides the main hypothesis, this study has another implication. Part of the data included in the main analysis here includes those obtained from participants who completed the self and social attribution study which is later discussed in Part C. Therefore the interrelations between wellbeing, traits and mood state discussed in this study will inform the attribution measures in the respective later studies.

2.2 Methods

We collected data over two separate studies with independent participants. The School of Psychology Ethics and Governance Committee, Bangor University approved the studies. Initially, 209 (128 female) participants with mean age of 21.63±5 and range of 17 – 54 completed measures for depression, personality traits and wellbeing. Later, the same measures were obtained from the 100 (69 female) participants with mean age of 20.41±4.75 and age range of 18 – 56, from the self and social attribution studies. Data from both studies are used here. All participants were recruited from Bangor University's student population, debriefed at the end of the study and provided with information regarding available psychological support.

Depression was measured using the Inventory of Depressive Symptomology – self rated (IDS) (Rush et al., 1986; Rush, Gullion, Basco, Jarrett, & and Trivedi, 1996). This measure assessed severity of all depressive symptoms in the seven day period prior to assessment, according to DSM-IV (American Psychiatric Association, 2000). There are 30 questions with responses from 0 (symptom not present) – 3 (symptom present always). Sum of 28 responses provided the total score that ranged from 0 to 84. From the two questions on increase or decrease of appetite and weight,

only one response for each was used to calculate the total score. Severity was graded as follows; 0–13 as ‘not depressed’, 14–25 as ‘mildly depressed’, 26–38 as ‘moderately depressed’, 39–48 as ‘severely depressed’, and 49–84 as ‘very severely depressed’.

In this study, the subjective wellbeing comprised of measures of eudemonic and hedonic wellbeing. Eudemonic wellbeing was measured using the Flourishing Scale (FS) (Diener et al., 2010), which had eight items describing aspects of human functioning, ranging from positive relationships to feelings of competence and purpose in life. The responses from 1 (strongly agree) to 7 (strongly disagree) were summed to obtain the total wellbeing score that range from 8 (lowest) to 56 (highest). Hedonic wellbeing was measured using the Scale for Positive and Negative Experiences (SPANE) (Diener et al., 2010), which is a 12-item questionnaire with six items to assess occurrence of positive feelings and the other six items relating to occurrence of negative feelings. The responses varied from 1 (very rarely or never) to 5 (very often or always). The score for positive experiences was the sum of responses for positive feeling, and the score for negative experiences was the sum of the responses for negative feelings. Both these scores vary from 6 (lowest) to 30 (highest), that is bigger scores indicating more frequent positive and negative experiences. Affect balance is computed by subtracting experience scores of negative from positive, indicating a balanced experience. The scores ranged from -24 (unhappiest) to 24 (highest balanced experience); positive/bigger scores indicate more positive than negative experiences.

The personality traits were measured using the MIPIP (Donnellan et al., 2006), which is a 20-item questionnaire; four questions relating to each of the big five

personality traits. Reponses varied from 1 (very inaccurate) to 5 (very accurate), and they were averaged per trait to obtain scores for agreeableness, conscientiousness, extraversion, neuroticism and openness. The scores ranged from 0 (lowest trait quality) to 5 (most trait quality).

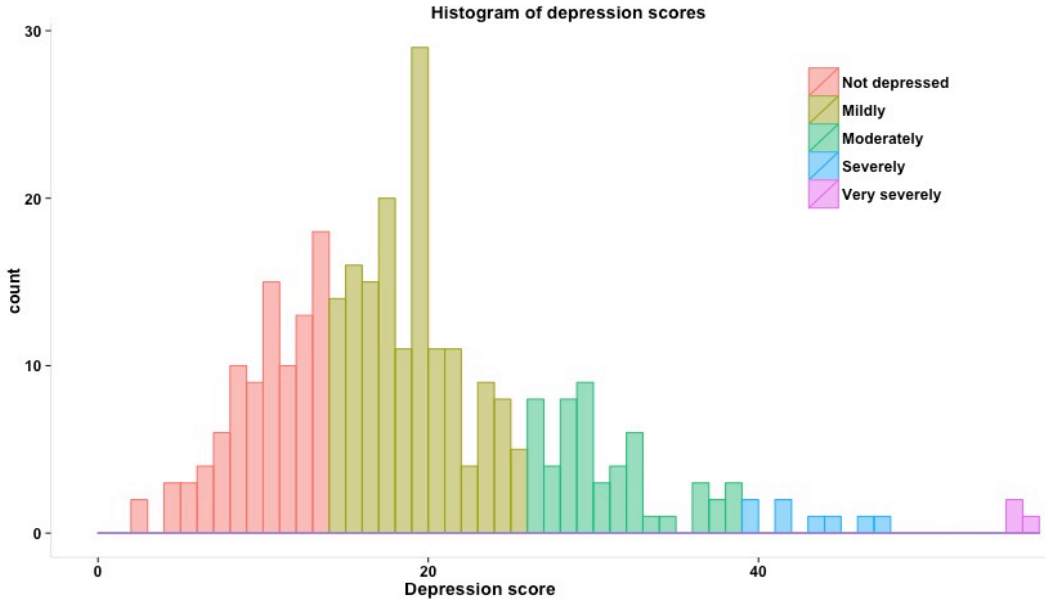
2.3 Results

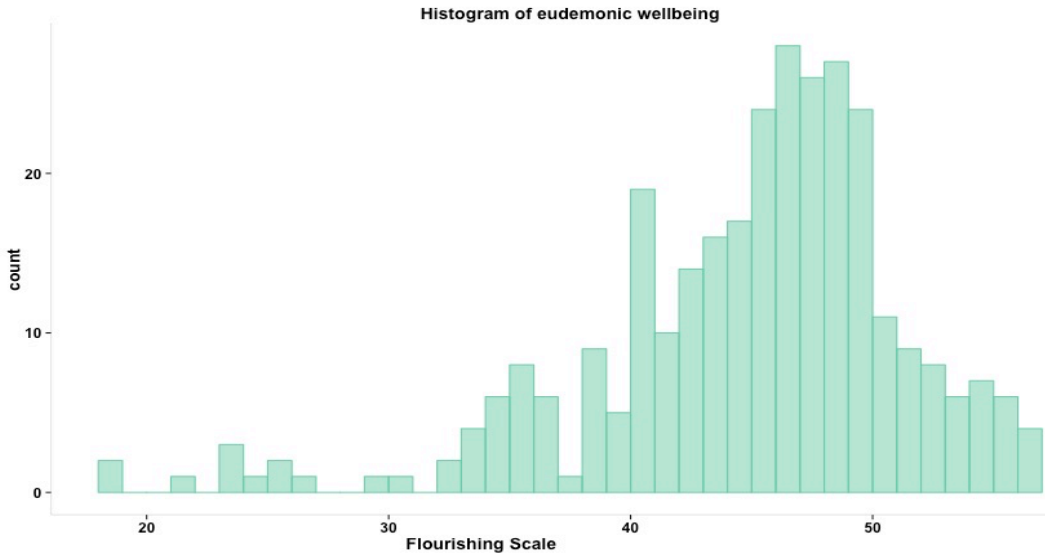
The group mean (*M*) and standard deviation (*SD*) of the measures are given in Table 2.1. The initial study had a total of 209 (128 female) participants (age *M* = 21.63, *SD* = 5.00, age range 17 – 54) and in the later study we recruited a total of 100 (69 female) participants (age *M* = 20.41, *SD* = 4.72, and range = 18 – 56). The distribution of depression and wellbeing, of the merged data, is shown in Figure 2.1.

Table 2.1. Mean and standard deviation of age, depression, wellbeing and personality for females, males, and total group.

	Females (*n* = 197)	**Males** (*n* = 112)	**Total** (*n* = 309)
Age	21.47 (5.676)	20.79 (3.251)	21.22 (4.939)
Depression score (IDS)	19.47 (9.143)	17.61 (9.027)	18.80 (9.131)
Flourishing Scale (FS)	44.40 (6.531)	44.11 (6.901)	44.29 (6.658)
Scale of positive and negative experiences (SPANE)			
Positive experience	23.23 (4.349)	22.80 (3.982)	23.08 (4.218)
Negative experience	13.43 (3.952)	12.63 (3.470)	13.14 (3.798)
Balanced experience	9.80 (7.665)	10.18 (6.717)	9.94 (7.327)
Personality traits			
Agreeableness	4.162 (0.648)	3.978 (0.718)	4.09 (0.679)
Conscientiousness	3.405 (0.862)	3.212 (0.808)	3.335 (0.847)
Extraversion	3.307 (0.963)	3.383 (0.915)	3.334 (0.945)
Neuroticism	3.026 (0.819)	2.511 (0.904)	2.839 (0.884)
Openness	3.815 (0.654)	4.049 (0.717)	3.899 (0.686)

Note. Descriptive statistics are reported as mean (standard deviation); *n,* Sample size*;* IDS, Inventory of Depressive Symptomology; FS, Flourishing Scale, SPANE, Scale of Positive and Negative Experiences.





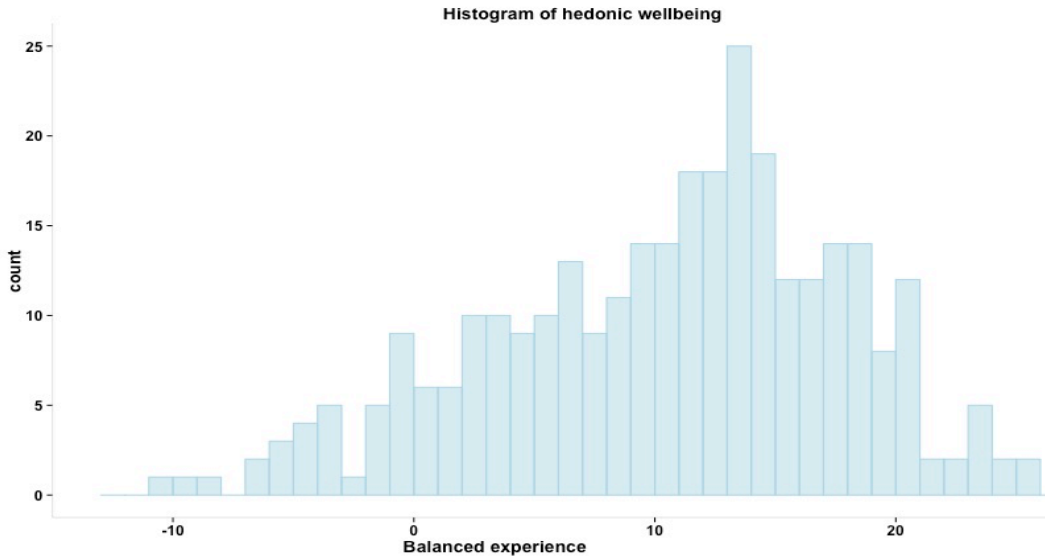


Figure 2.1. Distribution of depression and wellbeing measured in the target population.

We used one-way ANOVA to examine sex difference. Additional analyses were conducted using correlation and linear regression with three models to identify the predictors for depression. The base model (Model 1) included only the neuroticism score, the FS score was entered to the base model to form Model 2, and the balanced experience score was entered to the second model to form Model 3. This sample satisfactorily met all the assumptions of multiple linear regression analysis.

2.3.1 Sex difference

There were significant sex difference in scores of neuroticism, $F(1, 308) = 26.146$, $p < .001$, agreeableness $F(1, 308) = 5.318$, $p = .02$, and openness, $F(1, 308) = 8.543$, $p = .004$ (greater openness for males). However, no significant sex difference was found for depression scores, $F(1, 308) = 2.99$, $p = .085$, despite mean depression score being greater for females (19.47±9.14) than males (17.61±9.03).

2.3.2 Generalizability of the depression measured using IDS

One sample *t* test shows that the group mean depression score of 18.80 measured from the Bangor University student population was not significantly different, $t(308) = 0.82$, $p = 0.41$, from the mean score of 18.37 from a population sample of Netherlands with $n = 2981$ (Licht et al., 2008) or, $t(308) = 1.03$, $p = .30$, from the mean score of 18.26 from a population sample of South Carolina (Pincus et al., 2010). This suggests the depression measure used in this study is providing a measure that is generalizable and not displaying characteristics specific to the student population at Bangor University. The two datasets used in the analysis within this chapter were collected at different times across the academic year. One-way ANOVA comparing depression scores from the two datasets showed no significant difference, $F(1, 307) = .004$, $p = 0.95$. This result and the comparisons with population samples

suggest the depression measure used in this study is not displaying characteristics specific to students during any particular time in the academic year.

2.3.3 Correlations analysis

Age did not correlate with any of the measures.

Personality scores: Agreeableness correlated positively with extraversion (r = .162, p = .004), and openness (r = .163, p = .004). Conscientiousness correlated negatively with neuroticism (r = -.116, p = .04) and openness (r = -.144, p = .01). Extraversion correlated negatively with neuroticism (r = -.148, p = .009) and positively with openness (r = .130, p = .02).

Mood state: Depression (IDS) correlated significantly with eudemonic wellbeing scores of FS (r = -.486, p < .001), and hedonic wellbeing scores of positive experience (r = -.551, p < .001), negative experience (r = .604, p < .001) and balanced experience (r = -.630, p < .001). It was also significantly correlated with neuroticism (r = .492, p < .001). The significant correlations are shown in Figure 2.2.

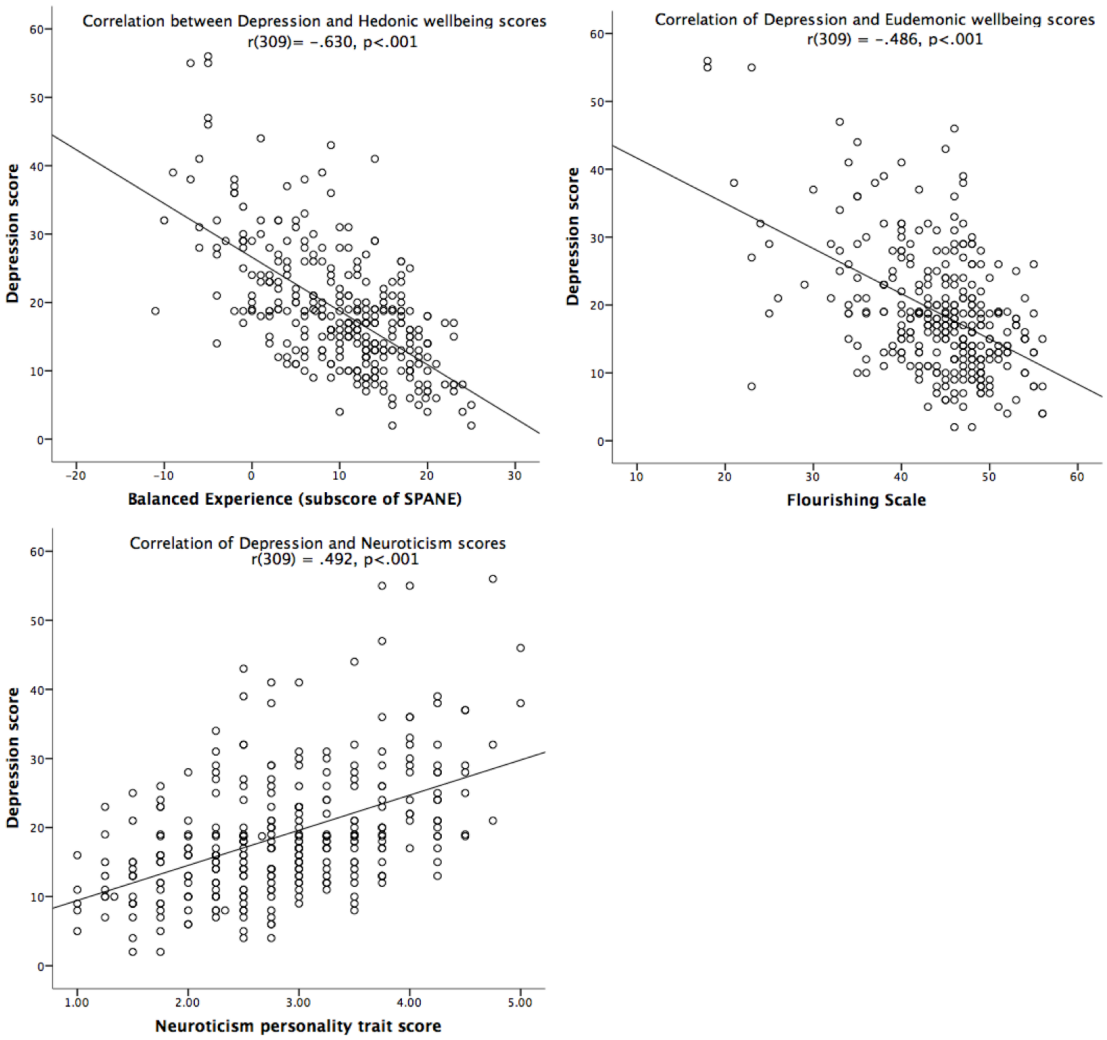


Figure 2.2. The significant correlations of depression score with the predictor variables of hedonic wellbeing, eudemonic wellbeing, and neuroticism scores. SPANE, Scale of Positive and Negative Experiences.

Eudemonic wellbeing: The FS score correlated significantly with hedonic wellbeing scores of positive experience (r = .587, p < .001), negative experience (r = -.506, p < .001) and balanced experience (r = .600, p < .001). It correlated positively with agreeableness (r = .215, p < .001), conscientiousness (r = .276, p < .001), extroversion (r = .303, p < .001) and negatively with neuroticism (r = -.340, p < .001).

Hedonic wellbeing: Positive experience significantly correlated with negative experience (r = -.670, p < .001) and balanced experience (r = .923, p < .001). It also correlated positively with agreeableness (r = .164, p = .004), conscientiousness (r =

.172, $p = .002$), extroversion ($r = .261$, $p < .001$) and negatively with neuroticism ($r = -.424$, $p < .001$).

Negative experience significantly correlated with balanced experience ($r = -.904$, $p < .001$). It also correlated negatively with conscientiousness ($r = -.194$, $p = .001$), extroversion ($r = -.199$, $p < .001$) and positively with neuroticism ($r = .573$, $p < .001$).

Balanced experience correlated positively with conscientiousness ($r = .200$, $p < .001$), extroversion ($r = .254$, $p < .001$) and negatively with neuroticism ($r = -.541$, $p < .001$).

2.3.4 Multiple regression analysis

Model 1 with neuroticism [$r^2 = .243$, $F(1, 307) = 98.29$ $p < .001$], Model 2 including eudemonic wellbeing [$r^2 = .357$, $F(2, 306) = 84.99$, $p < .001$] and Model 3 including hedonic wellbeing [$r^2 = .447$, $F(3, 305) = 82.10$, $p < .001$] were all significant predictors of depression. The results are shown in Table 2.2.

The beta coefficient for neuroticism ($\beta = .211$, $t = 4.157$ $p < .001$) maintains the positive relationship, that is, an increase in neuroticism will increase depression. Eudemonic wellbeing ($\beta = -.163$, $t = -3.059$, $p = .002$) and hedonic wellbeing ($\beta = -.419$, $t = -7.030$, $p < .001$) indicate a negative relationship, that is, an increase in subjective wellbeing relates to decreasing depression.

Table 2.2. The r^2 and F values for each of the three models predicting depression and the β and t values of each predictor variables within the respective models.

Models	r^2	F	Predictor variables	β	t	$Part^2$
1	.243	98.29 **	*Neuroticism*	.492	9.914**	24.21%
2	.357	84.99**	*Neuroticism*	.370	7.589**	12.11%
			Flourishing	-.360	-7.385**	11.49%
3	.447	82.10**	*Neuroticism*	.211	4.157**	3.13%
			Flourishing	-.163	-3.059*	1.69%
			Balanced experience	-.419	-7.030**	8.9%

Note. ** $p < .001$, * $p < .005$

2.4 Discussion

We investigated predictors of depression in the student population at Bangor University. The main theme throughout the later studies is the effect of mood, wellbeing and personalities on individual's attributions. It is therefore, essential to understand the interrelations between these measures obtained from our target group.

Contrary to existing evidence, neither age nor sex showed association with depression. One-way ANOVA comparing mean depression score showed no significant sex difference. Previous population studies have shown females having higher incidence of depression (Kessler et al., 2003; Piccinelli & Wilkinson, 2000). It is not clear why our group did not show similar sex difference, although the mean depression score was greater for females than males. The limited age range in this sample, with a composition of 90% aged 17 – 24 and 10% aged 25 – 56, may have implications on limited life experiences and other mediating factors of depression.

Regression analysis showed strong association of depression scores with wellbeing and neuroticism scores. Model 3 with neuroticism, eudemonic and hedonic wellbeing was a significant predictor of depression. It was evident from the β coefficients for hedonic wellbeing, neuroticism and eudemonic wellbeing that they contributed towards predicting depression, in that order. The results showed that an increase in neuroticism and decrease in subjective wellbeing (that is, hedonic and eudemonic wellbeing) could increase depression in this sample student population. It is interesting that by including hedonic wellbeing into Model 3, the β coefficient for neuroticism was reduced. This is consistent with existing evidence that improving wellbeing can moderate the effect of neuroticism (inherent trait) as a predictor of depressive disorder (Barnhofer, Duggan, & Griffith, 2011). Previous studies have found neuroticism trait as a significant predictor of most mental health disorders (Lahey, 2009). Studies have also found low wellbeing as a risk factor for depressive symptoms under stress (Grant et al., 2013), although the wellbeing measures were different from those used in this study. Thus, our study has provided insight into the construct of mental health using the measures of FS, SPANE and IDS in our target population. The target population of this study is limited to the students in Bangor University, although they make up a sample from countries across the world including European, Middle East and Asian countries.

We reported eudemonic wellbeing being correlated with hedonic wellbeing. Greater eudemonic wellbeing can affect how life events are experienced or in another perspective, a balanced (more positive and less negative) experience in life can improve eudemonic wellbeing. This mutually contributing relationship has been demonstrated in previous studies (Diener et al., 2010; Schotanus-Dijkstra et al., 2016).

Individual's wellbeing was also associated with personality traits in this study. Conscientious, extrovert and less neurotic traits were found to be associated with greater hedonic wellbeing. The three traits, along with agreeableness, were also found to be associated with greater eudemonic wellbeing in our study. Villieux et al., (2016), using the French version of FS, reported similar relationship of eudemonic wellbeing with conscientiousness, extroversion and less neuroticism. Steel et al., (2008a) also found similar associations between personality traits and subjective wellbeing providing a consistent picture of wellbeing as an inherent trait. Adoption and twin studies showed evidence for genetic influence on 80% of the stability of subjective wellbeing (Lykken & Tellegen, 1996; Nes, Røysamb, Tambs, Harris, & Reichborn-Kjennerud, 2006), which is unlike individual's mood-state that is mainly affected by environmental factors (Lyubomirsky, King, & Diener, 2005; Steel et al., 2008a). Diener and Lucas (1999) concluded that a substantial portion of stable subjective wellbeing is due to personality.

The impact of personality on wellbeing seems self-explanatory, although the attributions made to different personality traits can be subjective and vary between individuals. Agreeable person is friendly, and therefore more successful in social bonding (quality and quantity). A conscientious person is meticulous, highly focused and well planned in work and life. This could account for self-realisation, improved self-esteem and over all life satisfaction. An extrovert has the drive and energy to meet new people and develop relationships. Increased socialising can improve self-esteem, life experiences and over all life satisfaction. A less neurotic person would be emotionally better equipped to deal with the dynamics of social relationships in a stable manner. This emotional stability can mediate individual's subjective experience by moderating extreme negative feelings and impact subjective wellbeing (Villieux,

Sovet, Jung, & Guilbert, 2016). Although the personality inventories measure and identify individuals' traits, they do not give a full picture of individuals' social behaviour. Social behaviours are influenced by complex interactions between individuals, and this can be affected when different personality traits are attributed as positive or negative. All the studies discussed in this chapter provide greater understanding of such influences, but also identifies the need for further research on the interaction between personality and social behaviour.

2.5 Conclusion

We investigated the interactions of personality and wellbeing on mood in our target population. It can be concluded that neuroticism, eudemonic wellbeing and hedonic wellbeing individually, as well as in unison, are significant predictors of depression. The combination of factors, with increasing neuroticism and decreasing wellbeing (eudemonic and hedonic) predicted increase in depression. Individual's wellbeing was also modulated by core personality traits. Agreeableness, conscientiousness, extroversion and emotional stability were associated with greater wellbeing. In this sample, neither age nor sex was associated with depression scores. These results provide a construct of mental health in the sample student population at Bangor University.

PART B – The development

Social communication and social behaviour is heavily dependent on social cues, including face signals that could facilitate or hinder social interactions. Prior research has found reduced accuracy for facial expressions in individuals with mood, psychotic and developmental disorders (Archer, Hay, & Young, 1992; Bediou et al., 2012; Linden et al., 2011; Riby, Doherty-Sneddon, & Bruce, 2008). In future chapters (5, 6, 7, in Part C), we report the use of a visual self-attribution task in which the presented self-face can be manipulated by participants to display visual evidence of depression. The development of this scale will be discussed in this part.

Here I would like to mention that, although not included in this thesis, we conducted few pilot studies prior to finalising the current face scale. Initially we created a scale using 22 images, however the change in facial cues was not very observable, and hence created the current scale. Following the study discussed in Chapter 3, I further tested the agreeableness scale to ensure the observed inconsistency was not an artefact of low quality of our original stimuli. These studies replicated our original result. Thus the face scale has been controlled as much as possible to allow the images to display changes in face signals whilst limiting distortions. I do not report the full details of these small pilot studies, as they involved only simple tinkering and tweaks of stimulus presentation and method, and were not addressing ideas of any particular theoretical interest (e.g. whether the progression of items works better with 19 or 22 frames). The studies in this section, therefore, have a much more developmental character than the main experimental chapters in Part C. There are two chapters (3 and 4) in this section, in which I will discuss three different studies.

In Chapter 3, I will discuss the process of developing a 19-point face scale, using face composites of agreeableness, neuroticism, and depression. I will compare three face scales to identify the scale that provides consistent response from both male and female participants for male and female faces. Based on this result, I will select the best face scale for self, social and observer attribution studies in Part C. In Chapter 4, I will discuss two studies that explore the different social attributes made to the neurotic composite faces selected for creating the attribution task.

CHAPTER 3 – A pilot study to choose a face scale

Abstract

Attributions refer to the inference of the causes of observed behaviour and events. Such individual differences in attributions could relate to individual's personality and mental health. Thus, subjective attributions could be used creatively to investigate individuals' mood state. With this focus, we developed a face task with three categories, that is, neuroticism, agreeableness and depression. On this task, observers viewed a sequence of images giving an impression of subtly changing face signals. The aim was to identify the most accurate category that is consistent across sex (stimuli and observer), and we found neuroticism face scale to produce such systematic responses. The neurotic face scale was, therefore, chosen for exploring self and social attributions of individuals in future studies. Depression face scale was also accurate but the accuracy differed for male and female faces, where as agreeableness face scale had differential accuracy across stimulus and sex of observer.

3.1 Introduction

Social interactions are heavily dependant on observing social cues and making appropriate attributions, which could be compromised when experiencing mental health disorders (Couture, Penn, & Roberts, 2006). In order to investigate stereotypical and biased attributions, prior studies have used two alternative forced choice paradigms (Kramer & Ward, 2010; Scott et al., 2013). This is appropriate to understand the general attribution on average, but limited in investigating individual differences. In this study, we endeavour to develop a face scale that allows greater variance in responses.

3.1.1 Measuring individual differences in attributions

Individual differences relate to the variability of individual's behaviour. Despite adherence to general social norms each individual has unique beliefs, behaviours and experiences, and therefore display individualistic perceptions and attributions. This variability is reflected in individual's experience of social interactions, maladaptation or adaptation, and disorders (Allen-Walker & Beaton, 2015; Linden et al., 2011). Our intention is to capture variance in observer's attributions and potentially tap into individual's behavioural differences relating to their state of health and wellbeing. An individualised measure of attribution will provide more sensitive information about individual's perceptions, which will be more informative about subjective dynamics within the social dynamics.

3.1.2 Face stimuli for implicit measures

We read multitudes of social information such as emotions (Ekman et al., 1992), mental and physical health (Scott et al., 2013), and personalities (Kramer & Ward, 2010) from the face. Adapting face stimulus to measure individual differences could potentially give the added benefit of tapping on to more automatic processes relating to implicit cognitions (Axelrod, Bar, & Rees, 2015; Northoff, 2016).

This study aims to create a visual scale of face variation between two anchors, reflecting different trait values relating to depression. To illustrate in Figure 3.1, the neutral target face is progressively transformed between two extreme anchor values. On the one side the anchor is a composite with emotionally stable or without depressive traits and on the other side it is a composite with neurotic or depressive traits. The target face changes smoothly across the gradient to take on characteristics to reflect the difference between the anchors. For example, in Figure 3.1, one can

among other characteristics, see the gentle lowering of eye-gaze and brow as we move from one end of the scale to the other. Our intention was to find anchors to create a scale of variation that would be relevant to individual differences in attribution and depression.

We used two traits relating closely to depression: neuroticism (Kramer & Ward, 2010) and depressive symptoms (Scott et al., 2013). The development work here also included agreeableness as a comparison, even though an agreeableness variation was not being considered for our scale.

There are five main questions to be answered in this study. (1) Are systematic attributions made to the different forms of face variation? (2) Are the responses congruent to the instruction and scale for all the categories? (3) Are the responses consistent for both male and female faces? (4) Are the responses consistent from male and female participants in this task? (5) Which trait offers the best properties for future use based on the congruence of responses to instructions, the scale and across sex (stimuli and participants)?

3.2 Methods

We invited Bangor University students to participate in this study, which was approved by the Ethics and Governance Committee, School of Psychology at Bangor University. There were a total of 50 (40 females) participants with mean age of 19.70 ±1.876 and range (18 – 27). The study adhered to School of Psychology and Bangor University research guidelines, and participants were compensated for their time. In this study the participants completed the face task that is explained below. After participation students were debriefed and provided with information regarding available psychological support, should they feel the need for it.

3.2.1 Stimuli creation

We selected a total of 20 (10 female, 10 male) portraits from the lab's face database. Portraits in the database are neutral looking full frontal photographs of Bangor University students, who consented for their photographs to be used in future studies. All the portraits were screened for facial emotion expressions, make-up, face piercings, facial tattoos and facial hair. The selected portraits were cropped and rotated to present the correct pupil alignment along the transverse plane to minimise differences due to posture or angle of the head. Finally, each portrait was warped towards the three pairs of sex-congruent composites of neuroticism, depression and agreeableness.

In order to create the composite faces, the full-face portraits of 15 male and 15 females with neutral expression were selected for high and low of each category (agreeableness, depression and neuroticism). Exclusion criteria of facial expression, facial hairs, facial tattoos, head rotation, facial piercing and make up were applied during selection. A total of 139 landmarks were identified on each of the selected face and then each set of 15 faces was averaged using JPsychomorph (Tiddeman, Burt, & Perrett, 2001) to create the composite faces. The process of compositing or averaging of faces washes out any individuality and maintains only the common or salient features of the respective traits shared by the selected faces.

Warping was done using JPsychomorph (Chen & Tiddeman, 2010). In this process 139 landmarks were identified on each photograph and then warped towards the respective high and low composites, also accounting for their shape, colour and texture to create 19 images. In the resultant face scale, the original face was the mid-point, and gradually changed with high trait and state characteristics towards one end,

and lower trait and state characteristic towards the other end of the scale. The scores on the 19-point scale were from -9 (least trait) through 0 (original face) to +9 (most trait). In this implicit task, participants were not aware of the three underlying categories of the face scale. This process and the resultant scale are illustrated in Figure 3.1.

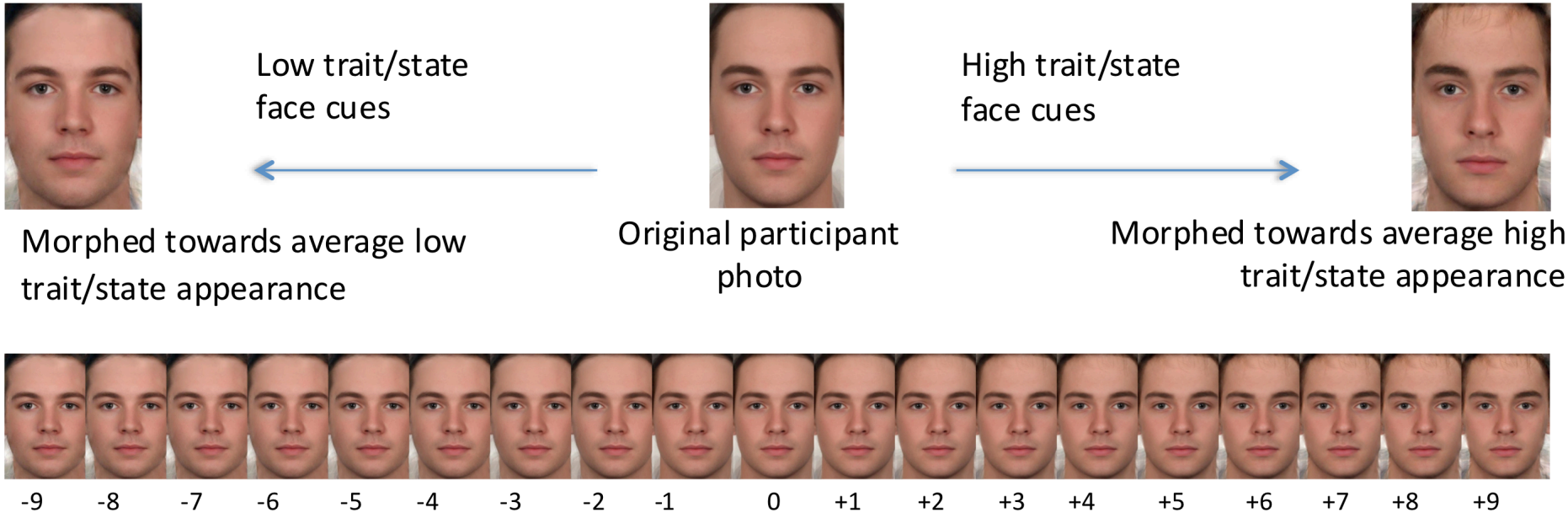


Figure 3.1. The graphical representations of an individual's photograph being warped towards low and high trait and state composite images. A row of warped images from being low trait and state (-9) to being high trait and state (+9) and the individual's original photograph in the middle (0) depicts the sequence of images in the order on the 19-point scale.

3.2.2 The attribution task

The task presented with three blocks (categories: agreeableness, neuroticism and depression) x 20 trials (identity: 10 male and 10 female faces) x 19 images (face warps). The blocks (categories) were randomly selected per presentation. The order of the trials (identity) was randomly selected in the first block, but maintained through rest of the blocks in the presentation. The first image of each trial (19 face warps) was presented randomly, but followed the order of sequence on the 19-point scale. The 19 images of each face (identity) were presented (500x500 pixels) one at a time in the middle of a computer screen, with instructions at the top. The presentation was not timed and allowed each face (identity) to be changed between low and high of the respective scale in order of sequence on the 19-point scale. The scale was presented on the screen as a circle, and therefore its lateral representation was not obvious to the participants. The face was displayed from the hairline to chin, vertically and face contour close to the ears, horizontally.

The instructions were specific to each block (category). For the neuroticism scale, the instruction was to make the face look 'most anxious and emotionally unstable' and 'most calm or emotionally stable and well balanced'. For the depression scale, the instruction was to make the face look 'unhappy and least content' and 'most happy and contented'. For agreeableness, the instruction was to make the face look 'most agreeable and friendly' and 'least agreeable and unfriendly'. In order for all responses to indicate increasing neuroticism, depression, and agreeableness, the responses were reverse scored for the second instruction per category. The presentation is illustrated in Figure 3.2.

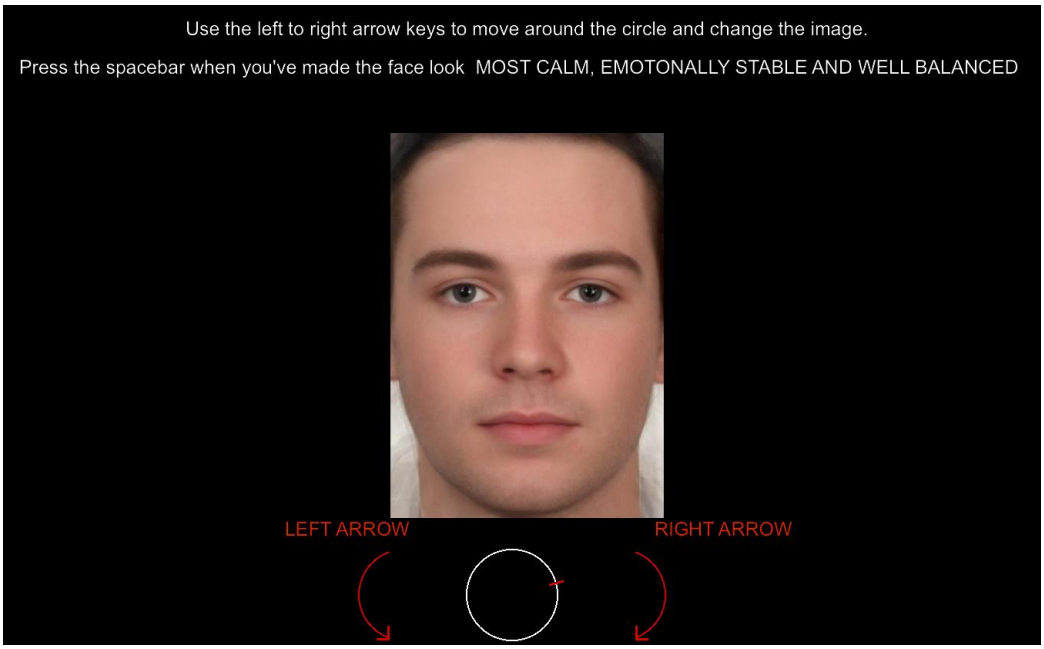


Figure 3.2. An illustration of a trial from the attribution task as presented on a computer screen, and viewed by the participants. When they press either the right or left arrow keys, the presented face will appear to be changing. By continued pressing of either of the keys, will present the 19 images in a continuous looped sequence. Without a lateral representation the end points of the scale was not obvious to the participants.

3.3 Data Analysis

We used the responses from the face task to compute group average scores per category, giving a total of six scores (3 categories x 2 sex of stimuli). Prior to averaging scores, we reverse scored the responses where the instructions were to make the face look least agreeable, emotionally stable or happy. Therefore, all the responses consistently reflected the face being made more agreeable, neurotic or depressed. In this manner, when the responses were congruent to the instructions the scores were greater than zero. The scale ranged from -9 to +9 indicating least agreeable, happy or emotionally stable and most agreeable, depressed or neurotic respectively. A mid point of the scale with a score of zero indicated the original face.

Using one sample *t*-test against the test value of zero, we examined whether participants' response concurred with the instructions. When the mean was greater

than zero, it indicated the concurrence between responses and instructions. In a further analysis, we used 2 (sex of participants) * 6 (2 (sex of stimuli) * 3(task categories)) repeated measures ANOVA (Bonferroni corrected for multiple comparisons). The six categories 2 (sex of stimuli) * 3 (task categories) were within-subjects factors and sex of participants was the between-subjects factor. This analysis identified the main effect of the sex of participants and any interactions.

3.4 Results

A total of 50 (40 females) participants with age $M = 19.70$, $SD = 1.876$ and range (18 – 27) completed this study. The group mean and standard deviation of the responses to the six task categories are shown in Table 3.1.

Table 3.1. Mean accuracy (*M*) and standard deviation (*SD*) for the scores from the face task.

	Agreeableness	**Neuroticism**	**Depression**
Female faces	-2.184 (3.612)	2.835 (3.490)	1.112 (3.278)
Male faces	2.492 (2.904)	2.245 (2.906)	4.308 (3.356)

Note. Descriptive statistics are reported as mean (standard deviation).

One sample *t*-test, corrected for multiple comparisons, showed that participants selected a face that was significantly different from the original face for all categories. When the participants made changes to the faces to look more neurotic, it was concurrent with the scale: female faces, $t(49) = 5.743$, $p < .001$, 95% *CI*(1.842, 3.826); male faces, $t(49) = 5.463$, $p < .001$, 95% *CI*(1.419, 3.070), and the positive *t* values for male and female faces indicated consistency across sex of stimulus. Similarly, consistent responses were seen for depression: female faces, $t(49) = 2.399$, $p = .003$, 95% *CI*(.180, 2.043); male faces, $t(49) = 9.077$, $p < .001$, 95% *CI*(3.354, 5.262). The male faces had a greater score than female faces, although the direction of

the change was the same. Except for agreeableness, responses were differential to sex of stimuli: female faces, $t(49) = -4.272$, $p < .001$, 95% $CI(-3.211, -1.156)$; male faces, $t(49) = 6.068$, $p < .001$, 95% $CI(1.666, 3.317)$. The male faces were changed in concurrence with the instructions and the scale but changes to female faces were made opposing to the instructions.

A 2 (sex of participant) * 6 (2 sex of stimulus) * 3 (categories)) repeated measures ANOVA (Bonferroni corrected for multiple comparisons) showed no significant main effect of sex of participant, $F(1, 48) = .627$, $p = .432$. There was a significant within-subjects main effect of sex of stimulus, $F(1, 48) = 19.069$, $p < .001$, which was due to the estimated mean (*EM*) score for female faces (0.800) being lower than male faces (3.047). This reflects on the lower score for female faces on the agreeableness and depression scale, as seen in Table 3.3. There was also a significant within-subjects main effect of category, $F(2, 48) = 17.190$, $p < .001$. Pairwise comparisons showed that the *EM* response on the agreeableness scale ($EM = 0.355$) was significantly different from the depression scale ($EM = 3.299$, $p < .001$) and the neuroticism scale ($EM = 2.117$, $p = .007$). The response on depression scale was also significantly different from response on neuroticism scale ($p = .047$).

In addition, we observed a significant interaction between sex of stimulus and category, $F(2, 48) = 7.051$, $p = .001$. This suggests that the difference in accuracy for the categories were different across sex of stimulus. The *EMs* highlights this difference for male and female faces as observed for agreeableness (female, -.1.51; male, 2.22) and depression (female, 1.69; male, 4.90) scales, but not for neuroticism (female, 2.21; male, 2.02) scale. This interaction between category*sex of stimulus is show in Figure 3.3.

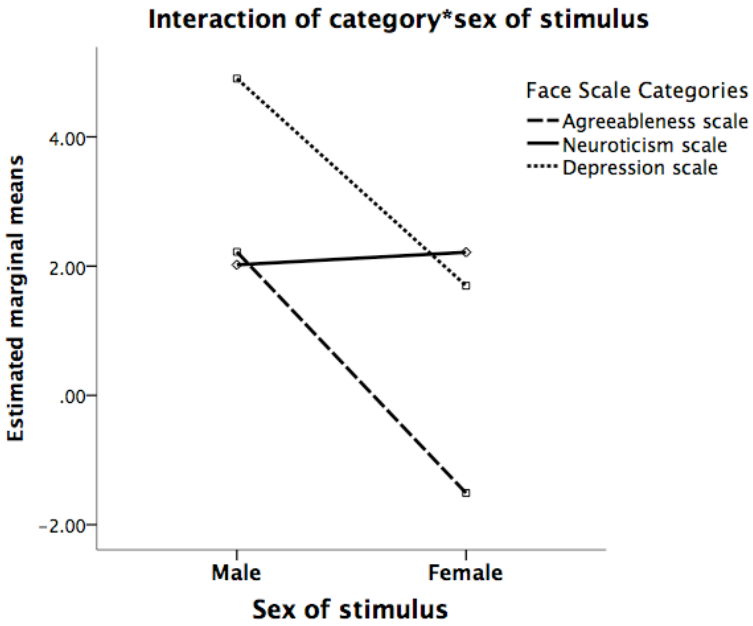


Figure 3.3. Interaction of category (agreeableness, neuroticism, and depression) and sex of stimulus (female and male faces), showing differential response for male and female faces on agreeableness and depression scales, but not neuroticism.

Finally, we found a significant category*sex of participant interaction, $F(1, 48) = 5.667$, $p = .005$, indicating differential accuracy for categories across sex of participants, which is explained by the estimated means shown in Table 3.2.

Table 3.2. Estimated marginal means to explain the category*sex of participants interaction.

	Agreeableness	**Neuroticism**	**Depression**
Female participants	0.02	2.82	2.32
Male participants	0.69	1.41	4.28

Despite the *EMs* being similar on the agreeableness scale across sex of participants, it has to be noted that the low mean score reflect the opposing scores for male and female faces as reported in Table 3.1. Both male and female participants made changes consistent to instructions only to male faces on the agreeableness scale. On the depression and neuroticism face scales, female participants made quite similar changes unlike male participants, which reflects on this significant difference. Male participants made greater changes to faces on the depression scale than on the

neuroticism scale. Thus showing least difference across sex of participant in the accuracy for the neuroticism scale.

3.5 Discussion

This is a pilot study to develop and test the face task with the intent to identify the best of three face scales. The best scale will be used to measure self and social attributions in later studies. The three scales included agreeableness, depression and neuroticism, with the scores from -9 (lower trait/state) to +9 (higher trait/state). The midpoint of the scale was zero, representing the original face. There were five main questions to be answered with this study.

The first question was whether the face task would elicit systematic attributions. This can be confirmed by the results of the one sample *t*-test against the test value zero, representing the original face. That is, if responses were made at random the mean response would be zero, representing the original face. The results showed that participants selected a face that was significantly different from the original face, for all the three categories.

The second question was whether the responses were congruent to the instruction and gradation of the scale, for all the categories. We can answer this question by further exploring the results from the one-sample *t* tests. The *t* values for the neurotic and depression scales indicated that the faces were changed to look more neurotic and depressed respectively, which was congruent to the instruction and the scale, and consistent across sex of stimulus. However, the *t* values for the agreeableness scale indicated a differential response. The male faces were changed to look more agreeable, which was instruction-scale congruent. Whereas, the female faces were changed to look less agreeable, which was instruction-scale incongruent.

Thus, the responses to instructions were congruent on the neuroticism and depression scales, and to male faces on the agreeableness scale.

The third question was whether the responses are consistent to male and female faces in this task. As explained above, the response on the agreeableness scale was differential to sex of stimulus. Regarding the depression and neuroticism scales, the results confirm the changes made to both male and female faces were congruent to the scale. On the depression scale, there were differences in how male and female faces were perceived, as confirmed by the significant interaction of sex of stimulus and category (shown in Figure 3.3). Thus, it was only the neuroticism scale that elicited consistent responses across male and female faces.

The fourth question was whether the responses are consistent from male and female participants in this task. The repeated measures ANOVA showed no main effect of sex of participant. It has to be noted however the study sample could not be controlled for sex ratio and had a small number of males, which is a limitation of this study. Although we did not observe any significant sex differences, it is possible that with a much larger sample of males we might have measured a significant difference in the degree to which traits influenced attributions to self and to others' faces. However, it should be noted that the general patterns relating attribution to traits was always in the same direction for men and for women.

Finally, the fifth question related to identifying the best of three scales based on instruction-scale congruence across sexes (stimulus and participants). From the results so far, the neurotic scale was instruction-scale congruent across sexes (stimulus and participant) and therefore clearly the best of the three categories.

3.6 Conclusion

In this study, we created a 19-point visual scale using face stimuli that could be adapted for future studies. On the basis of five criteria relating to validity and consistency, the neurotic scale was identified as the best of three scales used in this study and therefore chosen for future studies to investigate self and social attributions of individuals.

CHAPTER 4 – Neurotic face signals: What we perceive?

Abstract

Previous research has shown the accuracy for facial cues of neuroticism was reduced with tryptophan depletion (TD), which was similar to reduced accuracy for facial emotions of fear as reported by other TD studies. We propose that neuroticism trait overlaps with social and emotional information. In Study 1, we investigate the different social attributions that could be associated with neuroticism trait. We propose that the facial cues of high and low neuroticism are differentiated, and associated with perceptions of respective mood state. We further examine the subjective perceptions of attractiveness and perceptions of sex-typicality that are associated with high neuroticism. In Study 2, we investigate the perception of fear-related characteristics associated with high neuroticism. The results from Study 1 showed that high and low neurotic facial cues were systematically differentiated, and associated with appropriate mood state. Additionally, high neuroticism was systematically perceived as unattractive, but was perceived as feminine from female face and as masculine from male face. In Study 2, fear-related characteristics were systematically associated with high neuroticism.

4.1 Introduction

In the previous chapter, we found that the neurotic face scale elicited the most consistent and accurate responses from participants. This scale is anchored in the statistical regularities of visual appearance relating to high and low neuroticism, as embodied by the composites of men and women with extreme trait neuroticism

scores. In this chapter, I present two studies investigating some of the social attributes that are consistently associated with the visual appearance of neuroticism.

Attribution refers to the inferences of the cause of behaviour and events individuals observe (Kelley & Michela, 1980; Malle, 2011a; Weiner, Nierenberg, & Goldstein, 1976). Attributions made in a social context refer to social attribution and this includes the processing of social cues from the faces of other individuals. Some social cues, such as the concept of emotions, have generally accepted attributions in the wider society. For instance, faces expressing pain were attributed as sad (Kappesser & Williams, 2002). So certain facial expressions, including subtle facial cues can derive some widely accepted attributions. Scott et al. (2013) reported depressive facial cues being perceived as less socially acceptable. Neurotic face composites used in our previous study would have comparable facial cues with depression, and therefore reasonable to query what social attributes could be associated with neurotic traits. We propose that face signals of neuroticism could also be associated with some social attributes.

In the two studies here, we looked in more detail at the attributions made to these composite faces that display cues of high and low in trait neuroticism. In Study 1, we investigated average perceptions of neuroticism and mood state associated with neurotic face signals; specifically, whether high neurotic face signals will be perceived as anxious and unhappy, and less neurotic face signals will be perceived as emotionally stable and happy. A consensus of such attributions of neurotic facial cues across male and female faces can confirm the widely accepted positive and negative social concepts relating to these traits. This could further confirm the quality of the neurotic composites.

Besides these typical perceptions, Study 1 also investigated subjective perceptions associated with neurotic facial traits, such as concepts of femininity-masculinity and attractiveness-unattractiveness. Prior research reported facial cues of high neuroticism being attributed as feminine from female composite faces (Cunningham, 1986; Jones & Hill, 1993; Rhodes, Hickford, & Jeffery, 2000) , but did not demonstrate such clear attribution of male faces (Little, Jones, Penton-Voak, Burt, & Perrett, 2002; Little & Hancock, 2002; Perrett et al., 1998). Inconsistency regarding masculinity could be related to changing social norms that encourage men to be expressive, cuddle and nurture their offspring, which might be preferred by contemporary women. Sexual dimorphism also affects differential perceptions of attractiveness, showing strong correlation with femininity but not with masculinity (Komori, Kawamura, & Ishihara, 2009; Rhodes et al., 2000). Thus, this study will provide insight into perceptions driven by facial cues of neuroticism.

We further examine other biases relating to neurotic facial cues. We used a different pair of neurotic composites along with composites of other Big Five personality traits in a previous TD study (Ward, Sreenivas & Rogers, 2016) and reported decreased accuracy only for neurotic traits following TD. Previous TD studies using emotional faces found similar decreased accuracy for fear (Harmer et al., 2003b). Fear is widely associated with anxiety, and studies have reported reduced accuracy for fear in individuals diagnosed with anxiety and depressive disorders (Reeb-Sutherland et al., 2014; Walker, Jiang, Vetter, & Sczesny, 2011). Signals of fear and the accuracy for processing these signals are therefore closely linked with behavioural maladaptation relating to wider psychological disorders. Such evidence prompted the question, whether fear and neurotic traits have shared or overlapping face signals. Study 2 was designed to investigate whether the neurotic face signals are

attributed as more fearful. This will provide insight into the attributions made to face signals of neurotic traits and as we will see later, support the rationale for using the neurotic face composites in future studies which could have clinical implications.

Ultimately, both studies here shed light on the quality of the neurotic face composites. In Study 1, we propose that high neurotic traits will be perceived as anxious and unhappy, while low neurotic traits will be perceived as emotionally stable and happy. These elements of positive and negative attributions have general connotations, and therefore we hypothesis consistency of such perceptions for male and female faces. We further examine whether more neurotic traits are perceived as feminine or masculine and as attractive or unattractive. In Study 2, we propose that the facial cues of neuroticism will be attributed as fear-related characteristics.

4.2 Methods

The School of Psychology Ethics and Governance Committee at Bangor University approved both studies. We invited students from Bangor University who gave informed consent and participated in both studies; 130 participants completed Study 1 and 34 participants completed Study 2. They completed two-alternative forced choice task, where 2 pairs ((high–low) neurotic * (male–female) faces) of neurotic face composites were presented using Matlab. Only sex-congruent pairs (high-low) were presented. The questions appeared at the top of the screen and the participants responded by selecting a face for the answer. The tasks used in both studies had 16 trials (8 questions x 2 sex-congruent neurotic face pairs). The neurotic composites used in the previous study to create the 19-point face scale were used in the current studies. The process of developing composite faces is explained previously in Chapter 3.

In Study 1, participants selected whether the composite high or low in neuroticism was the better match for socially desirable and undesirable characteristics. The questions comprised, “Who is happier?”, “Who is unhappy?”, “Who is more emotionally stable?”, and “Who is more anxious?”. Choice of emotionally stable face as happy or emotionally stable and neurotic face as unhappy or anxious were accounted as accurate. Two questions relating to perceptions of sex (“Who is more feminine?” and “Who is more masculine?”) and attractiveness (“Who is more attractive?” and “Who is least attractive?”) were also included, to examine how the visual appearance of neuroticism mapped onto perceptions of sex-typicality and attractiveness.

In Study 2, the questions relating to less fearful characteristics included, “Who looks more courageous?”, “Who looks more confident?”, “Who looks calmer?” and “Who looks happier?”. The questions relating to more fearful characteristics include, “Who looks more frightened?”, “Who looks more fearful?”, “Who looks more afraid?”, and “Who looks sadder?”. The choice of less neurotic face for less fearful, and more neurotic face for fearful characteristics, were accounted as accurate.

We aggregated the responses to obtain group mean accuracies. Using one sample *t*-test against the test value of 0.5 (50% accuracy), we examined the better than chance accuracy. In addition, we used paired samples *t*-test to examine stimuli-sex difference. Since the previous study confirmed consistent accuracy for neurotic traits from male and female observers, we did not look at observer-sex difference.

4.3 Results

4.3.1 Study 1

A total of 130 observers participated in this study. Using one sample *t*-test against the test value of .50 (corrected for multiple comparisons), we observed significant accuracy for identifying less neurotic facial cues as happy (female face, $t(129) = 11.38$, $p < .001$; male face, $t(129) = 7.89$, $p < .001$) and emotionally stable (female face, $t(129) = 5.91$, $p < .001$; male face, $t(129) = 7.56$, $p < .001$). Similarly, we observed significant accuracy for identifying facial cues of high neuroticism as unhappy (female face, $t(129) = 8.52$, $p < .001$; male face, $t(129) = 8.52$, $p < .001$) and anxious (female face, $t(129) = 5.42$, $p < .001$; male face, $t(129) = 10.45$, $p < .001$). The paired sample *t*-test (corrected for multiple comparisons) showed significant difference in the accuracy for perceiving neurotic traits as anxious from female and male faces, $t(129) = -2.40$, $p = .001$. This differential accuracy was driven by greater accuracy for perceiving anxiousness from male composite face, rather than lack of accuracy from female composite face. Thus, we demonstrate that positive and negative perceptions are on average made consistently to low and high neurotic facial traits respectively. The group mean accuracies (Figure 4.1), and 95% confidence intervals for each category, are given in Table 4.1.

Table 4.1. Mean accuracy *(M)* and 95% *CI* of positive and negative attributions made to low and high neurotic composite faces respectively.

Composites	*M*	95% *CI*	*M*	95% *CI*
	Happy		***Emotionally Stable***	
Female faces	85%**	.79 to .92	73%**	.65 to .81
Male faces	78%**	.71 to .86	78%**	.70 to .85
	Unhappy		***Anxious***	
Female faces	80%**	.73 to .87	72%**	.64 to .79
Male faces	82%**	.75 to .88	84%**	.77 to .90

Note. Reported mean accuracy in percentage, ** $p < .001$; CI, Confidence Interval

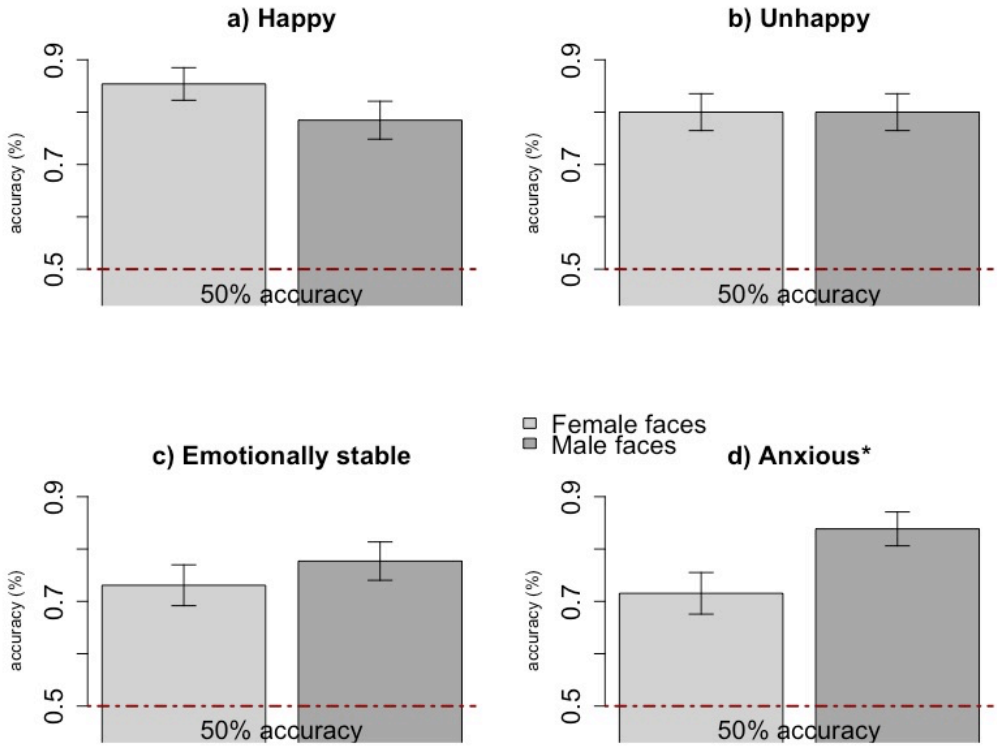


Figure 4.1. Accuracies for the positive and negative attributions made to low and high neurotic face composites respectively with error bars showing 1+/- se. * $p < .05$

We did similar analysis for the subjective perceptions of femininity, masculinity, attractiveness and unattractiveness. We were interested in exploring how these attributions mapped on to the high neurotic composite face. One sample *t*-tests against the test value of 0.5 (corrected for multiple comparisons), showed significantly less than chance for high neurotic traits to be perceived as attractive from

female, $t(129) = -5.186$, $p < .001$ and male, $t(129) = -5.662$, $p < .001$, faces. Consistently, the analysis also showed significantly better than chance for high neurotic traits be perceived as unattractive from female, $t(129) = 2.505$, $p = .001$, and male, $t(129) = 5.186$, $p < .001$, faces. Thus, we show that high neurotic traits were not perceived as attractive from either female or male faces, but were systematically perceived as unattractive. This consistency was also reflected in the results of paired sample *t*-test that did not show any significant stimuli-sex difference relating to these perceptions.

In contrast to the results so far, we found differential perceptions of femininity and masculinity from female and male neurotic faces. One sample *t*-test against the test value of 0.5 (corrected for multiple comparisons), showed significantly better than chance for high neurotic traits to be perceived as feminine only from female faces, $t(129) = 2.318$, $p = .001$. Despite the non-significant (n.s.) difference (shown by paired sample *t*-test) in perceptions of femininity from female and male faces, the perception from male faces was only at chance level (Figure 4.2). Furthermore, high neurotic traits were perceived as masculine from male faces non-significantly above chance, but at less than chance level from female faces. This differential perception of masculinity from male and female faces was statistically significantly different, $t(129) = 2.595$, $p = .001$. These results demonstrate that sex-typical perception of facial cues of high neuroticism was evident from female face, and at a chance level from male face; however, neither of these perceptions appear to be driven by attractiveness in this study. The group mean scores (Figure 4.2) and 95% confidence interval for femininity, masculinity, attractiveness and unattractiveness for female and male high neurotic faces are given in Table 4.2.

Table 4.2. Mean frequency of attributions (*M*) and 95% *CI* for attractiveness and unattractiveness, and femininity and masculinity from male and female high neurotic composite faces.

Composites	*M*	95% CI	*M*	95% *CI*
	Attractive		***Unattractive***	
Female	29%**	.21 to .37	61%*	.52 to .69
Male	27%**	.20 to .35	71%**	.63 to .79
	Feminine		***Masculine***	
Female	60%*	.51 to .69	42%	.34 to .51
Male	51%	.48 to .59	58%	.49 to .66

Note. Reported mean accuracy in percentage, ** $p < .001$, * $p < .05$; CI, Confidence Interval

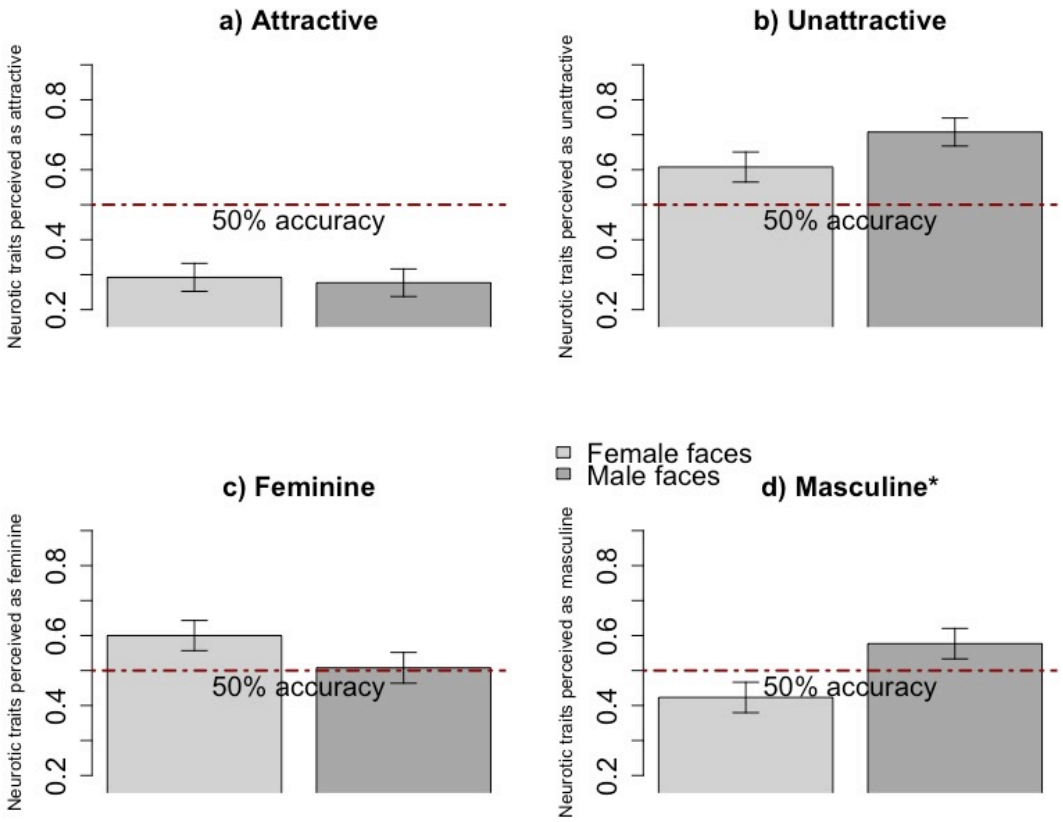


Figure 4.2. The frequency of attributing attractiveness, unattractiveness, femininity, and masculinity to high neurotic face composites with error bars showing 1+/- se. * $p < .05$

4.3.2 Study 2

I will now focus on the second study of this chapter in which we investigated whether fear-related characteristics are associated with neurotic traits. A total number of 34 participants with age M = 28.03, SD = 12.76 and range (18 - 57) completed this study. The participants completed a two-alternative forced choice experiment to identify fear-related characteristics from facial cues of neuroticism.

Using one sample t test (corrected for multiple comparisons) we observed that fear-related characteristics were identified from female face with an accuracy of 64.71% that was significantly better than chance, $t(33) = 3.644$, $p < .001$, 95% $CI(0.56, 0.73)$. Similarly, fear-related characteristics were identified from male face with an accuracy of 79.04% that was also significantly better than chance, $t(33) = 9.771$, $p < .001$, 95% $CI(0.73, 0.85)$. The results are shown in Figure 4.3. A paired sample t test showed statistically significant stimuli-sex difference, $t(33) = -2.862$, $p = .002$, 95% $CI(-0.24, -0.04)$, which was driven by greater accuracy for male face compared to female face. Thus, the neurotic trait signals were systematically identified as fear-related characteristics from both male and female high neurotic composite faces.

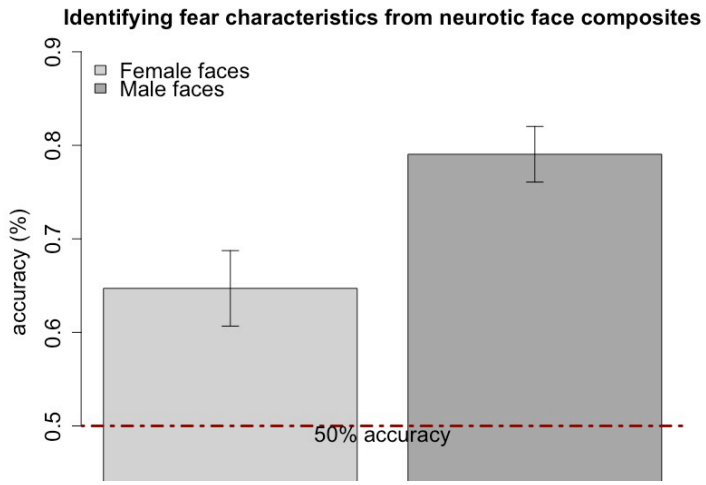


Figure 4.3. Accuracy for identifying fear from male and female high neurotic composite faces with error bars showing 1+/- se.

4.4 Discussion

The two studies in this chapter examined a variety of attributions made to neurotic face composites, the results of which have implications on later studies in this thesis. Firstly, we demonstrated that attributes of happy or emotionally stable and unhappy or anxious were systematically identified with facial cues of emotionally stable and high neuroticism respectively, across sexes. Results most consistent with ours come from a study by Scott et al. (2013), reporting how depressive cues were identified as less socially desirable. In our study, facial cues of high neuroticism were attributed as negative and this will not only confirm the quality of our composites but also inform future attribution studies that use the neurotic face scale developed using these composites. We propose that our neurotic face scale will also elicit similar positive and negative biases.

Secondly, high trait neuroticism was associated with sex-typicality rather than a simple femininity or masculinity shift. That is, high neuroticism in female faces was perceived as feminine, which concurs with previous research (Little et al., 2008). High neuroticism from male face was perceived as masculine at non-significantly better than chance level while perception of femininity was only at chance level, the reason for which is unclear, but we could query whether it is related to perceived attractiveness. Enhanced dimorphism is often associated with attractiveness (Rhodes, 2006), although this is more robustly seen with women's than men's faces (Perrett et al., 1998). In the current study, however, high neuroticism was systematically perceived as unattractive, and it is unclear how the same might elicit sex-typical perceptions of femininity and masculinity.

Attractiveness has been associated with face symmetry. Prior studies reported that faces of individuals with high neuroticism traits were observed to be asymmetric, and therefore unattractive (Noor & Evans, 2003; Shackelford & Larsen, 1997; Shuler, 2012). Unlike the previous studies, we used composites that are averages of individual faces and the composite method eliminates or greatly reduces fluctuating asymmetry. Thus, the main varying factor in the composites is the facial cues of neuroticism, which appears to be driving sex-typical perceptions of femininity from female faces and masculinity from male faces (n.s.).

The overall evidence demonstrates that facial cues of high neuroticism appear to be driving systematic negative perceptions of anxiety, unhappiness, and unattractiveness, whereas facial appearance of emotional stability appears to be driving systematic perceptions of positive characteristics such as emotional stability, happy mood state, and attractiveness. The results so far, support the quality of the composites as well as the questions that attain systematic responses and therefore the questions relating to positive and negative perceptions will be used in future attribution studies.

Finally, we demonstrated fear-related characteristics being consistently identified with neurotic traits. Our literature search did not find similar studies investigating attribution of fear from neurotic face composites and therefore this study provides new evidence of fear-related characteristics associated with face signals of high neuroticism. Previous studies reported reduced accuracy for facial emotion of fear with TD (Harmer et al., 2003b; Merens et al., 2008), while our previous TD study (Ward, Sreenivas & Rogers, 2016) showed similar reduced accuracy for neurotic face composites, following depletion. TD is used to investigate the behavioural and neural

effects of acute neurobiological changes relating to depression. Therefore the neurotic face composites could be used for future studies involving individuals experiencing depression, not only because the neurotic traits are closely linked with depression but also because of its overlap with fear-related characteristics. Fear is one of the basic emotions (Ekman et al., 1992), and the perception of related characteristics from faces displaying neurotic traits may be the reason why it was easier for participants to attribute generic positive and negative social meaning to these composite pairs, as demonstrated in Study 1 of this chapter.

4.5 Conclusion

Study 1 demonstrated systematic association of facial cues of high neuroticism with negative attributions and emotional stability with positive attributions. We further observed sex-typical perceptions of facial cues of high neuroticism, that is, femininity from female neurotic face and masculinity from male neurotic face (n.s), despite evidence of systematic perceptions of unattractiveness relating to high neuroticism observed in this study. Thus, it appears that cues, other than attractiveness, are driving sex-typical perceptions.

Based on the evidence from Study 2, we conclude that fear was accurately identified from the neurotic face composites. This was systematically perceived from female and male faces. Thus, the overlap of fear-related characteristics and neurotic signals in the composites make them uniquely adaptable for studies involving clinical populations of depression and anxiety.

PART C – Individual differences in attributions of facial appearance

In the next three experimental studies, I will be discussing methods and results from an attribution task based on facial appearance. In this section, I will give a "big picture" view of the different attribution tasks, what they are measuring, and how they are related.

In the previous chapters, I discussed the process of developing and piloting the stimuli for the attribution task using face images. As a first step, the composite faces of three personality traits were created (neuroticism, agreeableness, and depression). The scales based on the three traits were compared for their accuracy and consistency across sexes (stimuli and observers), and we found that participants were more accurate and consistent in their response on the neuroticism scale. Further to this evidence of the quality of the Neurotic Face Scale, there is also evidence of neurotic traits being closely related to depression. That is, the Neurotic Face Scale illustrates progressive change in the visual appearance of low and high neuroticism, and for those at low and high risk of depression. In this light, it is interesting to investigate how individuals experiencing depression would make attributions on the Neurotic Face Scale. Using this scale for the attribution tasks, we will investigate self, social, and observer's attributions, and discuss the results in three different chapters in this section. Below I discuss these different, but related, attribution tasks.

Attribution, with regard to the studies discussed here, refers to attributions made to facial appearance, either one's own appearance or other peoples'. The facial attribution task I use extends previous work on self and social attributions. Attribution generally refers to the explanation for behaviours, such as inferences (e.g., reason for behaviours) or ascriptions (e.g., blame to a person) (Malle, 2011). When these are

self-directed, it accounts to self-attributions, and when directed at others, it refers to social attributions (Harvey, Madison, Martinko, Crook, & Crook, 2014; Weiner, 1985). Individuals are therefore making inferences or giving meaning to behaviours, because they do not have complete access to their (or other's) internal states such as attitudes, beliefs, emotions, motives and traits (Heider, 1958; Niemiec, 2007). Inferring attributes from the observations of own behaviours and the situational contexts in which they occurred, rely on mental representation of self (Markus & Wurf, 1987).

Markus and Wurf (1987) discussed different types of self-representations such as the 'ideal self' (Rosenberg, 1989), the 'actual self' (Higgins, Klein, & Strauman, 1985), and concepts of 'positive self' and 'negative self' (Andersen, Tuskeviciute, Przybylinski, Ahn, & Xu, 2015; Decker, 1985; Sullivan, 1953). The different types of selves are essentially how individuals perceive themselves, and therefore relate to their subjective mental representations of self (Bodenhausen & Morales, 2013). The subjective role of these representations of self is illustrated by the fact that they are modulated by attention bias, inferences and cognitive distortions (Bodenhausen & Morales, 2013). Markus and Wurf (1987) proposed that conflicting self-representations or a discrepancy between representations of self can induce a state of discomfort, and different kinds of discrepancies produce different types of discomfort relating to different mental health disorders. Various self-discrepancies were found to be associated with body dissatisfaction (Strauman, Vookles, Berenstein, Chaiken, & Higgins, 1991), depression and anxiety disorders (Phillips & Silvia, 2010a; Roelofs et al., 2007).

C.1 The Attribution Tasks

In the attribution tasks, I will be using observers' selection from a continuum of face variation, a face that best matched a predefined attribution. As indicated earlier, the Neurotic Face Scale was used in all the attribution tasks reported here. In these tasks, a single face was morphed between two specific anchor images, reflecting high emotional stability at one end and high neuroticism at the other. The original face was referenced with value 0, images of increasing emotional stability were increasing negative values (-9 minimum), and images of increasing neuroticism were increasing positive values (+9 maximum). This is illustrated in Figure C.1. In the self-attribution task, the face being morphed on the Neurotic Face Scale was the observer's own face. For attributions to others, the faces used were those of unfamiliar men and women. In all cases, observers were given a question to apply, such as "most attractive", and move back and forth through the images one at a time until they were satisfied that they have found the image best matching the question. Observers were not told about the nature of the scale, that it is a neurotic appearance scale that varies from emotional stability to neuroticism, or about the numerical rating associated with their image choice. In this way, very similar procedures were used for self- and other-attribution tasks, the main differences being the kinds of questions we can sensibly ask about self and others.

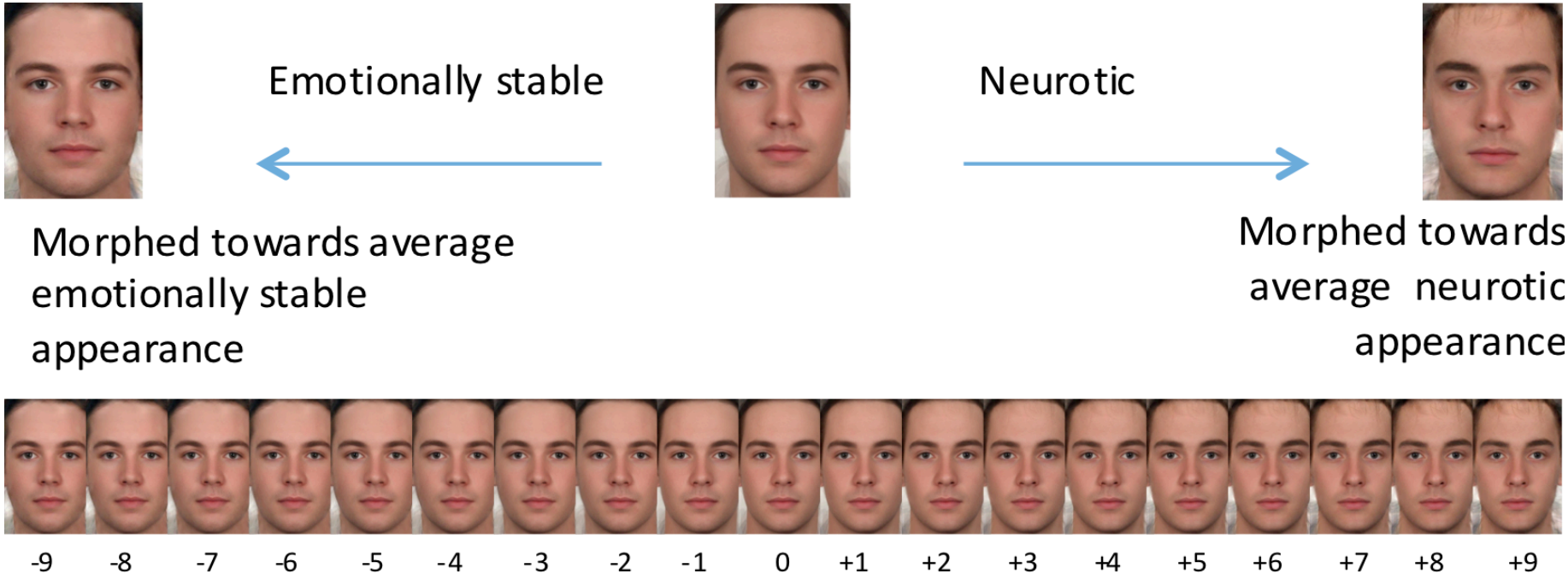


Figure C.1. The graphical representations of an individual's photograph being warped towards emotionally stable and neurotic composite images. A row of warped images from being emotionally stable (-9) to being neurotic (+9) and the individual's original photograph in the middle (0) depicts the sequence of images in the order on the 19-point Neurotic Face Scale.

Our aim was to look at the full range of attributions relating to self and others. We can refer to the individuals of most interest as "actors" when comparing self and others' attributions. We examined the attributions the actors made to themselves (self-attributions) in Chapter 5, the attributions the actors made to others (social attributions) in Chapter 6, and the attributions others made to the actors (observer attributions) in Chapter 7. The three attributions are illustrated in Figure C.2. In Chapter 7, we further triangulated these three attributions. By measuring and triangulating these attributions, we can understand the relationship between them. For instance, this paradigm will enable us to study how an actor's self-attributions are similar or dissimilar to their attributions to others (social attributions), as well as the attributions others' make to the actor (observer attributions). This is an invaluable means to investigate the dynamics between the three attributions, which are made solely on the subtle information gathered from the neurotic appearance of the faces.

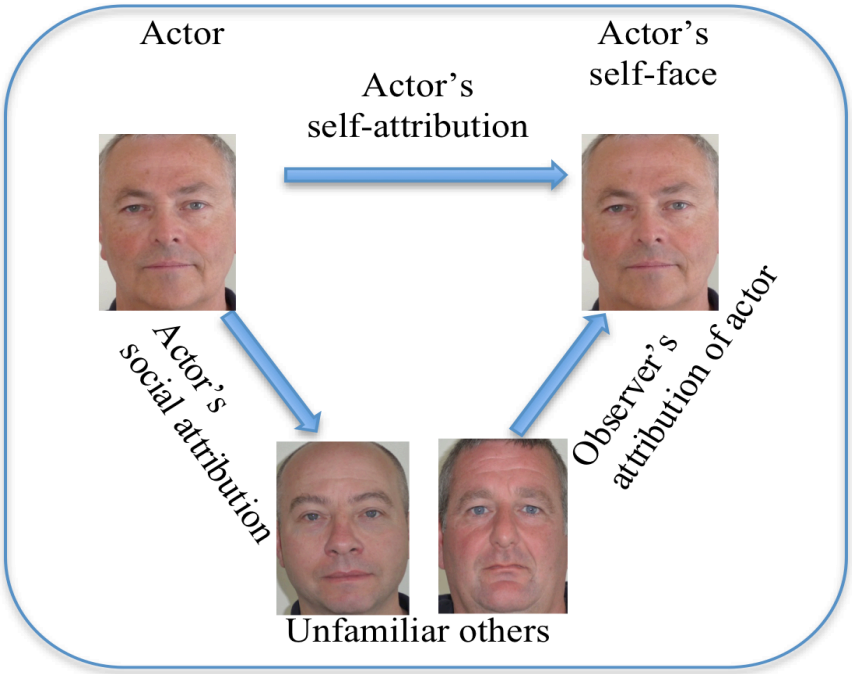


Figure C.2. Illustration of the three different perspectives that were investigated in the three attribution studies. Attributions of actors on their self-image were self-attributions. Attributions of actors on the images of unfamiliar others were social attributions. Attributions of unfamiliar observers on the image of actors were observer attributions.

C.2 Self-attribution

Our self-attribution task used the framework of the previous work on self-attributions, and provided four basic self-attribution measures based on facial appearance: actual self, ideal self, positive self and negative self. These are called *basic* measures because actors made ratings directly related to them. *Discrepancies* between these basic measures were also expected to be informative, as in previous research on self-attribution (Markus & Wurf, 1987), and could be associated with inherent traits and transient states. For example, a person experiencing depressive symptoms exhibits greater self-negativity (Beck, 2008), and might therefore make less distinction when choosing actual self and negative self. In contrast, a person with greater self-esteem exhibits greater self-positivity (Watson, Dritschel, Obonsawin, & Jentzsch, 2007), and therefore might make less distinction when choosing actual self and positive self. Thus, we measured actor's self-discrepancies as the magnitude of separation between their basic self-attributions on the Neurotic Face Scale. When the two images identified as actual and negative selves are less separated, there is less distinction between those two mental representations of self, as illustrated in Figure C.3. In this instance, it could be explained as the actor having greater self-negativity. On the contrary, if there were greater separation between the two images identified for actual and negative selves, as illustrated in Figure C.3, it would indicate lesser self-negativity.

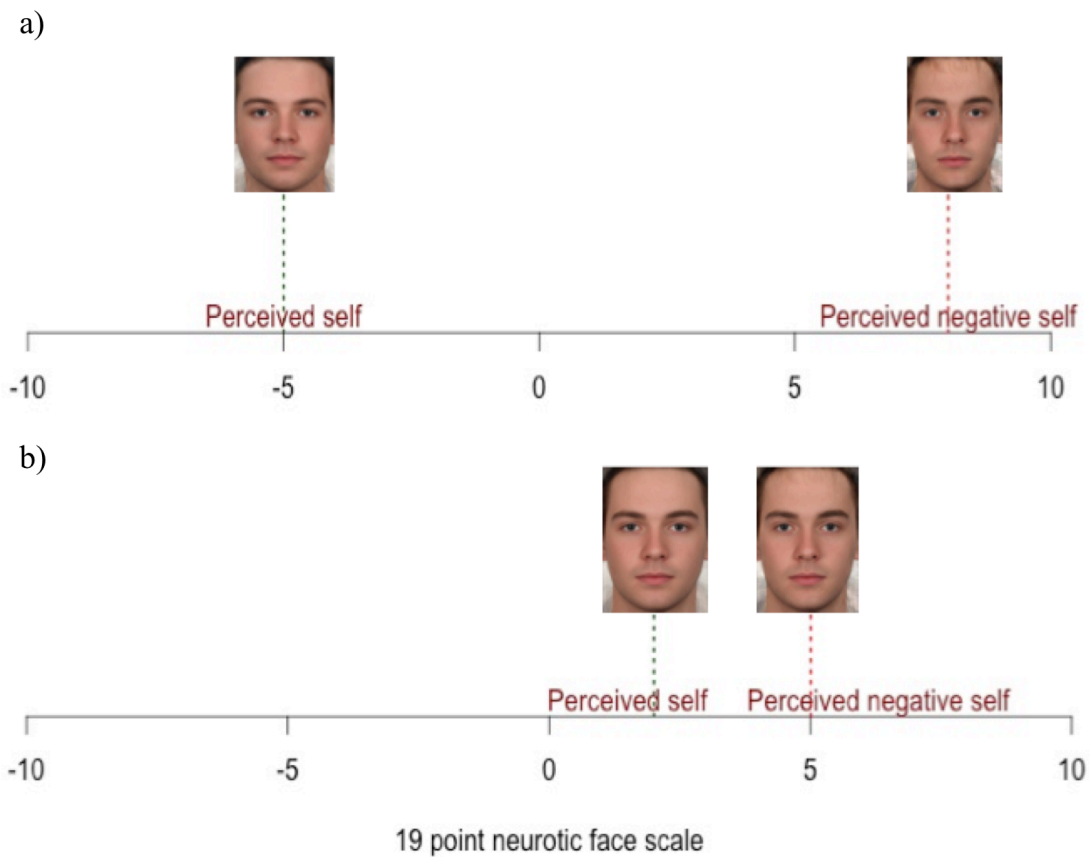


Figure C.3. The figure illustrates the magnitude of separation between the attributions of actual self and negative self on the Neurotic Face Scale. a) Shows greater separation between the two attributions, and refers to lesser self-negativity. b) Shows lesser separation between the two attributions, and refers to greater self-negativity. This illustration explains how the measures of magnitude of separation (separation index) between the attributions can reflect on actor's self-discrepancies.

Each discrepancy measure is reported here as a separation index (SI), calculated as the square root of the square of the difference between two attribution scores. For example, SI between perceived actual and negative selves was calculated as, $\sqrt{(actual - negative)^2}$. SI refers to the magnitude of separation between the respective attributions on the 19-point neurotic face scale, as illustrated in Figure C.3. Three measures of discrepancies were computed as the separation indices (SIs). The SI of actual-ideal pair referred to the classic *self-discrepancy* (ie, the discrepancy between perceived actual and ideal self), the actual-negative pair referred to *self-negativity*, and actual-positive pair referred to *self-positivity*. Greater SI therefore

indicates greater distinction between the respective perceptions. On this basis, greater SI scores mean greater separation between the two basic self-attributions, and therefore refer to reducing self-negativity, and self-positivity, but increasing self-discrepancy. It means that two of the three SIs are inverse scales. To ensure consistency of increasing scores referring to increasing self-negativity and self-positivity, in the same way as self-discrepancy, the inverse scales were reverse scored.

The self-attribution task thus provided a total of seven scores: four basic self-attribution scores and three SIs. In this task, actors responded on the Neurotic Face Scale in response to instructions relating to images of their own face. The self-attribution task was developed with the intention to explore individual differences in self-attribution, and the possibility of monitoring subtle behaviour changes. I argue that it has two useful qualities in this regard. First, the nature of the scale allows for significant individual variation in the basic and SI measures. This might not be the case for example, if we directly followed the work of Scott et al. (2013) in which an individual face is morphed to create just two images displaying "high depression" and "low depression" self, and then participants picked their most preferred self or most positive self. Second, participants are not told that face images vary in appearance of emotional stability to neuroticism. That is, judgements relating to facial neuroticism are entirely implicit, as participants simply see unlabelled continuous variation of facial appearance. Therefore, the self-attributions will be less likely to be contaminated by explicit biases about the social value of emotional stability or neuroticism. Existing literature supports that with ambiguous or limited information individuals depend on self-inference, whilst making attributions (Mitchell, Banaji, & Neil Macrae, 2005). In light of these, I propose that these qualities make our attribution paradigm more sensitive to actor’s mood and wellbeing state.

C.3 Social attribution

The attribution task was adapted to measure social attribution in a way similar to self-attribution, by using photographs of other individuals to create the Neurotic Face Scale. Having the actors from the self-attribution task rate other people's faces, allows us to see whether any biases in self-attribution carry over into attribution of others. As in the self-attribution task discussed above, the participants were instructed to scroll through the image sequences to make the presented face look positive (happy, calm and most attractive) and negative (unhappy, anxious and least attractive). Theory of Mind postulates that, when making social attributions with limited information, individuals tend to make inference to self in order to understand or give meaning to other's behaviours (Mitchell et al., 2005). Inference to self, inadvertently relates to individual's basic traits and mood state, but tapping into these processes requires paradigms that allow more automatic processing. Previous research supports automatic processing of face stimuli (Axelrod et al., 2015; Winston, Strange, O'Doherty, & Dolan, 2002), and our social attribution paradigm using faces of unfamiliar individuals, promises sensitive measures that depend on self-inference. Another study reported exaggerated perception of dynamic facial expression in clinical population (Sato, Uono, & Toichi, 2013; Trautmann-Lengsfeld, Domínguez-Borràs, Escera, Herrmann, & Fehr, 2013), suggesting aberrant perception of facial cues. These studies support our proposition that the measures from the social attribution task could show the effect of actor's inherent traits and transient states on their social attributions. Unlike the self-attribution task, however, the social attribution task provided only two basic attribution scores highlighting one of their key differences.

The difference between the social and self-attribution tasks relates to the questions that can be sensibly asked. In the social attribution task, the actors saw a number of men's and women's faces, and were instructed to make the presented face look most positive and most negative. That is, unlike the self-attribution task, actors did not indicate an "actual" or "ideal" appearance. Another important factor of the social attribution task is that, we endeavoured to control for the mood state of the observed others in order to control for the related variations in the face signals as observed by the actors. To ensure this consistency, the faces were selected from an existing database, on the basis of low depression scores. Lower depression score shows that individuals are experiencing milder depression. As explained in Chapter 1, it would indicate that the individuals are experiencing fewer or milder depressive symptoms. This was important to ensure we are measuring the actor's mental representation relating to their mood state and trait, and not a complex interaction of these with the mood state of others', who are being observed. For example, if the observed others' face displayed their low mood state then it would be further exaggerated on the Neurotic Face Scale. Furthermore, we endeavoured to control for the unknown factors that may affect attributions, by ensuring the social attribution task was completed in the same session as the self-attribution task.

C.4 Observer's attribution

The observer's attributions were measured using the same paradigm as the social attribution task. For the observer attribution task, the faces were those of the actors from the self-attribution task, and measured two basic attributions (i.e., positive and negative). This task allows us to assess whether the actors' self-attributions agree with the judgements made by external observers of the actors' faces. Unlike for the

social attribution task, we did not control for the observed actor's mood state because this study focused on investigating how observer's attribution related to actor's mood and wellbeing state. This line of thinking reflects on the social stigma or prejudice towards individuals experiencing problems relating to their mental health and wellbeing. By comparing and triangulating self, social and observer's attributions, we can get an overview of how actor's mood, wellbeing and trait may modulate not just their self-attributions and attributions of others, but also the attributions of the actors made by unfamiliar observers.

Actors and observers in all the three studies, in this section, completed a trait-identifying task, which is explained in Chapter 5. This task was to ensure that observers were able to accurately differentiate the high-low neurotic facial cues, from the composite faces, that were used as the anchor points for creating the Neurotic Face Scale.

C.5 Analysis plan

Using the attribution task in self, social and observer contexts, we measured a range of attributions. The attributions of ideal and actual self were made only in the context of self-attribution, whereas the positive and negative attributions were made in all the three contexts (i.e. self, social, and observer). The three responses for positive and negative attributes were averaged respectively, for scoring positive and negative attributions. Initially, all the individual responses were examined for their distribution, as well as the correlations between the individual responses for the respective positive and negative attributions. On the basis of these correlations, individual responses were averaged to score the positive and negative attributions.

We further explored how actor's mood, wellbeing, personality and attributional style, related to their self and social attributions as well as observer's attributions. The associations were explored using raw correlations, with the intention to portray the consistent picture emerging from all the significant correlations. I acknowledge the correlations do not equate to causation, and multiple correlations could bring false positives. However, using a simple method of putting together meaningful correlations to understand the bigger picture would be more suitable to gauge the quality of our new task. The non-significant correlations that contributed to the bigger picture were also reported in the results appropriately. The correlations of self and social attributions with the actor's mood, wellbeing, personality and attributional style helped to build a picture of the attribution task measuring the related subtle behavioural changes. More specifically, the results displayed the underlying link of attribution with mood, wellbeing and neuroticism. This is interesting because in Chapter 2, we reported wellbeing and neuroticism as predictors of depression. When the correlations provided a consistent picture of attributions relating to the aforementioned measures of trait and state, it substantiated the multifaceted quality of the new attribution task. The following self, social and observer attribution studies explore these relations, and are discussed in three separate chapters within this section. Since self-attribution is of key interest, its association with trait and state measures will be discussed in greater detail.

CHAPTER 5 – Looking in the mirror: Self-attributions

Abstract

Cognitions are affected by the mental representations of self and social cues. These can be negatively biased with depression and related traits, indicating misattributions and dysfunctions. We measured self-attributions of facial appearance using the novel self-attribution task. We propose that depression, wellbeing and neuroticism will relate to misattributions of self. The results consistently showed that participants with increasing severity of depression, low hedonic wellbeing and high neuroticism identified more neurotic images as their actual self, indicating an exaggerated negative perception of self. They also chose more neurotic images as their positive self, indicating increased misperceptions. Mental representations of self-negativity increased with increasing depression and neuroticism, and decreasing hedonic wellbeing, while self-discrepancy decreased with increasing wellbeing. The misperceptions relating to depressogenic states and trait are consistent with the existing literature, and substantiate the self-attributions measured using our self-attribution task. We quantify self-negativity, self-positivity and self-discrepancy in visual modality, which are sensitive to emotional dysregulations.

5.1 Introduction

Self-attribution refers to the process by which individuals determine the antecedents and consequences of their own behaviours (Niemiec, 2007). They have previously been investigated using positive and negative words or adjectives (Munevar et al., 2014), scenarios (Ball, McGuffin, & Farmer, 2008) and affective

pictures (Ochsner, Ray et al., 2004). Our most personal and individualising attribute, however, is likely to be our facial appearance. Self-face paradigms have been used to investigate self-recognition (Devue et al., 2007; Kircher et al., 2001), self-enhancement (Epley & Whitchurch, 2008; Felisberti & Musholt, 2014), and differentiation of self and other (Schulte-Rüther, Markowitsch, Fink, & Piefke, 2007). This evidence suggests that self-face stimuli activate self-referential processing with distinct neural underpinnings, and is useful to investigate emotional and cognitive processes relating to self (Keenan et al., 2000; Kircher et al., 2001). Important to this study, such self-referential processes are affected in those individuals experiencing depression (Christoff, Cosmelli, Legrand, & Thompson, 2011; Keenan et al., 2000).

More recently, a study used face-morphing technique to morph self-face in gradual gradients towards stranger-faces and famous-faces to create images that were presented in a two alternative forced choice paradigm (Liu et al., 2014). They reported self-face bias during face processing in patients with major depressive disorder, which was interpreted as impaired self-processing and self-recognition. Other studies have reported exaggerated perceptions of self (Uono, Sato, & Toichi, 2015) and negative bias during face processing (Anderson et al., 2011; Zhu et al., 2016) in individuals experiencing mental health problems, indicating misattributions. Christoff et al., (2011) explained these observed misattributions on the basis of reduced connectivity within the self-processing neural networks in individuals with mental health disorders. These studies put together a picture of the unseen complimentary roles of neural mechanisms and attribution. From the observer's vantage, only the behavioural aspects are obvious, and these misattributions can detrimentally affect individual's social functioning leading to social isolation (Seivewright, Tyrer, & Johnson, 2004; Steger & Kashdan, 2009; Weightman, Air, & Baune, 2014), and further mediating

depressive symptoms such as feelings of worthlessness and loneliness (Seligman et al., 1979).

5.1.1 Attributions, depressive symptoms, and neuroticism

Cognitive styles have been investigated as vulnerability factors of depression (Bentall, Kinderman, & Kaney, 1994), besides the underlying neural mechanisms. These factors affect emotional regulation (Beauregard, Paquette, & Le`vesque, 2006; van Rossum, Dominguez, Lieb, Wittchen, & van Os, 2011) and reality distortion (Dobson & Shaw, 1981), driving the vicious cycle of distorted self and social attributions (Golin, Sweeney, & Shaeffer, 1981; Murphy & Bates, 1997; Pearson et al., 2015) leading to dysfunction. Most studies investigating attribution and depression used various self-esteem measures and the Attributional Style Questionnaire (ASQ) (Peterson et al., 1982), and found low self-esteem and depressive attributional style in individuals predisposed to depression (Bush, Ballard, & Fremouw, 1995; Seligman et al., 1979). Using the ASQ, it was found that those vulnerable to depression regard negative events as being caused by self (Ball et al., 2008), indicating a negative self-concept. Other studies have used stimuli of positive and negative words or adjectives (Munevar et al., 2014), and affective pictures (Ochsner, Knierim et al., 2004), which helped to understand that individuals experiencing depressive symptoms chose negative attributes to describe themselves. These studies substantiate the model of negative self-concept and misattributions disrupting social behaviours (Beck, 2008; Joiner, 2000). The above paradigms may be effective in measuring attributional style and negative self-concepts relating to depressive symptoms, but are limited in measuring visual self-attributions.

Measuring self-attributions of visual stimuli would benefit from paradigms using self-face. Kircher et al. (2001) found that self-face stimuli uniquely activated self-referential processing with distinct neural underpinnings. Medial prefrontal cortex (MPFC) and anterior cingulate cortex (ACC) activations were identified with processes of self-referencing and recognising self-face (Keenan et al., 2000; Northoff et al., 2006; Qin & Northoff, 2011; Schneider et al., 2008), which are also closely linked to mood disorders (Lemogne et al., 2010; Lemogne, Delaveau, Freton, Guionnet, & Fossati, 2012). This link between behaviour and brain, could explain some of the behavioural symptoms of mood disorder. A major symptom of depression is negativity of self, which may be coupled with grandiosity of self in manic depression. The disruptions in the self-referential neural networks could explain such distorted self-perceptions in the bipolar spectrum. MPFC being an active link in the fronto-parietal attention network (Amodio & Frith, 2006) may also explain other mood disorder symptoms such as attention bias and inability to concentrate. Tryptophan depletion studies have shown the effect of neuromodulators in these networks, whilst processing face signals (Daly et al., 2010). Tryptophan is the precursor of serotonin, the depletion of which temporarily mimics a depressive neurobiology (Marsh et al., 2006; Young, 2013). Depleted tryptophan levels were associated with reduced accuracy for facial emotions such as fear (Harmer et al., 2003b; Hornboll et al., 2013) and trait signals of neuroticism (Ward, Sreenivas & Rogers, 2016).

Prior studies have reported the strong association of neuroticism with mental health (Cheng & Furnham, 2003; Lahey, 2009), especially mood and anxiety disorders (McConville & Cooper, 1998; McCrae & Terracciano, 2005; McWilliams, 2003). In Chapter 2 of this thesis, I discussed the predictive role of neuroticism for the

severity of depressive symptoms, which is further substantiated by neurobiological studies that reported the link between neuroticism and serotonin transporter binding (Hong et al., 2011; Stewart, Deary, & Ebmeier, 2002; Takano et al., 2007) . There is evidence of greater neural activation whilst processing negative facial emotions, in those with greater neuroticism (Canli, 2004).

The studies discussed so far overwhelmingly support our proposition of misperceptions in general and specifically towards self, in relation to depressive mood and neuroticism. We propose to measure self-attributions, using our visual self-attribution task. Reflecting on the existing evidence, we propose that increasing depression and neuroticism will relate to increasing self-negativity, demonstrating misattributions. Such misattributions of self could perpetuate depression, disrupt social behaviours, and diminish wellbeing.

5.1.2 Attributions and wellbeing

Wellbeing is strongly associated with mental health and social functioning (Ryan & Deci, 2001; Seligman et al., 1979; Taylor & Brown, 1988). Wellbeing, commonly described as subjective wellbeing, consists of three interrelated components: life satisfaction, pleasant affect, and unpleasant affect (Diener & Lucas, 1999). Affect refers to pleasant and unpleasant moods and emotions (hedonic), whereas life satisfaction refers to a cognitive sense of satisfaction with life (eudemonic) (Diener et al., 2010). Essentially, subjective wellbeing accounts for both eudemonic and hedonic wellbeing, along with mood state. The hedonic perspective suggests that maximizing one's pleasurable moments is the pathway to happiness, whilst eudemonic perspective advocates that living a life of virtue, and actualizing one's inherent potentials improve wellbeing (Delle Fave et al., 2011). Previous studies

support the association of individual's mental health and wellbeing with their concepts of self, such as self-image and self-esteem (Cheng & Furnham, 2003; Corning, 2002; Crocker & Luhtanen, 1990; Rathbone, Holmes, Murphy, & Ellis, 2015), which also affect their casual attributions of success and failure (Farid, Akhtar, & Qamar, 2014). We propose that our self-attribution measures will be associated with individual's wellbeing.

Self-attribution, in the context of our study, refers to attributions of self-facial appearance. The process of making attributions to self-facial appearance, involves multiple processes, such as recognition of self-image, processing facial cues, and self-referential processes. Face processing, especially self-face, involves more automatic processing, and therefore may be reliant on non-conscious processes (Axelrod et al., 2015). Our self-attribution paradigm would, therefore, provide sensitive measures of subtle behaviours elicited by mood, wellbeing, and other internal processes.

In this study, we measure self-attribution using our novel self-attribution task to investigate the association of individual's self-attributions with their depressive state, neuroticism trait and wellbeing state. We propose that depression, neuroticism and wellbeing will relate to self-attributions. Specifically, we propose that increasing severity of depressive symptoms, neuroticism and decreasing wellbeing will relate to increasing self-negativity.

5.2 Methods

We recruited 100 (69 females) participants with a mean age 20.41±4.72 from the 1st and 2nd year undergraduate student population at Bangor University, who gave informed consent prior to participation and were compensated for their time in compliance with School of Psychology and Bangor University research ethics and

regulations. After participation students were debriefed and provided with information regarding available psychological support. They completed questionnaires including: Inventory of Depressive Symptomology – self rated (IDS) (Rush et al., 1986; Rush et al., 1996) to measure depressive mood state, Flourishing Scale (FS) (Diener et al., 2010) and Scale of Positive and Negative Experiences (SPANE) (Diener et al., 2010) to measure eudemonic and hedonic wellbeing respectively, Mini International Personality Item Pool (MIPIP) (Donnellan et al., 2006) to measure personality, and ASQ (Peterson et al., 1982) to measure attributional style. All the above measures, except ASQ, have been described in Chapter 2.

Briefly, FS is an eight-item scale that provided a single measure of psychosocial flourishing relating to eudemonic wellbeing. The SPANE is a 12-item scale that measured three different scores for hedonic wellbeing (positive experience, negative experience and balanced experience). The positive and negative experience scores refer to the frequency of positive and negative experiences respectively, in the past four weeks. The balanced experience is computed as the difference between the positive and negative experiences scores. A greater balanced score indicate better wellbeing, with more positive than negative experiences; therefore used as the hedonic wellbeing measure. MIPIP provided the big five personality scores. ASQ has 12 different hypothetical events; six good and six bad events. These events also have additional quality of half being interpersonal or affiliative, and the other half being achievement related. Following each event are parallel questions. First step was to "write down the one major cause" of the event, and then to rate the cause along the three attributional dimensions, such as internal, stable and global. Finally, importance of the situation described was rated on a 7-point scale. By collapsing across the achievement-affiliation distinction, ASQ provides six sub scores, (internal, stable,

global) * (positive, negative), and two aggregate scores (composite style for good events and composite style for bad events).

Participants then completed the self-attribution task, in which they selected images of themselves they felt best matched the respective instructions. They also completed the trait-identifying task. Both the tasks were explained below.

5.2.1 Self-attribution task

The self-attribution task was set up using the participant's own photograph at the time of data collection. The data collection procedures for setting up the task included taking photograph of the participant, creating the image sequences and setting up the task. All the procedures were completed in a single session.

Photograph: A front facing portrait of each participant was taken using a Nikon D3000 camera, Nikon DX (AF-S Nikkor) 18-55 mm (1:3.5-5.6 G) lens, and Nikon SB-400 flash. The camera was placed on a tripod at an approximate height of 90 cm and participants seated approximately 215 cm away. The flash was turned 45^{o} upwards facing the white ceiling, to provide soft/diffused lighting by bouncing light on to the subject. All other lightings were controlled. A full-face portrait taken, devoid of any make up or face tattoos and with a neutral expression (no expression), was used to set up the task.

Stimuli creation: The portraits taken in the first phase of the study were used to set up the self-attribution task. The portraits were cropped and rotated to present the correct pupil alignment along the transverse plane, to minimise differences due to posture or angle of the head. Portraits were cropped using Microsoft Photo Editor. Head rotation correction was done by aligning the midpoint of the eyes (iris) to the

same temporal plane at 0^{o} angle. These were then warped towards a pair of sex-congruent composite faces with high neuroticism and emotionally stable traits, respectively. Warping is a process of gradual change of the internal reference points of an individual face towards the respective reference points on the composite faces, as explained later. The composite face pairs of neuroticism were adopted from the study detailed in Chapter 4. The composites had accuracy of 69% for female pair and 77% for male pair, which was significantly better than chance.

Warping participant's photograph towards sex-congruent composite face pairs created the image sequences for the task. This was done using JPsychomorph (J. Chen & Tiddeman, 2010). In this process, 139 landmarks were identified on each photograph and then warped 100% towards the emotionally stable and the neurotic face composites, also accounting for their shape, colour and texture, to create 19 images. In the resultant Neurotic Face Scale, the original face was the mid-point of the scale and gradually changed with increasing emotionally stable facial appearance towards one end and neurotic facial appearance towards the other. The scores on the 19-point scale were from -9 (least neurotic) through 0 (original face) to +9 (most neurotic). Figure C.1 shows the graphical illustration of the warping process and the image sequences on the 19-point neurotic face scale. This is an implicit task because the participants were not aware of the underlying neurotic appearance of the scale.

Presentation: In the self-attribution task, the participant's own face images were presented using Matlab. The task presented with eight blocks (questions: ideal, actual, happy, emotionally stable, attractive, unhappy, anxious and least attractive) x 1 trial (self face) x 19 images (face warps). The blocks (questions) were randomly selected per presentation. The order of images (19 face warps) in the trial was

randomly selected in each block. The 19 images (self-face warps) were presented (500x500 pixels) one at a time in the middle of a computer screen with instructions at the top, as shown in Figure 5.1. The images were presented one at a time in order of the sequence of the 19-point face scale and looped back and forth through the sequence to provide seamless increase and decrease of neurotic traits.

The instructions were to choose their actual ('Choose your actual face'), ideal ('Choose your ideal face'), positive self and negative self. There were three positive and negative self-attributions. The instructions for positive-self were, 'Make the face look most happy and content', 'Make the face look calm, stable and well-balanced' and 'Make the face look most attractive'. The instructions for negative-self were, 'Make the face look unhappy and least content', 'Make the face look anxious and emotionally unstable' and 'Make the face look least attractive'.

The first image per presentation was randomly selected from the 19 images. When participants pressed either the right or left arrow keys, the images changed through a looped sequence in their order on the implicit neurotic face scale. This gave the impression of the presented face changing, as controlled by the participant. The presentation of looped sequence of images made it difficult for the observer to understand the lateral representation of the scale, and therefore its end points. Participants selected one image for each instruction by pressing spacebar. This task was not timed.

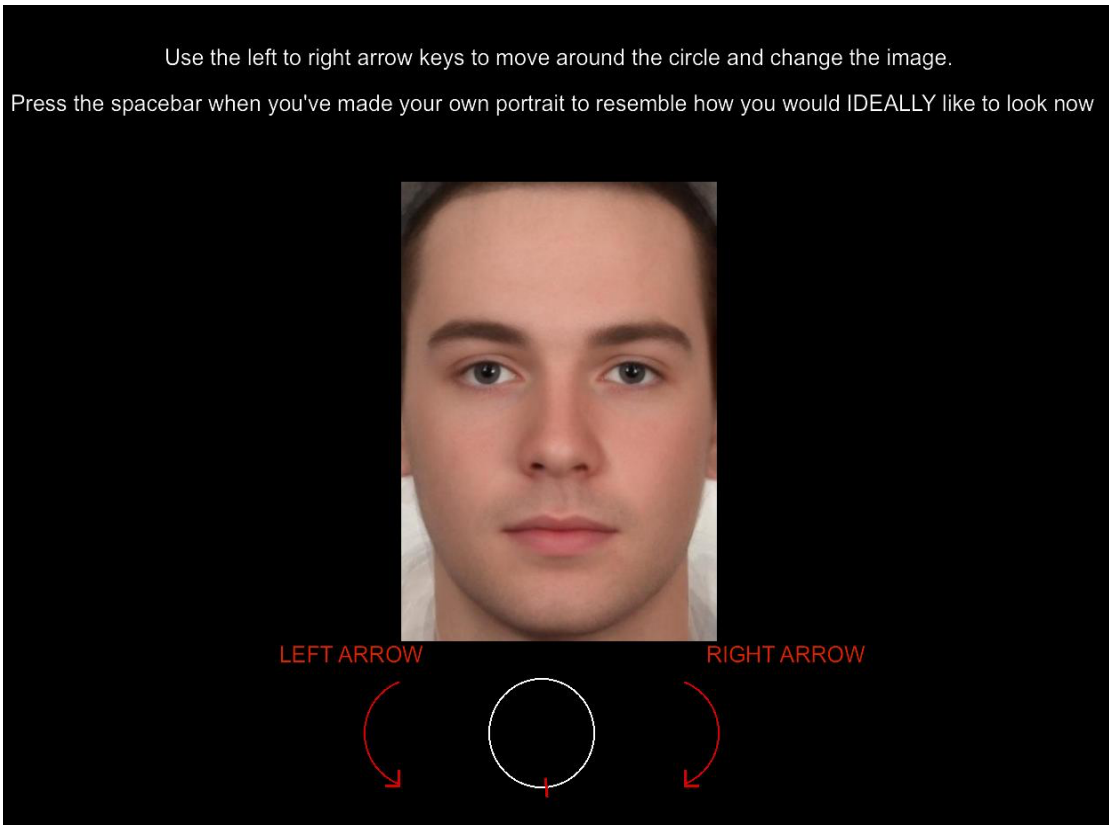


Figure 5.1. An illustration of a trial from the self and social attribution task as presented on a computer screen and viewed by the participants. When they press either the right or left arrow keys the presented face will appear to be changing. By continued pressing of either of the keys, will present the 19 images in a continuous looped sequence. Without a lateral representation, the end points of the scale were not obvious to the participants.

5.2.2 Trait identifying task

This task was used in all the attribution studies. The composites (male and female) of high neuroticism and emotionally stable traits, used as anchor points to create the sequence of images for the attribution tasks, were used in the trait-identifying task (two-alternative forced choice paradigm). The task had four presentations with 2 (questions) x 2 (sex-congruent neurotic face pair). The high-low neurotic pair that was also sex-congruent was presented at the same time with an instruction. The instructions read ‘Who is more neurotic?’ and ‘Who is less neurotic?’. Descriptions for neuroticism such as ‘experiencing frequent mood swings’, ‘getting upset easily’, ‘frequently tensed’, ‘feeling blue’, as per Mini

International Personality Item Pool (Donnellan et al., 2006), were also provided. The results from this task confirmed the accuracy in identifying the neurotic traits from neutral looking composite faces.

5.3 Data Analysis

The primary outcome measures were the basic self-attributions (actual self, ideal self, positive self, and negative self) and the SIs. The positive self and negative self were computed as the average of three respective individual responses. The inter-correlations between the three individual responses are reported. We further report the correlations between the four basic self-attributions. The three SIs measured in this study include the SI of perceived actual self and perceived negative self (SI_{an}) measured self-negativity, the SI of perceived actual self and perceived positive self (SI_{ap}) measured self-positivity and the SI of perceived actual self and perceived ideal self (SI_{ai}) measured self-discrepancy. As explained previously, the inverse scales were reverse scored as required to ensure that increasing SI_{an}, SI_{ap} and SI_{ai} indicated increasing self-negativity, self-positivity and self-discrepancy respectively.

The secondary outcome measures were scores from IDS, FS, SPANE, ASQ and MIPIP. We use correlation analysis to identify associations between the primary and secondary measures. Reflecting on the predictors of depression discussed in Chapter 2, we will report and discuss the significant correlations of depression score, neuroticism and balanced wellbeing with the self-attribution measures. This will demonstrate the consistent picture of self-attribution in relation to mood state, trait and wellbeing. Self-attributions did not show significant correlations with FS, and showed differential associations with ASQ and the personality traits. The correlations that contribute towards demonstrating the quality of the self-attribution measures are

briefly discussed in this chapter. We used trait-identifying task to measure participant's accuracy for the male and female composite faces. One sample *t*-test against the test value of 0.5 (50%) will identify better than chance accuracy in identifying traits from these composite faces, to confirm participant's accuracy. The bigger picture that emerges from all these results will be discussed.

5.4 Results

A total of 100 (69 female) participants with a mean age $M = 20.41$, $SD = 4.725$ and range = 18 – 56, participated in this study. The group had mean depression score $M = 18.75$, $SD = 8.177$, mean hedonic wellbeing score $M = 9.320$, $SD = 7.768$, and mean neuroticism score $M = 2.822$, $SD = .885$.

5.4.1 Trait identifying task

The one sample *t*-test against the test value 0.5 found significantly better than chance accuracy in identifying neurotic traits for female; 58%, $t(99) = 2.264$, $p = .026$, 95% *CI*(.009, .150) and male; 73%, $t\ (99) = 7.697$, $p < .001$, 95% *CI*(.174, .295) composite faces. This confirms participants' accuracy in judging neurotic traits from the composite faces. That is, the participants demonstrated an understanding of the neuroticism scale used to create the images, and accurately identified that one anchor appeared more neurotic than the other.

5.4.2 Exploring basic self-attributions

These are new measures of self-attribution and therefore we will explore the inter-reliability of the different measures. There are four basic self-attributions: actual self, ideal self, negative self and positive self. A score of zero indicates the participant's actual picture. Positive scores indicate the choice for the self-attribution

(e.g. actual self) was more neurotic in appearance; negative scores indicate the attribution was less neurotic in appearance.

5.4.2.1 Individual responses for positive and negative self-attributions*:* The positive self-attribution is an average of the responses for happy self, emotionally stable self and most attractive self. There were significant positive correlations between these three responses. Happy self correlated positively with emotionally stable self, $r(100) = .400$, $p < .001$ and attractive self, $r(100) = .403$, $p < .001$. Emotionally stable self also correlated positively with attractive self, $r(100) = .528$, $p < .001$. These correlations demonstrate consistency in participant's responses for the individual positive attributions.

The negative self-attribution was an average of the responses for unhappy self, anxious self and least attractive self. Again, there were significant positive correlations between the three responses. Unhappy self correlated positively with anxious self, $r(100) = .228$, $p = .023$ and least attractive self, $r(100) = .236$, $p = .018$. Anxious self also correlated positively with least attractive self, $r(100) = .228$, $p = .023$. Similar to the three correlations between the individual positive attributions, we demonstrate consistency in participant's responses for the individual negative attributions as well. These significant positive correlations between the respective individual responses substantiate the rationale for aggregating them to compute the positive and negative self-attributions.

5.4.2.2 Four basic self-attributions: Actual self correlated positively with ideal self, $r(100) = .353$, $p < .001$ and positive self, $r(100) = .297$, $p = .003$. This indicates that participant's perceived actual self concurred with their perceived ideal self and positive self. Ideal self correlated positively with positive self, $r(100) = .695$, $p < .001$

and negatively with negative self, $r(100) = -.453$, $p < .001$. A positive correlation indicates that those participants who identified more neurotic image as their positive self, also made similar attributions for their ideal self. Whereas, a negative correlation indicates that participants who identified more neurotic image as their negative self, attributed less neurotic images to their ideal self. These results show that perceived ideal self concurred with participant's perceived positive self and contrasted with their perceived negative self.

Positive self correlated negatively with negative self, $r(100) = -.537$, $p < .001$. This indicates participants who identified more neurotic images as their negative self, identified less neurotic images as their positive self. Here we see that 'perceived' positive and negative were distinctly differentiated in this task. We propose that 'perceived' positive and negative have influenced participants' attributions of their actual self in this study and relate to implicit distortions.

Table 5.1. Correlations between the basic self-attributions.

	Perceived actual self	Perceived ideal self	Perceived positive self	Perceived negative self
Perceived actual self		.353**	.297*	-.084
Perceived ideal self			.695**	-.453**
Perceived positive self				-.537**
Perceived negative self				

Note. Correlations are reported as Pearson's *r*, * $p < .05$, ** $p < .001$

One sample *t*-test against the test value of zero provided evidence for these influencing perceptions that were observed as basic positive and negative bias on the 19 point face scale. The mean positive self-attribution of -1.07 with *SD* of 3.64 was significantly more emotionally stable than original self-face, $t(99) = 2.94$, $p = .004$,

95% *CI*(-1.79, -0.35) and the mean negative self-attribution of 3.23 with *SD* of 4.43 was significantly neurotic than original self-face, $t(99) = 7.29$, $p < .001$, 95% *CI*(2.35, 4.11). These results suggest that on average there was positive bias for emotionally stable appearance and negative bias for neurotic appearance, which was consistent with the results discussed in Chapter 4. The interesting fact is, that despite having 19-point scale that allowed greater variance in responses, on average, such basic biases were maintained.

Overall, the results demonstrate that the basic self-attributions are correlated in the expected manner, and demonstrate basic biases. It also confirms participants' understanding of the task, and ability to use the scales in a consistent pattern of responding. Now we proceed to examine how participant's mood, wellbeing and neuroticism could affect their individualistic self-attributions more than their average positive and negative biases.

5.4.3 Self-attributions, depression, hedonic wellbeing and neuroticism

We examine whether self-attributions are revealing in the sense of being correlated with individual differences in traits related to depression, neuroticism and wellbeing. Neuroticism and hedonic wellbeing were significant predictors for depression, as reported in Chapter 2, and therefore we focus on their correlations with our measures of self-attributions (Table 5.2). Eudemonic wellbeing had non-significant correlations with self-attributions (see Table App.1 in the Appendix) and showed trends consistent with hedonic wellbeing. The correlations reported here demonstrate the consistent relation of the self-attribution measures with depression, wellbeing and neuroticism.

Table 5.2. Correlations of self-attributions, including basic and discrepancies, with depression, wellbeing and neuroticism.

	Depression	Hedonic wellbeing	Neuroticism
Basic self-attributions			
Perceived actual self	.219*	-.140	.200*
Perceived ideal self	.182	-.011	.232*
Perceived positive self	.253*	-.124	.277**
Perceived negative self	-.138	.136	-.108
Separation Indices (mental self-representations)			
Self-discrepancy (SI_{ai})	.153	-.253*	.094
Self-positivity (SI_{ap})	-.055	.171	-.014
Self-negativity (SI_{an})	.263**	-.233*	.243*

Note. Correlations are reported as Pearson's *r*, * $p < .05$, ** $p < .001$

5.4.3.1 *Depression*

Depression, as measured using IDS, correlated significantly with actual self, $r = .219$, $p = .029$ and positive self, $r = .253$, $p = .011$ and non-significantly with ideal self, $r = .182$, $p = .070$. This means participants with increasing severity of depressive symptoms, identified more neurotic images as their actual, positive and ideal selves. These associations demonstrate misattributions of self-facial appearance by individuals, with increasing depression scores. Figure 5.1 shows the two significant correlations of basic self-attributions of facial appearance with depression scores. The misattributions modulated by the severity of depressive state, were further explored using the SIs, which references two self-attributions providing an understanding of how different (separated) or similar (close) the two attributions were on the Neurotic Face Scale.

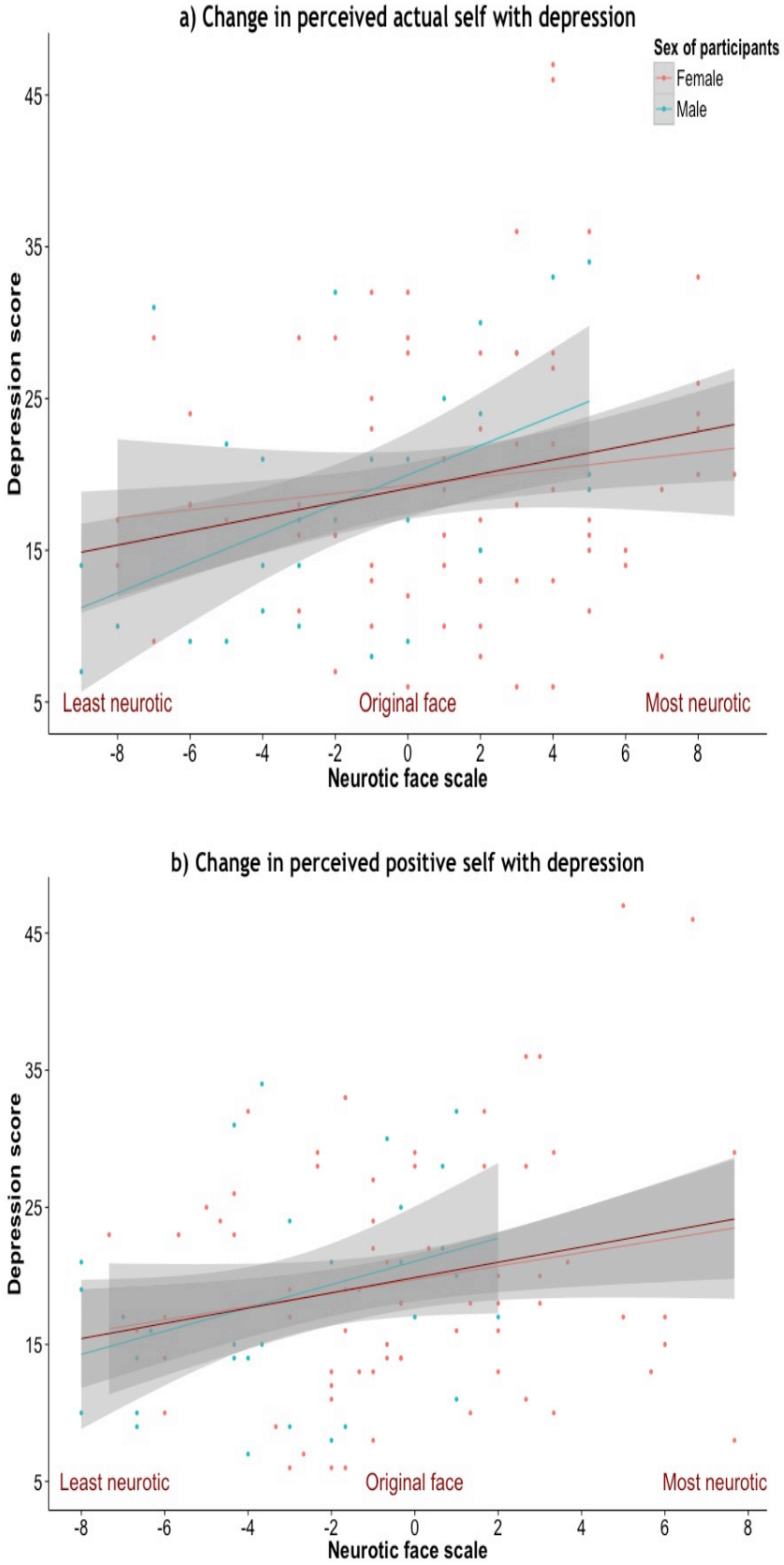


Figure 5.1. The graphs show the significant (only when including outliers) correlations of depression score with the basic self-attributions of a) perceived actual self and b) perceived positive-self. Neurotic images were identified as actual self and positive self with increasing severity of depression.

IDS score correlated with SI_{an}, $r = .263$, $p = .008$, as shown in Figure 5.2, indicating increasing self-negativity with increasing severity of depressive symptoms. This supports the misperception of self-facial appearance relating to depression, supporting classic self-negativity when experiencing depression. Here we have an explicit measure of visual self-negativity that is sensitive to mood state.

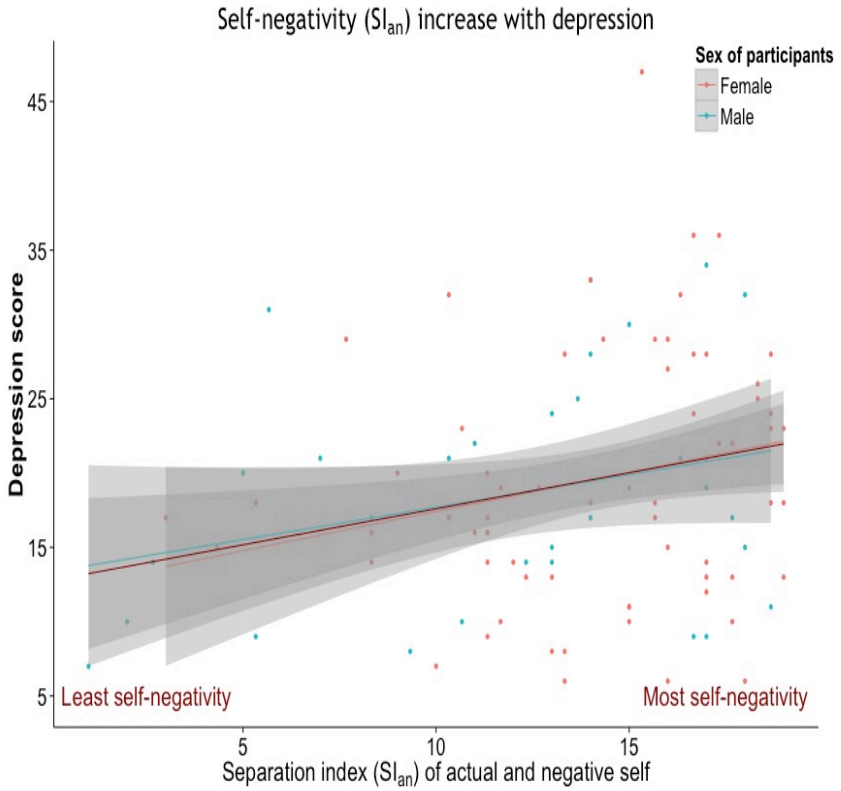


Figure 5.2. The graph shows the significant correlation of depression score with self-negativity, that is increasing depression relates to increasing self-negativity.

The graphs in Figure 5.1 and 5.2 shows two depression scores greater than 40, i.e. 'severely depressed'. Despite the two scores being closer to the median of IDS scores that range from 0 to 84, the two participants could be termed as outliers within this sample. After excluding these outliers, depression correlated non-significantly with actual self, $r = .187$, $p = .06$, positive self, $r = .152$, $p = .13$ and self-discrepancy (SI_{ai}), $r = -.189$, $p = .06$, but significantly with self-negativity (SI_{an}), $r = .241$, $p = .02$. Since the focus of this thesis is on individual differences and later analyses do not show the same outliers, no exclusions are imposed on later analyses.

5.4.3.2 *Hedonic wellbeing*

Balanced experience score is a robust measure of hedonic wellbeing, accounting for the frequency of both positive and negative experiences. Although hedonic wellbeing did not correlate significantly with the basic self-attributions, they correlated significantly with SI_{an}, $r = -.233$, $p = .020$ and SI_{ai}, $r = -.253$, $p = .011$. These correlations build a picture of decreasing hedonic wellbeing affecting increasing self-negativity and self-discrepancy respectively. These correlations are shown in Figure 5.3.

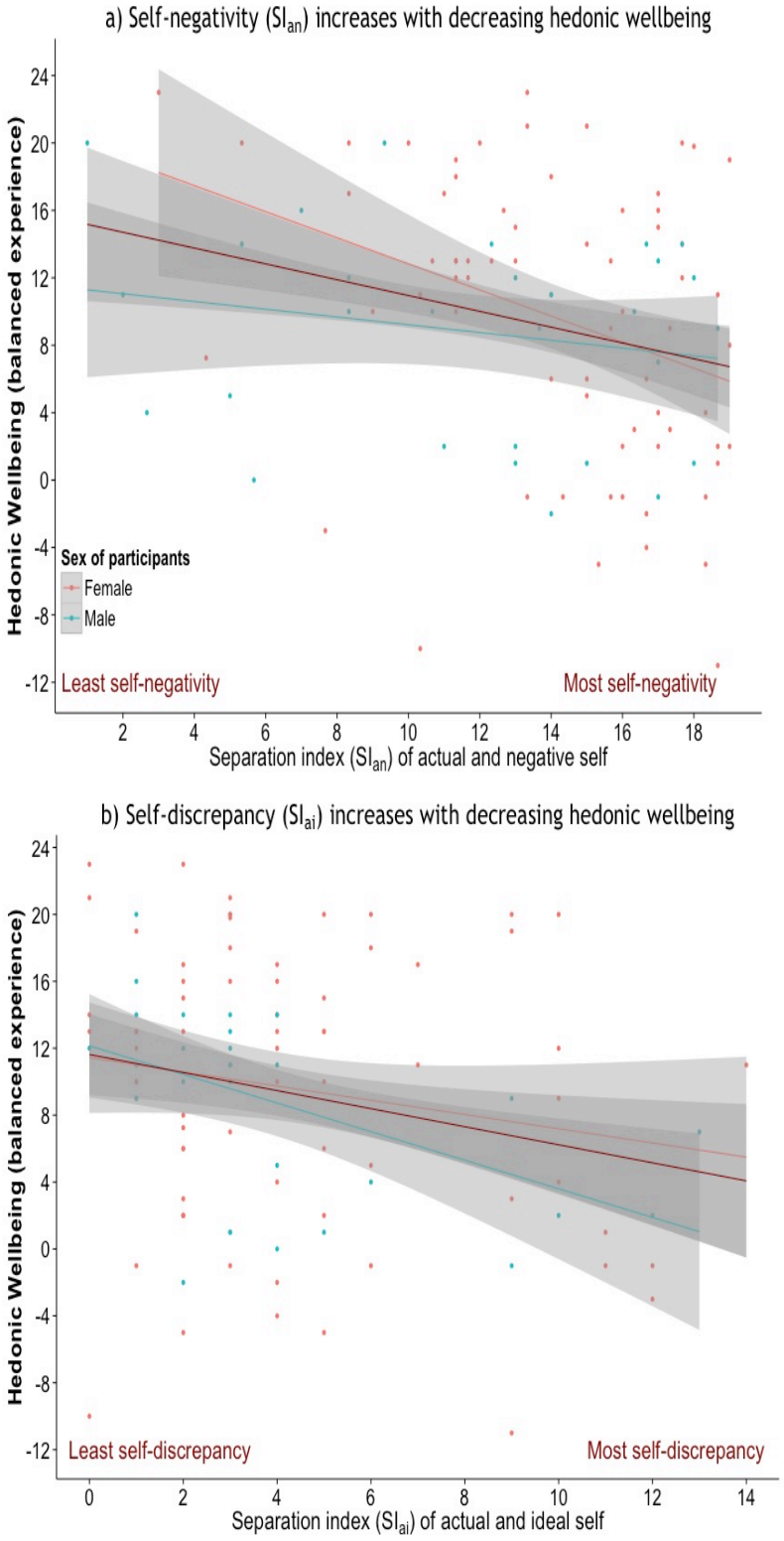


Figure 5.3. The graphs show the significant correlations of hedonic wellbeing (balanced experience). With decreasing balanced (more negative and less positive) experience there was increasing a) self-negativity (SI_{an}) and b) self-discrepancy (SI_{ai}).

Balanced experience had a non-significant correlation with SI_{ap}, $r = .171$, $p = .089$, suggesting increasing self-positivity with increasing hedonic wellbeing. These results show that greater balanced (more positive and fewer negative) experience related to decreasing self-negativity, self-discrepancy and enhancing self-positivity. The importance of participant's hedonic wellbeing in improving their adaptive behaviours is evident from these results.

5.4.3.3 *Neuroticism*

Neuroticism correlated positively with perceived positive self, $r = .277$, $p = .005$, perceived ideal self, $r = .232$, $p = .020$, and perceived actual self, $r = .200$, $p = .046$. Consistent with depression, neurotic traits of participants also related to misattribution of neurotic images as their positive, ideal and actual self as shown in Figure 5.4. Thus the misattributions to self-facial appearance are related to inherent neurotic trait as well.

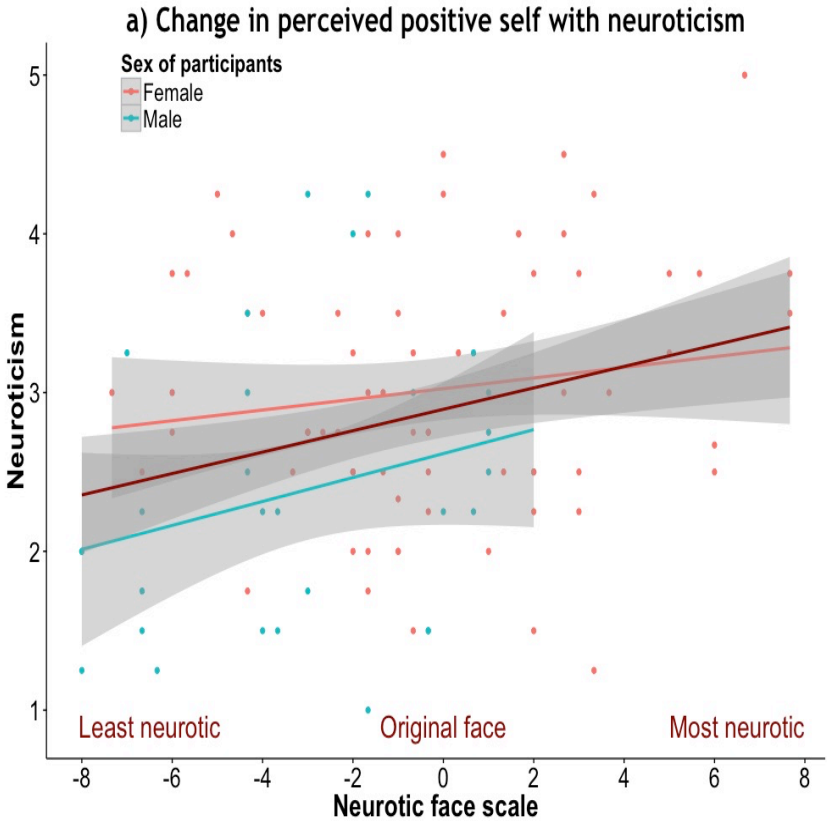


Figure 5.4. The graph shows the significant correlation of neuroticism with positive self. The graphs continued in the next page.

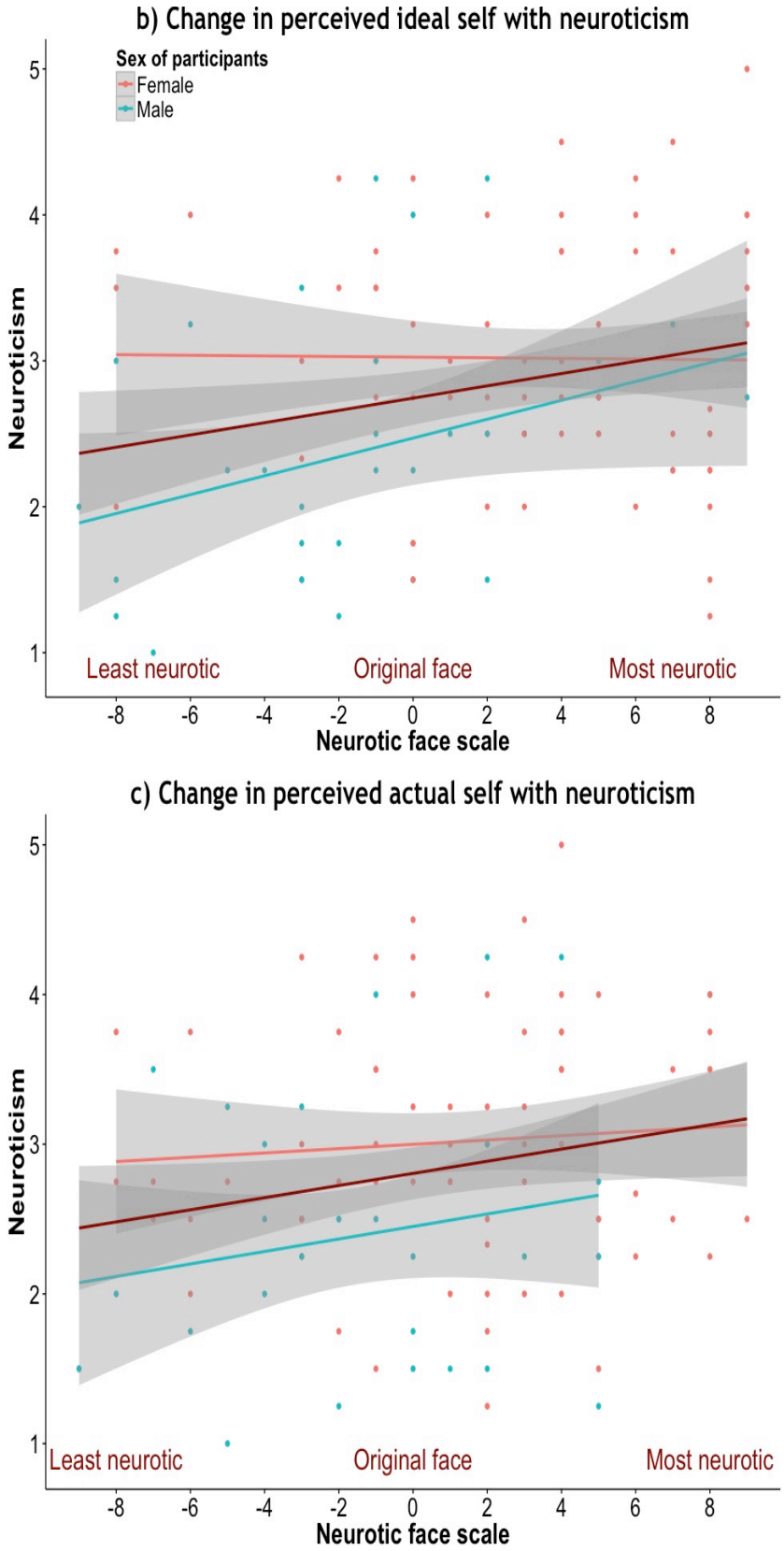


Figure 5.4. The graphs show the significant correlations of neuroticism with self-attributions; positive, ideal and actual self. The 19-point neurotic face scale ranged +9 (most neurotic image), 0 (original face), -9 (least neurotic image). With increasing neuroticism, participants chose more neurotic images for positive, ideal and actual self.

The SI explained the quality of misattributions relating to neuroticism. Neuroticism correlated with SI_{an}, $r = .243$, $p = .015$, indicating increasing neuroticism relating to increasing self-negativity, as shown in Figure 5.5. This is consistent with the existing literature that reports increased internalising of negativity with increasing neuroticism trait (Griffith et al., 2009; Lahey, 2009). This further qualifies our self-attribution task and SIs to be sensitive to underlying traits that mediates internalising disorders including depressive disorders, anxiety disorders, and PTSD.

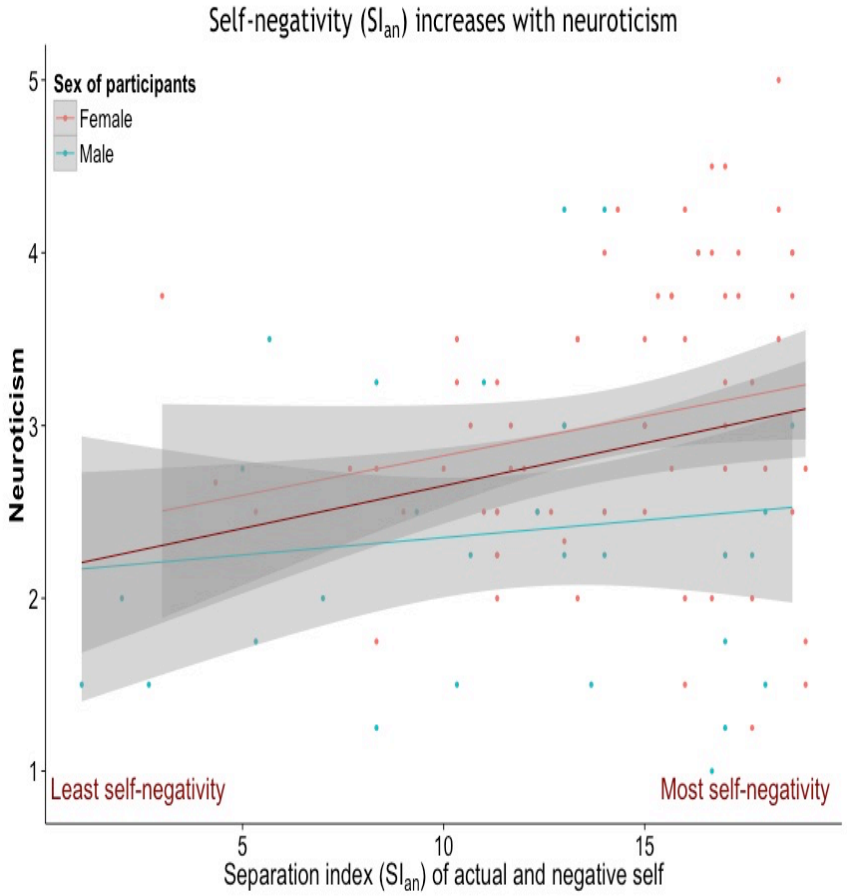


Figure 5.5. The graph shows the significant correlation of neuroticism with self-negativity (SI_{an}). SI scale ranged from 0 (no separation) to 19 (most separation). The graph shows increasing self-negativity with increasing neuroticism.

All the significant correlations reported thus far, indicate small to moderate effect size (i.e. 0.1 – 0.3), which is what we can expect to find with a sample size of 100 (i.e. $N >= 85$) participants (Cohen, 1988). While we cannot take such

prescriptions too literally, our results demonstrate the correlations between participant's self-attributions and their depression, neuroticism and wellbeing scores, and quantify the degree of effect. From these correlations, we have an emerging picture that displays the consistencies and the dynamics of participant's self-attributions with their mood state, wellbeing state and inherent neuroticism trait. These demonstrate the overall quality of our self-attribution measures, especially the SIs (self-negativity, self-positivity and self-discrepancy) with its sensitivity and consistent relation to participant's transient state and inherent trait.

5.4.4 SIs distinguish maladaptive-adaptive behaviours relating to inherent traits

Previously we reported that neuroticism correlated positively with perceived positive self. Interestingly, agreeableness also correlated positively with perceived positive self, $r = .246$, $p = .014$ and perceived ideal self, $r = .197$, $p = .049$. This shows that similar to participants with increasing neuroticism, participants with increasing agreeableness also identified neurotic images as their positive self and ideal self. Despite the similar basic self-attributions, the SIs distinguished the trait related behaviours. Agreeableness correlated with SI_{ap}, $r = .243$, $p = .015$ and SI_{ai}, $r = -.206$, $p = .039$ (see Figure 5.6). This shows that agreeableness relates to increasing self-positivity and decreasing self-discrepancy, both of which indicate adaptive behaviours. Thus, the SIs distinguish the increasing self-negativity relating to neuroticism indicating maladaptive behaviour, from increasing self-positivity and decreasing self-discrepancy relating to agreeableness indicating adaptive behaviour. This specifically highlights the sensitive quality of SIs compared to the basic attributions, which helps to better understand our self-attribution measures.

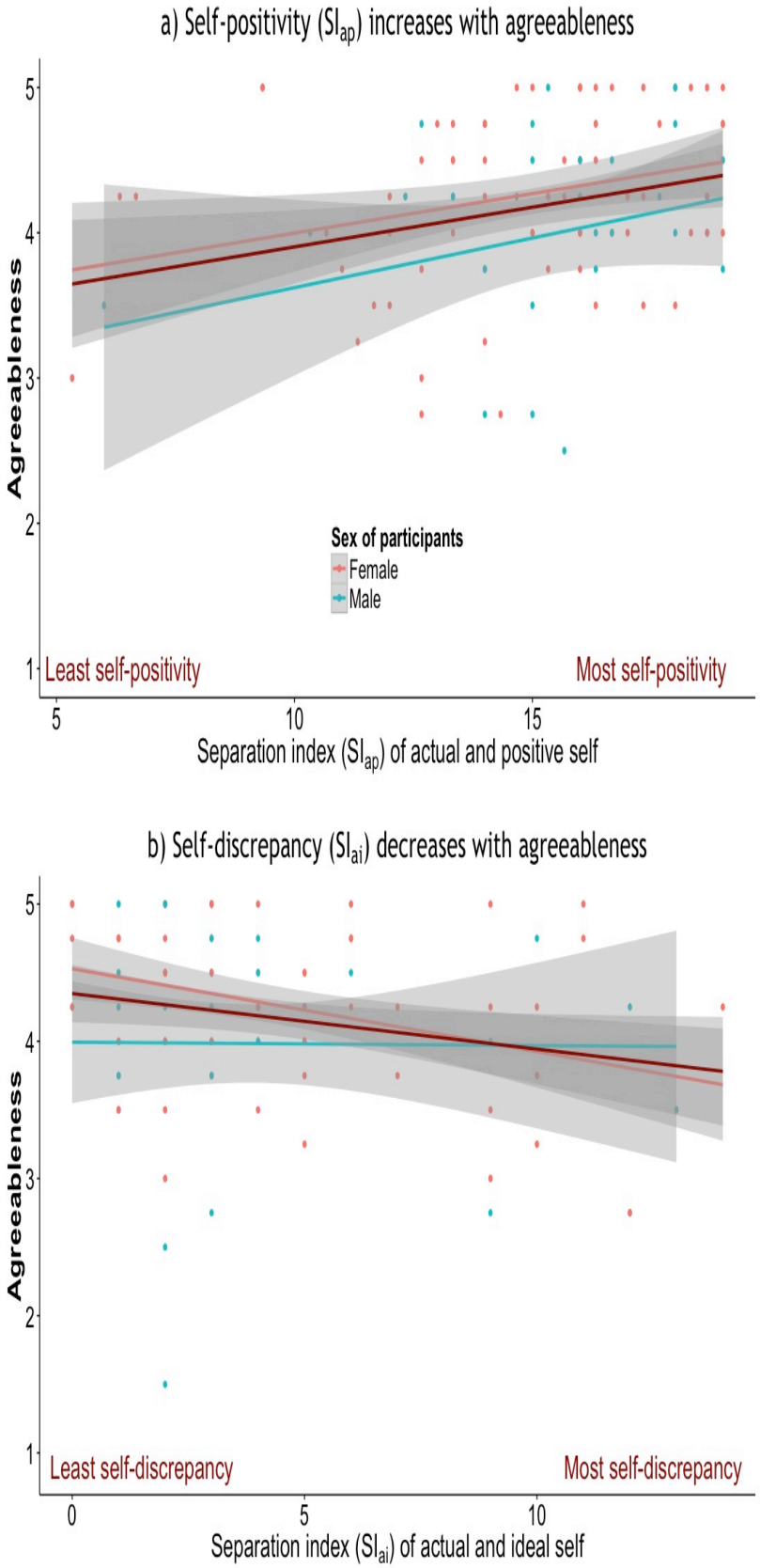


Figure 5.6. The graphs show the significant correlations of agreeableness with a) self-positivity and b) self-discrepancy. SI scale, 0 (no separation), 19 (most separation), shows that increasing self-positivity and decreasing self-discrepancy seen with increasing agreeableness.

5.5 Discussion

We investigated the influence of individual's depression, neuroticism and hedonic wellbeing on their self-attributions. Using our new self-attribution task that has an implicit Neurotic Face Scale, we measured self-attributions of facial appearance. The basic self-attributions included perceived actual, ideal, positive and negative selves and the SIs included self-negativity, self-positivity and self-discrepancy. Accuracy in identifying neurotic traits from faces was a pre-requisite for this investigation, which is confirmed by the significantly better than chance accuracy reported using the trait identifying task. Despite this accuracy, we observed misattributions of self-face, which could be due to the sensitivity of our 19-point scale that measure individual differences in attributions, compared to the two alternative forced choice paradigms. Furthermore, self-face processing appears to be modulated by mood state, neuroticism trait, and hedonic wellbeing. Prior studies reported that self-reference and internal inference impacts how individuals process face stimuli (Wisco & Nolen-Hoeksema, 2010), which was demonstrated in our study.

Associations between the basic self-attributions in this study suggest that neurotic trait signals from face, in conjunction with perceived positive and negative, modulated individual's responses. Perceived negative self contrasted with the rest of the three self-attributions, whilst the triad (actual, ideal, positive attributions) showed concurrence between each other. This confirmed that participants generally identified and differentiated the trait signals along the implicit neurotic face scale used in this study. One sample *t*-test confirmed that, on average, participants were displaying an underlying positive bias towards emotionally stable appearance and negative bias towards neurotic appearance on the Neurotic Face Scale; corroborating previous

results reported in Chapter 4. Scott et al. (2013) also reported similar negative bias towards facial cues of depression. Such biases were observed even without factoring for participant's mood state or personality traits. Results from the current study, provide further evidence of how transient mood, wellbeing state and neuroticism personality modulate individual's attributions of self-facial appearance.

Self-attributions of positive self correlated with depression and neuroticism, while actual self correlated only with depression. It has to be noted that the correlations between depression and the basic self-attributions after excluding the two outliers were non-significant, however the positive correlation trend was maintained. Although the group mean depression score of the study sample does not fully represent the full range of severity of depression as by the IDS scale, it is clear that neurotic images were perceived as actual self, with increasing depression score. Although the original face of depressed individuals would have signalled their current mood state, they chose a more neurotic image as their self. Similarly, neurotic images were identified for positive self-attribution with increasing depression and neuroticism. This indicates exaggeration or negativity in their self-perception with increasing severity of depression, substantiating negative self-concept (Markus & Wurf, 1987; Markus, 1990) and negative bias (Beck, 2008; Gollan et al., 2008). Although, the positive correlation between the basic self-attributions of actual and positive selves indicate that in reality individuals chose the images they perceived as positive for their actual self. This indicates that the 'perceived' positive seems to be modulating perceptions of actual self. This similarity between positive and actual self-attributions could have been driven by individuals with greater agreeableness trait, as reported in the results. Whereas the shift in 'perceived' positive, i.e., perceiving more neurotic image as positive, could be directly related to distortions

due to depression. The SIs clarified such ambiguities relating to the basic self-attributions, to a greater extent.

Depression related self-negativity was substantiated by SI_{an}, a measure of self-negativity of facial appearance, which increased with increasing depression and neuroticism, and decreasing hedonic wellbeing. It is exciting that the self-attribution measures consistently demonstrate the relation between depression and its predictors such as neuroticism and wellbeing. In previous studies, neuroticism was linked with self-negativity relating to low self-esteem (Robins, Tracy, Trzesniewski, Potter, & Gosling, 2001) and depressive symptoms (Frokjaer et al., 2010); substantiating the self-negativity found in our study. Studies on attributional style also reported greater self-negativity with depression (Ball et al., 2008; Seligman et al., 1979). Attributional style, by virtue of the measure, looks at attributions of conceptual scenarios, whereas this study reported negativity in visual perception of self. We found differential association between our self-attributions and ASQ measures (see Table App.1 in the Appendix). These could potentially be because they are targeting mental processes at different levels. It could be that the ASQ measures explicit attributions while our self-attribution task could be measuring more implicit processes because of the self-face stimuli and the implicit neurotic face scale. Both these approaches could, therefore, provide a holistic picture of depression related negativity. Other studies have also reported depression related negative bias and misreading signals from other-faces (LeMoult et al., 2009; Linden et al., 2011) and distorted reality (van Rossum et al., 2011).

Cohen and Sherman (2014) discussed the possibility of distortions being self-created by construing a situation in a manner that it renders less threatening to self-

integrity. This refers to reducing cognitive dissonance (Festinger, 1957; Stone & Cooper, 2001) through self-affirmation (Cohen & Sherman, 2014; Steele, 1988a) or self-consistency (Thibodeau & Aronson, 1992). Cognitive dissonance is explained as the psychological discomfort due to conflicting self-perceptions (Festinger, 1957). In this study, it would mean that depressed individual's perception of neurotic or negative image as actual self was used defensively to affirm self-consistency. For this to be true, we have to assume that individuals have a negative self-image and therefore chose a neurotic or negative image as their actual self. To support this, the perceived actual and negative selves should display a positive correlation showing concurrence. Similarly, the perceived actual and positive selves should display a negative correlation showing opposing perceptions. The results, however, show that the perceived actual self is not correlated with perceived negative self but is positively correlated with perceived positive self. This suggests that distortions are not self-created in this study, although it modulates individual's perception of actual self. Our study paradigm, using faces and an implicit neurotic face scale, may have relied on non-conscious processing of face signals (Axelrod et al., 2015) and therefore very unlikely that these distortions were consciously created. Imaging and ERP studies have reported the processing of emotionally salient facial appearance (Bryant et al., 2008; Faivre, Charron, Roux, Lehéricy, & Kouider, 2012; Thomas et al., 2014) and self-face (Laureys, Perrin, & Brédart, 2007; Pannese & Hirsch, 2011; Pannese & Hirsch, 2013), involves non-conscious neural processing. This implicates a process of non-conscious or implicit cognitive dissonance relating to distortions in depression but unrelated to explicit processes of self-affirmation or self-consistency.

Implicit cognitive dissonance could have new implications on existing theories of social withdrawal (Caldwell, Rudolph, Troop-Gordon, & Kim, 2004; Girard et al.,

2014; Rubin, Coplan, & Bowker, 2009) and helplessness (Klien, Fencil-Morse, & Seligman, 1976; Landgraf, Long, Der-Avakian, Streets, & Welsh, 2015; Maier & Watkins, 2005) with depression, which are currently explained as self-propagated. Previous research has demonstrated implicit cognitive dissonance using animal models (rats), when rats placed grater value on outcome for which they had to work harder (Lydall, Gilmour & Dwyer, 2010). We propose that if the self-attribution measures reflect non-conscious distortion of self-perceptions relating to depression, it explains individual's behaviour and resultant social dysfunction as unintentional rather than as individual's latent urge for withdrawal. This new insight could be fed into adapting related behavioural interventions to target and correct implicit misperceptions, with the aim of improving personal and social functioning.

Self-discrepancy theory posits that discrepancy of actual and ideal selves are associated to depression (Higgins et al., 1985; Higgins, 1989; Higgins, Vookles, & Tykocinski, 1992; Markus & Wurf, 1987), which we did not find in our study. We did, however, demonstrate significant decrease in self-discrepancy with increasing hedonic wellbeing, which is a predictor of depression as reported in Chapter 2. Increasing hedonic wellbeing (increasing positive and decreasing negative experiences) is often referred as increasing happiness (Ryan & Deci, 2001; Ryan et al., 2008). The results provide evidence that increasing happiness can reduce self-negativity and self-discrepancy. Increasing happiness closely relate to improved mood, which understandably reduce self-negativity. Self-discrepancy theory proposes that actual-ideal self-discrepancies predict dejection and depression (Higgins et al., 1985; Higgins, 1989), which could explain the reverse pattern of reduced self-discrepancy with increasing happiness, found in our study. We are, however, unclear as to why depression itself was not related to self-discrepancy in this study.

Ideal self has been strongly linked with self-esteem (Andrews, 1998; Bosson, Brown, Zeigler-Hill, & Swann, 2003; Moretti & Higgins, 1990), potentially affecting the perceptions of ideal self observed in our study. We, however, did not measure self-esteem or use diagnostic criteria to confirm depression, which are limitations of this study. The IDS measures the core symptoms of depression as discussed in the introduction, along with associated symptoms such as, anxiety and psychosomatic symptoms. By using diagnostic criteria to confirm clinical depression, we could have ensured that we are looking at the main influence of depressive state on self-attributions. Additionally, using a self-esteem measure would have provided greater understanding of its association with the measures of ideal and positive selves, allowing more meaningful interpretation of our results.

Some previous studies have investigated depression related positive self-schemata, with the co-existence of high implicit self-esteem and low explicit self-esteem (Creemers, Scholte, Engels, Prinstein, & Wiers, 2012; De Raedt, Schacht, Franck, & De Houwer, 2006; Dunn, Stefanovitch, Buchan, Lawrence, & Dalgleish, 2009; van Tuijl, de Jong, Sportel, de Hullu, & Nauta, 2014), however, the majority of studies on depression focused on the negative self-schemata (Beck, 2008; Bradley & Mathews, 1983; Evans, Heron, Lewis, Araya, & Wolke, 2005). In our study, self-negativity and not self-positivity was related to depression. We think self-positivity might increase when self-negativity decreases in relation to improving mood. This could be investigated in future studies by monitoring improvements in mood longitudinally.

Besides measuring attributions relating to mood and wellbeing state, the SIs distinguished behaviours relating to traits. These are unique measures of mental self-

representations that are comparable to the subjective mental representations proposed by Markus and Wurf (1988), and are closely related to subjective mental health. In our study, individuals with high agreeableness trait chose more neurotic images as their positive and ideal selves, which was similar to the attributions made by individuals with high neuroticism trait. We could assign this similarity of misattributions to the underlying neurobiology relating to serotonin mechanisms that are closely related to neuroticism as well as agreeableness (Moskowitz, Pinard, Zuroff, Annable, & Young, 2001; Young, 2013). The measures of SIs, however, differentiated the behaviours relating to these two traits, despite the similarity in the basic self-attributions. Self-positivity increased with agreeableness in contrast to increasing self-negativity relating to neuroticism. Thus, the SIs uniquely distinguishes the self-attributions relating to the underlying maladaptive or adaptive traits that are more stable, whilst maintaining sensitivity to mood and wellbeing state that are more transient.

The self-attribution task developed in this study, provides a useful paradigm in measuring perception of 'self' in visual modality. This method provides perception of 'actual self' and referential perceptions of positive and negative selves. The measure of self-negativity is unique since it references 'current or actual self' to perceived negative self. 'Current self' by nature, should be transient with time, mood and hedonic wellbeing state; hence potentially a dynamic measure. Increasing self-negativity could be the early perceptual changes that are affected in depression and therefore a potential tracker for behaviour changes with remission. Prior studies have proposed implicit cognitions to represent the origin of depression (Chen et al., 2006; Haeffel et al., 2007), as well as a reliable predictor for past, present and future depressive episodes (Chang et al., 2011; Philippi & Koenigs, 2014; Phillips & Silvia,

2010b). The self-attribution task, especially with its measure of self-negativity, seems a promising tool to measure and monitor longitudinal behaviour changes in clinical population.

5.6 Conclusion

We conclude that depression, neuroticism and hedonic wellbeing affect attributions of self-facial appearance. Although participants were able to accurately discriminate the emotionally stable and neurotic "anchor" images used to create the image sequences, attributions to increasingly stable and neurotic self-appearances depended upon the individual's traits related to depression. In this study we quantified self-negativity, self-positivity and self-discrepancy in visual modality. We found that the severity of depression and neuroticism relates to greater self-negativity, while increasing hedonic wellbeing relates to decreasing self-negativity and self-discrepancy. Unlike the basic self-attributions, the SIs distinguishes maladaptive and adaptive behaviours relating to underlying traits. Self-negativity increased with neuroticism whilst self-positivity increased with agreeableness. This was identifiable due to the sensitivity of SIs to mood, wellbeing and traits, which validates their importance. The SI of self-negativity identified in this study, is promising a measure for future longitudinal studies on depressive disorder.

CHAPTER 6 – Looking through dark glasses: Social attributions

Abstract

Social attributions relates to making inferences of other individual's behaviours, which can be impaired due to psychological and psychiatric disorders. Social attribution of facial cues has been widely researched using emotional faces. We used our social attribution task, with an implicit neurotic face scale, that provided measures of social attributions that were comparable to the self-attribution measures. We propose that depression, wellbeing and neuroticism will relate to misattributions in social context, consistent with social projection. Increasing severity of depression and decreasing wellbeing were related to misattribution of more neurotic images as positive, consistent with the self-attributions. Unlike self-attributions, social attributions did not relate with neuroticism, suggesting social attributions are modulated by transient mood state rather than stable traits. We demonstrate social projection whilst making attributions to other-faces. The misattributions could also be related to common underlying cognitive and neural mechanisms that are impaired with depression.

6.1 Introduction

Social attributions refer to the processes of perception or inference of causal explanation for events or behaviours of others (Heider, 1958; Kelley & Michela, 1980). Kelley and Michela (1980) proposed a general model of the process of attribution that starts with antecedents (information, beliefs, motivation), leading to attributions (perceived causes) and ending with consequences (behaviour, affect,

expectancy). When there is limited information about an individual or stimulus or situation, attributors make inferences to make sense of the ambiguous situation (Bradford, Jentzsch, & Gomez, 2015; Kelley & Michela, 1980) and make social projections. Social projection is explained as the process or set of processes by which people come to expect others to be similar to themselves (Robbins & Krueger, 2005). By inferring on self whilst making social attributions, individuals could be triggering automatic self-referential processes (Cho & Knowles, 2013; Krueger & Stanke, 2001; Mitchell et al., 2005) that are modulated by individual's current and past experiences (Van Boven & Loewenstein, 2003). In this manner, self-referential processes relate to a host of factors inherent to the person making the attribution, including mental and physical health, social and cultural background, and belief system (Markus & Wurf, 1987). Our self-attribution study (Chapter 5) demonstrated misattributions of self in relation to increasing depression, decreasing hedonic wellbeing, and greater neuroticism trait. Such maladaptive perceptions cause misinterpretation during social interactions (Park et al., 2016; Park, Lee, Kwak, Cha, & Jeong, 2013), thereby leading to social dysfunction (Markus & Wurf, 1987).

Social functioning is dependant on effective social communication, which includes accurate display and reading of social cues (Addington, Saeedi, & Addington, 2006; Corrigan, 2000). Facial cues form the basic and natural means of communication in a social context (Kramer & Ward, 2010). Prior studies have investigated impaired processing of facial emotions with psychiatric disorders (Anderson et al., 2011; Archer et al., 1992; Linden et al., 2011) and attributions of more subtle facial cues (Scott et al., 2013), using two alternative forced choice paradigms. In this chapter, I will discuss the next study in which the social attribution paradigm uses faces of unfamiliar individuals on the 19-point neurotic face scale to

obtain more individualised social attributions similar to the self-attributions. This allows measurement of positive (happy, emotionally stable, attractive) and negative (unhappy, anxious, least attractive) social attributions of male and female faces that are comparable to the respective self-attributions measured in our self-attribution study (Chapter 5).

In Chapter 5, I discussed increasing misattributions of self-facial appearance with increasing depression, decreasing hedonic wellbeing, and increasing neuroticism. It would be interesting to investigate if such misattributions of facial-appearance are limited to self-face or are they indicative of a global misattribution as influenced by transient states, and stable traits. Misattributions of self-face extending into misattributions of other-faces will substantiate the social projection theory. In this study, we investigate whether participant's depressive and wellbeing states, and neuroticism trait will affect participant's attributions of other people's facial appearance. Reflecting on the social projection theory and inferring on the results of the self-attribution study, we propose that with increasing severity of depressive symptoms, individuals will identify more neurotic image of other-face for positive social attributions. That is, the positive attributions made to neurotic self-appearance will carry over to the neurotic appearance of others. If such misattributions reflect on the social projection theory, we would expect to see the attributions to be consistent across female and male faces. On this basis, we further propose that the positive and negative attributions of female and male faces will be consistent respectively.

6.2 Methods

All the participants from the self-attribution study participated in this study and the data was collected on the same day. This was essential to control for the

participant's over all experience on that day, which could affect their perceptions of self and other. We used the social attribution task, which followed the same paradigm as the self-attribution task. A key difference was that the participants made attributions to faces of unfamiliar men and women. These faces were selected from an existing database.

The photographs in this database were taken at annual photo-shoot events conducted by the lab group at Bangor University. Although the event was open to all, the majority of the participants were Bangor University students. The photographs at the events were taken using Canon EOS 1100D DSLR camera with 18-55 mm lens, and diffused lighting. The criteria for the photographs were consistent with the self-attribution study. The social attribution task could be adapted depending on the study and its specific aims, by tailoring the selection criteria for the photographs. Since the focus of this study was to measure social attribution in relation to changes in individual's mood and wellbeing state, we endeavoured to control for observed individuals' depressive state. The selection criteria for this study therefore included individuals with IDS score less than 14, which is categorised as 'not depressed'. A total of 20 photographs were selected; 10 male and 10 female faces. General criteria of neutral facial expression, front facing, without make up, facial tattoos, facial piercing and facial hair applied. The procedures for creating stimuli for the underlying Neurotic Face Scale and the related scores were similar to self-attribution task, as explained in Chapter 5 and graphically shown in Figure C.1. Briefly, the selected faces were warped towards sex-congruent composite face pairs that displayed signals of neurotic and emotionally stable traits, to create 19 image sequences per face. These image sequences were presented as explained below.

Presentation: In the social attribution task, faces of unfamiliar men and women were presented using Matlab. The task presented with six blocks (questions: happy, emotionally stable, attractive, unhappy, anxious and least attractive) x 20 trials (identity: 10 male and 10 female faces) x 19 images (face warps). The blocks (questions) were randomly selected per presentation. The order of the trials (faces) was randomly selected in the first block, but maintained through rest of the blocks in the presentation. The first image of each trial (19 face warps) was presented randomly, but followed the order of sequence on the 19-point scale. The 19 images of each face (identity) were presented (500x500 pixels) one at a time in the middle of a computer screen, with instructions at the top. The images were presented one at a time in order of the sequence of the 19-point face scale and looped back and forth through the sequence to provide seamless increase and decrease of neurotic traits. This presentation was similar to self-attribution task, as explained in section 5.2.1 and shown in Figure 5.1, in Chapter 5. A key difference in the instructions related to the questions that can be sensibly asked. The instructions for social attribution task were limited to making the presented face look most positive and most negative. The instructions for most positive included, 'Make the face look most happy and content', 'Make the face look calm stable and well-balanced', and 'Make the face look most attractive'. The instructions for most negative included, 'Make the face look unhappy and least content', 'Make the face look anxious and emotionally unstable', and 'Make the face look least attractive'. The selected faces were presented in six blocks, with one instruction per block. The order of faces was random per block and maintained across all presentations in the respective block. The first image per presentation was randomly selected from the 19 image sequences. When participants pressed either the right or left arrow keys, the images changed through a looped sequence in their order

on the implicit neurotic face scale. This gave the impression of the presented face changing, as controlled by the participant. The presentation of looped sequence of images made it difficult for the participants to understand the lateral representation of the scale and therefore its end points. Participants selected one image for each instruction by pressing the spacebar. This task was not timed.

Consistent to the method of scoring positive and negative self-attributions, we averaged the three respective scores to create the positive and negative attributions of male and female faces. Thus, we had four attribution measures; positive and negative attributions of female faces, positive and negative attributions of male faces. We report the correlations between the respective attributions on male and female faces and average them to score positive and negative social attributions, which are therefore comparable to the respective self-attributions.

As explained in the self-attribution study, we used IDS to measure depression, FS to measure eudemonic wellbeing and SPANE to measure hedonic wellbeing, MIPIP to measure personality traits and ASQ to measure attributional style. We will maintain our focus here on the measures of depression, hedonic wellbeing and neuroticism in order to be consistent with the self-attribution study. This will help to explain the concept of social projection, whilst making social attributions in visual modality. Similar to the self-attributions, social attributions were differentially correlated with personality and attributional style.

6.3 Results

All the 100 participants from the self-attribution study completed the social attribution task. Both studies were completed in one session on the same day.

Therefore, the demographics and group mean of mood and trait measures are the same as in the self-attribution study.

6.3.1 Inter-correlations of social attributions of male and female faces

The participants made 12 attributions: three positive (happy, emotionally stable, attractive) and three negative (unhappy, anxious, least attractive) attributions to male and female faces. The three positive and negative measures were averaged to obtain respective attributions of female and male faces. In the first instance, we checked whether the attributions made of female and male faces were consistent, which would support our proposal that the attributions are driven by the implicit neurotic face scale rather then the faces being observed.

We found that the four social attribution measures significantly correlated with each other, as expected. The attributions of female and male faces correlated positively for positive, $r = .524$, $p < .001$ and negative, $r = .376$, $p < .001$ categories respectively. Positive attributions of female faces correlated negatively with negative attributions of female, $r = -.694$, $p < .001$ and male, $r = -.249$, $p = .012$ faces. Positive attributions of male faces correlated negatively with negative attributions of female, $r = -.393$, $p < .001$ and male, $r = -.588$, $p < .001$ faces.

These results, further confirm consistency in participant's attributions of male and female faces for both positive and negative categories, which shows that participants made attributions to male and female faces in a similar way. On this basis, the attributions made to male and female faces were averaged to obtain positive and negative social attribution scores, which were comparable to the self-attributions. Positive social attribution negatively correlated with negative social attribution, $r = -.664$, $p < .001$. Similar to reading signals from self-face, the positive and negative

signals from other-faces were also differentiated by the participants and on average could project similar positive and negative biases.

One sample *t*-test against a test value of zero provides evidence for positive and negative biases, in social context. The mean positive social attribution of -0.82 with *SD* of 1.85, was significantly different from the original other-face, $t(99) = -4.42$, $p < .001$, 95% *CI*(-1.19, -0.45). The mean negative social attribution of 2.73 with *SD* of 2.10, was significantly different from the original other-face, $t(99) = 12.97$, $p < .001$, 95% *CI*(2.13, 3.15). These results indicate that on average, participants demonstrated positive bias towards emotionally stable appearance of others as well as negative bias towards neurotic appearance of others. This is similar to the average positive and negative bias of participants to self-appearance and therefore indicative of projection of bias.

We now have positive and negative social attributions that are comparable to self-attributions, which lead to our next question, whether the social attributions are affected by participant's depressive state, wellbeing state, and neuroticism in a way similar to self-attributions. The following results will focus on these measures in order to answer this question.

6.3.2 Depression and social attributions

Depression correlated positively with positive social attribution, $r = .239$, $p = .017$, as shown in Figure 6.1. A score of zero indicates the original image of other-faces. Positive scores indicate that the image chosen was more neurotic in appearance and negative scores indicate emotionally stable image was chosen. The result, here, indicates that participants with increasing depression chose a more neurotic image for positive social attribution. This is similar to the correlation between positive self-

attribution and depression scores, in the self-attribution study. In this study we provide evidence for participant's misattribution of others being modulated by participant's depressive symptoms, which is similar to misattributions of self, and therefore provide evidence for classic social projection. The significant correlation between depression and positive social attribution was not maintained when excluding the two outliers.

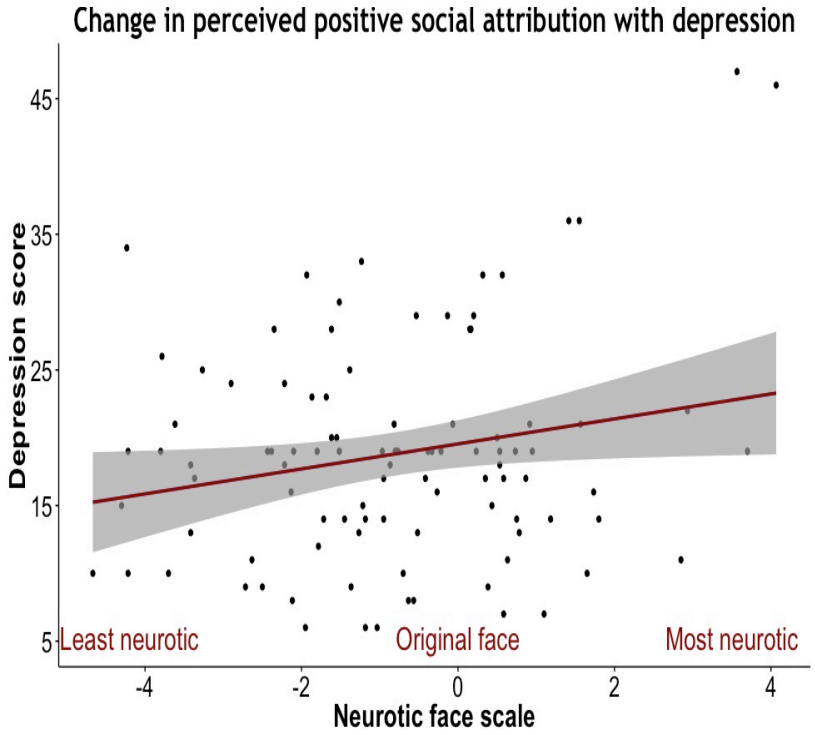


Figure 6.1. The graph shows the significant correlation of depression score with positive social attribution. The Neurotic Face Scale is from +9 (more neurotic) to -9 (less neurotic) and midpoint 0 (original other-face). Increasing scores indicate more neurotic images were chosen for positive social attribution with increasing depression.

Participant's negative social attribution did not correlate with their depression score, which is also similar to the results from self-attribution study. Thus, it is the positive attributions that are affected when experiencing depression, and the related misattributions of self are extended to social contexts, demonstrating classic social projection relating to mood state. Previously, we discussed with sufficient evidence

the close association between depression and wellbeing, so the next analysis will look at the association between wellbeing and social attributions.

6.3.3 Wellbeing and social attributions

The balanced experiences (hedonic wellbeing) correlated negatively with positive social attribution, $r = -.199$, $p = .047$, as shown in Figure 6.2. This shows individuals with decreasing balanced experiences, chose a more neurotic image for positive social attribution and vice versa. Decreasing balanced experience score account for more negative experiences and fewer positive experiences, which related to decreasing hedonic wellbeing. Eudemonic wellbeing also had a non-significant association with positive social attribution, $r = -.169$, $p = .093$, indicating similarly increasing misattribution with decreasing eudemonic wellbeing.

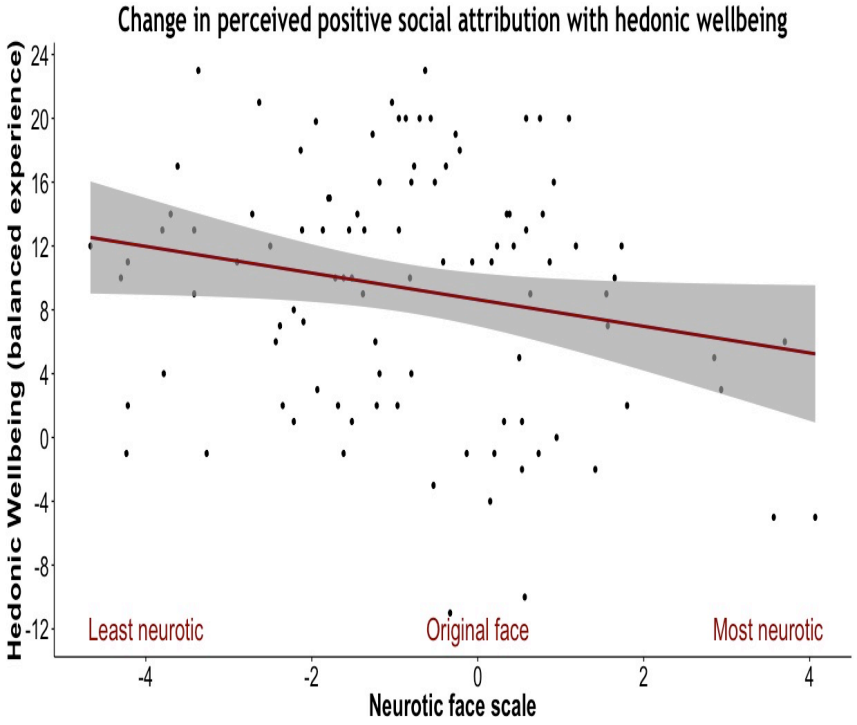


Figure 6.2. The graph shows the significant correlation of hedonic wellbeing (balanced experience) correlated with positive social attribution. The Neurotic Face Scale is from +9 (more neurotic) to -9 (less neurotic) and midpoint 0 (original other-face). With decreasing hedonic wellbeing participants misattributed more neurotic images as positive and with increasing hedonic wellbeing they correctly attributed less neurotic images a positive.

In the self-attribution study, discussed in Chapter 5, it was observed that hedonic or eudemonic wellbeing had only weak negative correlation trends with the basic positive self-attribution (see Table App.1 in the Appendix). The associations of wellbeing with positive social-attributions, albeit weak, potentially highlight their greater importance towards social functioning. Wellbeing is closely associated with socialising, contact with family and friends, and community involvements (Dolan, Peasgood, & White, 2008; Taylor & Brown, 1988). This social quality of wellbeing might be highlighted through the attributions made in our study, thereby providing evidence of social projection relating to wellbeing state. The negative social attribution did not correlate with the wellbeing scores, which is consistent with negative self-attribution. So far, we have observed a consistent picture of greater misattributions relating to increasing depression and decreasing wellbeing in self and social contexts.

Third and final measure, that was relevant to depression as well as self-attribution, was neuroticism. There were, however, no significant correlations of social attributions with neuroticism, which deviates from the pattern of self-attributions. Neuroticism is strongly related to internalizing disorders including mood and anxiety disorders (Eysenck, 1991; Griffith et al., 2009), however, unlike mood state, it did not affect social attributions in this study. The social attribution measures might be differentiating the negative biases and internalizing qualities triggered by a transient mood state relating to depression, from those triggered by an inherent personality trait of neuroticism.

We propose, that these results display the sensitivity of our attribution tasks to self and social contexts, whilst also differentiating the stable traits of internalizing

negativity from the transient states of generalized negativity or global bias towards negativity. In other words, individuals with stable neuroticism personality traits have a consistent internalizing feature of negativity towards self, which might be maintained or exaggerated with depression, whereas, individuals with transient depressive state might be displaying global negativity (i.e., self, others and generally to everything in life). Our self and social attribution tasks seem to be unpicking these differentiating characteristics of neuroticism traits, from what otherwise appears indistinguishable from depressed mood state.

The results so far provide an interesting picture of similar misattributions in self and social contexts, whilst differentiating those misattributions unique to self. This raises the next question, of how similar or dissimilar were the attributions the individuals made in self and social contexts, without accounting of their states and traits. The following analyses will focus on the same.

6.3.4 Correlations between self and social attributions

There is a specific difference between the self and social attribution measures. Unlike the self-attribution scores that are responses to a single face (self-face), the social attribution scores are an average of responses to 20 other faces. The following results, however, highlight their similarities.

Positive self-attribution correlated positively with positive social-attributions, $r = .274$, $p = .006$ whilst negative self-attribution correlated positively with negative social attributions, $r = .244$, $p = .014$, as shown in Figure 6.3. Both these associations confirm that similar cues from self and other faces were identified for positive and negative attributions respectively. In other words, individuals who chose less neurotic self-images for positive self-attribution also chose less neurotic other-face-images

similarly for positive social attribution. Likewise, similar choices were made for negative self and social attributions. Thus, when individuals had accurate perception of emotionally stable and neurotic facial cues as positive and negative respectively, it was observed consistently in both self and social contexts. Here we demonstrate remnants of classic social projection, specifically whilst making attributions to facial appearance of self and others.

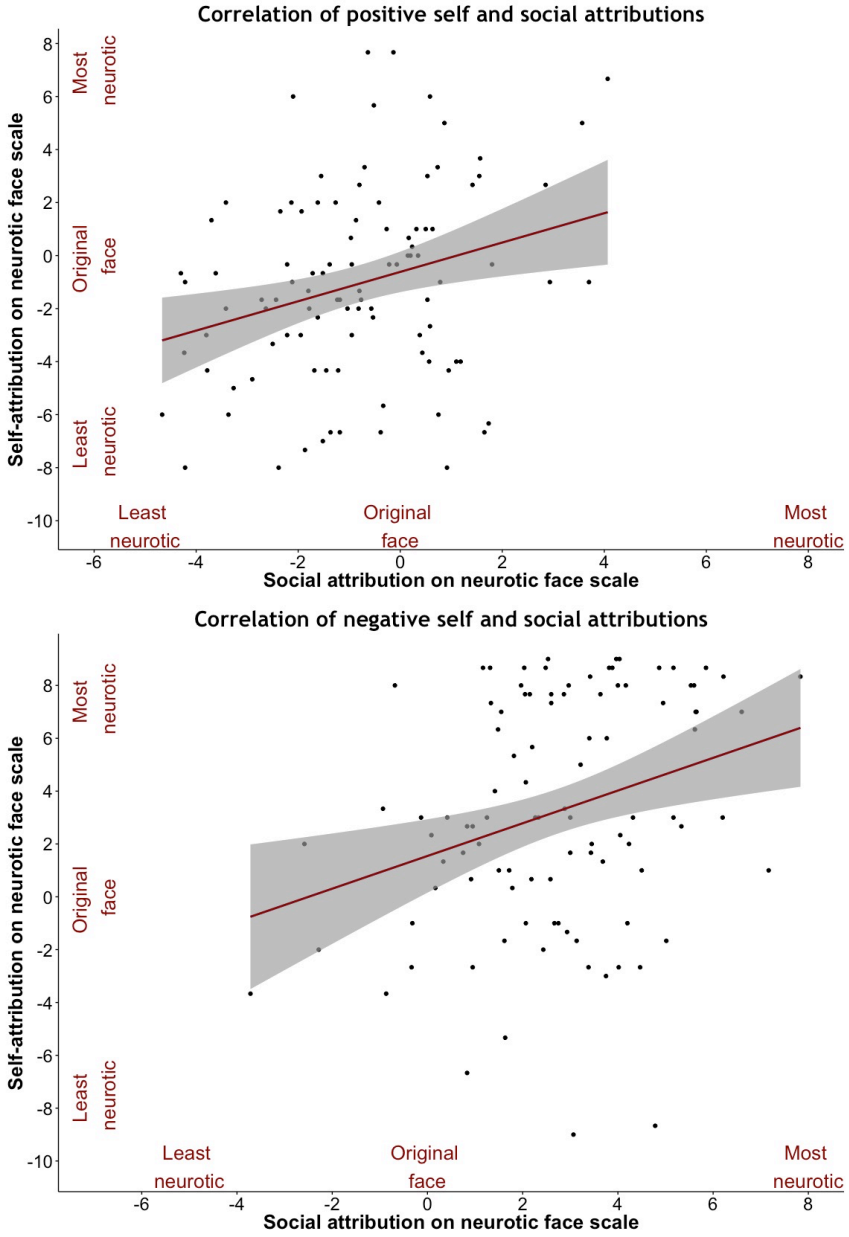


Figure 6.3. The graphs show the significant correlations of positive self-attribution with positive social attribution and negative self-attribution correlates with negative social attribution. The Neurotic Face Scale is from +9 (more neurotic) to -9 (less neurotic) and midpoint 0 (original other-face). This shows consistency of positive and negative attributions of self and others supporting social projection theory.

From the evidence so far, it appears that individual's state of mood and wellbeing, and neuroticism traits, affect their perception of positive and negative facial cues. Our evidence also shows that mood and wellbeing affects global misperception, while neuroticism related misperceptions are limited to self.

6.4 Discussion

In this chapter, we investigated the relation of social attribution with individual's mood, wellbeing, and neuroticism trait. Consistent to the positive and negative self-attributions, we computed the positive and negative attributions for female and male faces. Based on the correlations between these four measures, the measures were averaged across sexes to obtain two basic social attributions, i.e. positive and negative. Similar to the self-attribution measures, the social attributions also have the 19-point neurotic face scale from +9 (most neurotic) to -9 (least neurotic) and midpoint 0 (original other-face). Increasing positive social attribution would mean that a more neurotic image was chosen as positive.

This study had results similar to that from the self-attribution study. We reported a positive association between positive social attribution and depression score, indicating that individuals with increasing depression identified more neurotic facial appearance as positive. The significant correlation was not maintained when excluding the two outliers with severe depression, a pattern that was also seen with self-attribution. This shows that individuals' mood state was mediating misattributions in the social context, in a way similar to the misattributions of self. This substantiates our proposition of social projection whilst making attributions of facial appearances. Misattribution has previously been identified as a cognitive vulnerability for depression (Beck et al., 1979; Beevers, 2005; Elliott, Zahn, Deakin,

& Anderson, 2011; Fennell & Campbell, 1984), although it is not clear whether misattribution is a product of depression or the cause.

Our self and social attribution measures, appear to be differentiating misattributions driven by inherent traits and transient traits. We found depression related misattribution to self and others whilst neuroticism related misattribution was only observed to self. On this basis, our attribution task might be differentiating negativity at a global level from negativity limited to self. This clearly demonstrates cognitive vulnerability relating to depression and neuroticism, however, we cannot untangle whether misattribution to self precedes or follows misattribution to others or vice versa. As discussed earlier in the results section, the misattributions might be modulated by inaccurate perception of facial cues. Leppanen et al. (2004) reported that depressed patients were less accurate in identifying neutral faces than sad or happy faces. Additionally to this inaccuracy in perception, there is also evidence of exaggerated or caricatured perception relating to mood state. Patients made more misattribution errors of neutral and low arousal facial expressions in the direction of high arousal emotions (Csukly et al., 2009). Csukly et al. (2009) concluded that the inability to accurately recognize non-emotional or emotional facial expressions, along with the tendency for attributing towards the high arousal emotions, could represent two basic contributing factors to social dysfunction in patients experiencing depression.

In addition to misperceptions and exaggerated attributions relating to state and traits, there is also evidence for related negative bias and increased attention to negativity. One study identified deficiency in inhibiting attention to negative stimuli in depressed patients, that renders them unable to disengage from negative

information (Feng et al., 2009). This could explain the negative perception or bias that causes the maintenance and development of depression (Feng et al., 2009). This could be one of the underlying mechanisms leading to misattributions. This study used neutral looking face stimuli, which in reality displayed neurotic traits. These subtle negative facial cues might be triggering similar mechanisms, whilst making attributions and therefore we were seeing misattributions in individuals with depressive symptoms. Such misattribution of self and others can lead to social dysfunction and reduce individuals' wellbeing.

We reported the association of participant's hedonic wellbeing with their positive social attribution. We found that, with increasing wellbeing individuals more accurately chose emotionally stable faces for positive attributions, where as with decreasing wellbeing more neurotic images were misattributed as positive. Consistent to this result, Taylor and Brown (1988) discussed how individuals' wellbeing affects perceptions of self, the world and their future. Reduced wellbeing is, however, closely associated with depression (Grant et al., 2013; Santos et al., 2013), making it difficult to disentangle the effects of depression and wellbeing on individual's behaviours. The key findings from the current study are consistent with the theory of social projection and depression related misattributions leading to social dysfunctions; the evidence for which was obtained by comparing attributions in self and social contexts.

6.5 Conclusion

We conclude that participant's social attributions were similar to their self-attributions. We found that individuals with increasing severity of depressive symptoms and decreasing wellbeing chose more neurotic images of other-faces whilst making positive social attribution. This echoed participant's self-attributions and

substantiated social projection, whilst making attributions to facial appearances. Besides our social attribution measures might be differentiating misattributions driven by global negativity in relation to transient depressive state, from those misattributions driven by negativity focused on self in relation to neuroticism.

CHAPTER 7 – Triangulation of self, social, and observer attributions

Abstract

Attribution is the process of giving meaning to situations or behaviours, which could differ across individuals and contexts. Prior studies have found that positive attributions were made as dispositional (inherent) by actors, while observers saw it as situational (external) and the reverse for negative attributions. We investigated the association of observer's attributions of actors with actor's self-attribution, and actor's mood and wellbeing states, and neuroticism trait. In this study, we selected 70 actor's face image sequences from the self-attribution study, and 50 independent observers made attributions to each of these target faces. Actor's mood was associated with their positive attribution of self but dissociated with observer's attribution of the actors. The similarity between actors and observers was that they consistently displayed underlying positive and negative biases towards emotionally stable and neurotic appearances respectively. On average, this bias was maintained irrelevant of actor's transient mood or wellbeing state or inherent traits but appears to be affected in those experiencing depression, leading to their misattribution of neurotic appearance as positive.

7.1 Introduction

Attribution theories focus on the causal explanations that individuals construct for their own behaviour and the actions of others (Monson & Snyder, 1977). In the literature, the observed 'others' are generally referred to as 'actors'. The actor-observer literature predicts asymmetry between the attributions made by actors and

observers because of informational differences (Jones & Nisbett, 1972). This differential access to information leads to the apparent dichotomy of dispositional and situational attributions (Monson & Snyder, 1977). Dispositional attribution refers to causality being internal factors where as situational attribution refers to causality being external or situational (Jones & Davis, 1965; Ross, 1977). By the complexity of social behaviours, these two types of attributions may sometimes lose the distinctive dichotomous classification and simply coexist as a combination of both external and internal factors (Monson & Snyder, 1977).

Jones and Nisbett (1972) suggested that an actor would optimize by constructing situational self-attributions and dispositional social attributions, although the counter argument suggests the interchangeable role of situational and dispositional factors. Situational attribution reflects on the impression that the situation is in control of the individual, whereas dispositional attribution of inherent traits, attitudes and desires could mean that the individual is in control (Monson & Snyder, 1977). In the opposing view of the latter, the individual could be perceived as being controlled by their traits and impulses (Monson & Snyder, 1977). The type of attribution would therefore depend on the intentions of the actors and the observers.

Attribution theorists posit that actors might alter self-attributions to protect or enhance their self-esteem (Heider, 1958; Kelley & Michela, 1980). Our previous results suggested no evidence of self-enhancing attributions. Instead, we found harsher self-attribution in relation to increasing severity of depression (Chapter 5). It has been previously proposed that people who are most generous in self-attributions (e.g., non-depressed actors in our self-attribution study) may be the harshest judges of others, while the harshest self-judges (e.g., depressed actors in our self-attribution

study) may be the most generous in social-attributions (Anderson, 1985). Anderson (1985) however reported positive correlation between actor-observer attributions, which contradicted his own proposal. Our results from the previous studies reported similar positive correlation of self and social attributions (Chapter 6). The natural progression of our attribution studies would be to investigate the association of actor's self-attributions with attributions of actors made by unfamiliar observers. In other words, is there a difference in how we perceive ourselves from how other individuals perceive us. Another aspect of observer's attribution of actors is its association or disassociation with actor's transient mood and wellbeing state, and more inherent personality traits, which relates to stigma.

Previous research reported that observers perceived people experiencing depression as more dangerous than people without mental health disorder, people experiencing nonclinical stress, and people with eating disorders (Crisp, Gelder, Rix, Meltzer, & Rowlands, 2000; Link, Phelan, Bresnahan, Stueve, & Pescosolido, 1999; Phelan & Basow, 2007). This is classic evidence of observer's perception of actors, as well as social stigma towards mental health. Another study reported difference in attributions of depressed and not-depressed people, especially with more negative attributions towards depressed people (Sacco & Dunn, 1990). We utilise self and observer attribution studies to examine whether actor's mood state or inherent traits affect observer's attribution of them. Some of the participants who completed the self and social attribution study were selected to be observed and are referred to as 'actors' in this chapter. Whilst the self and social attributions of an individual provided a first-person's perspective that could be modulated by their mood state and traits, the observer's attribution provided a third-person's perspective as illustrated in Figure

C.2. Therefore, providing a unique opportunity to explore the consensus and contrasts in attributions relating to the different perspectives.

In this study, we investigate the association of observer's attributions with actor's depression, wellbeing, and neuroticism. We propose that actor's traits and states may not affect observer's basic attributions because of the lack of information available to observer's regarding the actors. The consistency or inconsistency of self-observer attributions will provide evidence of how first person's perspective relates to unfamiliar third person's perspectives. In addition, we triangulate the results from Chapter 5 and 6 to discuss the consistencies and disparities of the attributions measured in self, social, and independent observer contexts.

7.2 Methods

A total of 70 actors from the self-attribution study gave their full informed consent for their photographs to be used in future studies and to be observed by other future participants. These 70 faces were grouped into two groups of 20 and one group of 30, and used in three separate observer attributions tasks between a total of 150 independent observers. This was done in order to reduce the issues of fatigue and boredom that could compromise observer's attributions. Thus, 50 independent observers viewed each of the actors.

Participants were undergraduate students from Bangor University and the study adhered to School of Psychology and Bangor University research and ethics guidelines. After participation students were debriefed and provided with information regarding available psychological support.

7.2.1 Observer attribution task

The observer's attribution was measured by adapting the social attribution task using the photographs of the actors who completed the self and social attribution tasks. The sequence of 19 images relating to each of the 70 actors, which was used in the self-attribution study, was used to set up the observer attribution task. This ensured consistency of the images viewed, that is, the observers in this study viewed the same images viewed by the actors in the self-attribution study.

The presentation and the instructions were similar to the social attribution task and are described in Chapter 6. The independent observers made positive (happy, calm, most attractive) and negative (sad, anxious, least attractive) attributions of the actors' facial appearance on the Neurotic Face Scale. The observer's positive and negative attributions thus measured were comparable to the measures of actor's self-attributions.

7.3 Results

A total of 70 (45 female) actors were selected, with age, M = 20.51, SD = 5.32, and range = 18 -56; IDS, M = 19.07, SD = 8.089; FS, M = 44.63, SD = 6.43; balanced experience, M = 10.01, SD = 6.98; neuroticism, M = 2.74, SD = 0.86.

The basic measures of observer's positive and negative attributions were negatively correlated, r = -.545, $p < .001$, indicating that the observers differentiated the contrasting facial cues. This also confirms that observers differentiated the positive and negative appearance on the implicit neurotic face scale, suggestive of bias in observer's attributions that is similar to actor's underlying bias irrespective of their mood state.

One sample *t*-test against a test value of zero provided evidence for observer's positive and negative bias. The mean observer's positive attribution of -1.88 with *SD* of 1.09 was significantly more emotionally stable than actor's original face, $t(69) = -14.3$, $p < .001$, 95% *CI*(-2.14, -1.61). Similarly, the mean observer's negative attribution of 3.88 with *SD* of 0.87 was significantly more neurotic than actor's original face, $t(69) = 37.53$, $p < .001$, 95% *CI*(3.68, 4.09). These results suggest that, on average, observers demonstrate positive bias towards emotionally stable appearance of actors and negative bias towards neurotic appearance of actors. This is consistent with the average bias of actors found in self and social contexts.

The consistent picture of positive and negative biases demonstrated in all the three contexts of self, social, and observer suggests that even without factoring for individual's transient state or inherent traits, there are basic underlying concepts of positive and negative attributes. Our study in Chapter 4, demonstrated such biases by using a two alternative choice paradigm that allows only dichotomous response. Such biases are maintained even when using a scale that allows greater variance in response. This evidence supports the underlying positive-negative bias towards emotionally stable-neurotic appearance respectively, which is largely suggestive of social concepts such as stereotyping and social stigma relating to facial appearances. The results discussed in Part C, corroborate the evidence from previous studies demonstrating social stigma relating to facial appearances of depression (Scott et al., 2013), physical and mental health (Kramer & Ward, 2010). Now that we have established an underlying bias in observer's attributions, it is intriguing whether this bias will be modulated by actor's transient state or stable traits.

7.3.1 Attributions relating to actor's mood, wellbeing, neuroticism

7.3.1.1 Actor's Depression

We firstly confirm that the subset of 70 actors, taken from the self-attribution study, showed the same pattern of correlation of depression with positive self- (r = .236, p = .049) and social- (r = .145, n.s.) attributions. This meant that, from among the actors being rated by observers in this experiment, those with greater depressive experience chose a more neurotic image as their positive self and that of others, suggesting mood modulated misattributions.

The main focus in this study was to investigate whether observer's attributions could be modulated by actor's transient state or inherent traits. The results demonstrate that observers' positive attribution of actors was dissociated from actor's depression score, r = -056, p = .654 (see Figure 7.1), unlike actor's positive self-attribution. This means that on average, the preferences of external observers were not influenced by the actors' depressive state. The appearance preferences seen in the self-attributions, therefore, do not reflect the preferences of the larger group. The dissociations are observed despite the underlying bias in observer's positive and negative attributions reported earlier.

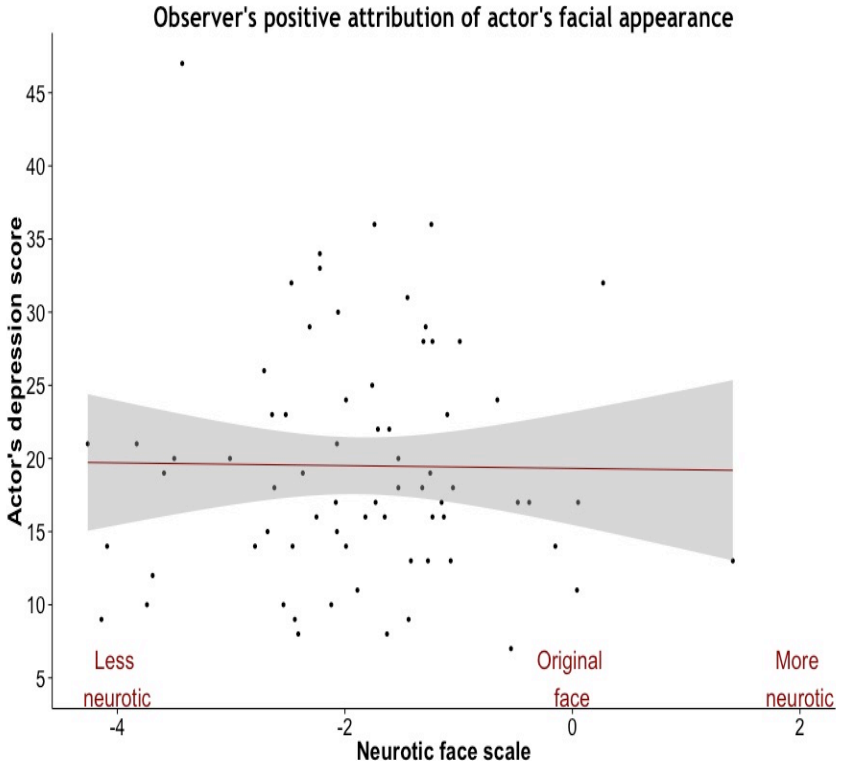


Figure 7.1. The graph shows the dissociation of observers' positive attributions of actors' facial appearance with the actors' depression scores.

Visually analysing the graph it is clear that actor's mood is not modulating observer's attributions, however, it is also clear that on average observer's chose a less neurotic image of actors whilst making positive attributions of the actors. The Neurotic Face Scale ranges from -9 (emotionally stable) to +9 (neurotic) with the original face as the midpoint represented as zero. This reinstates bias of the observers in identifying emotional stability as a positive attribute. Similar results were reported in Chapter 4 and discussed earlier. These results demonstrated observer's preference for emotionally stable composite faces as positive and neurotic composite faces as negative. Scott et al. (2013) used faces warped towards varying degrees of depressive facial cues, to force a choice by presenting two faces. Their results demonstrated a bias for milder depressive facial cues as positive. In our current study, we demonstrate similar bias despite using a 19-point scale that allows greater variation in responses and therefore provides stronger evidence for this positive bias. This bias of observers

is in stark contrast with the bias of actors making self-attributions. The actors demonstrated mood modulated negative bias of choosing a more neurotic face for positive self-attributions.

7.3.1.2 Actor's Wellbeing

We did not find significant correlations of actors' hedonic and eudemonic wellbeing with observers' positive or negative attributions, which is similar to the above results. In the social attribution study in Chapter 6, hedonic wellbeing correlated negatively with positive social attribution, suggesting increased misattribution of others with decreasing wellbeing. This subset from self-social attribution study, did not show significant correlation of actor's self and social attribution with their wellbeing. By pulling together the results of self and social attributions from the previous two studies (Chapter 5 and 6), the result here reiterates those reported earlier in this study that unlike actor's self and social attributions, observer's attribution of actors was not modulated by actor's wellbeing.

7.3.1.3 Actor's Neuroticism

Neuroticism was positively correlated with positive self-attribution, $r = .279$, $p = .019$, maintaining the results from the self-attribution study. This means that actors with greater neuroticism chose a more neurotic image for positive self-attribution. However, observers' positive and negative attributions of actors did not correlate significantly with actors' neuroticism showing a pattern similar to the results reported here previously.

The results so far provide a consistent picture, that observer's attributions were not modulated by actor's transient mood state or inherent neuroticism trait. It

therefore appears that observers' attributions were driven by their own underlying biases. Similar underlying bias was observed for actors as well. This naturally leads to the question of how similar or dissimilar are observer's attributions of actors to actor's self-attributions, without accounting for actor's mood state? Our next analysis provides evidence towards this actor-observer consistency or inconsistency.

7.3.2 Basic attributions in self and observer's context

The actors' positive self-attribution correlated significantly with observers' positive attribution, $r = .297$, $p = .012$, but not the negative attributions (see Figure 7.2). The significant positive correlation demonstrates that when not accounting for actor's mood state, there is some consistency between actor's positive self-attribution and observer's positive attribution of the actors. A different picture emerges, however, when visually analysing the graphs in Figure 7.2.

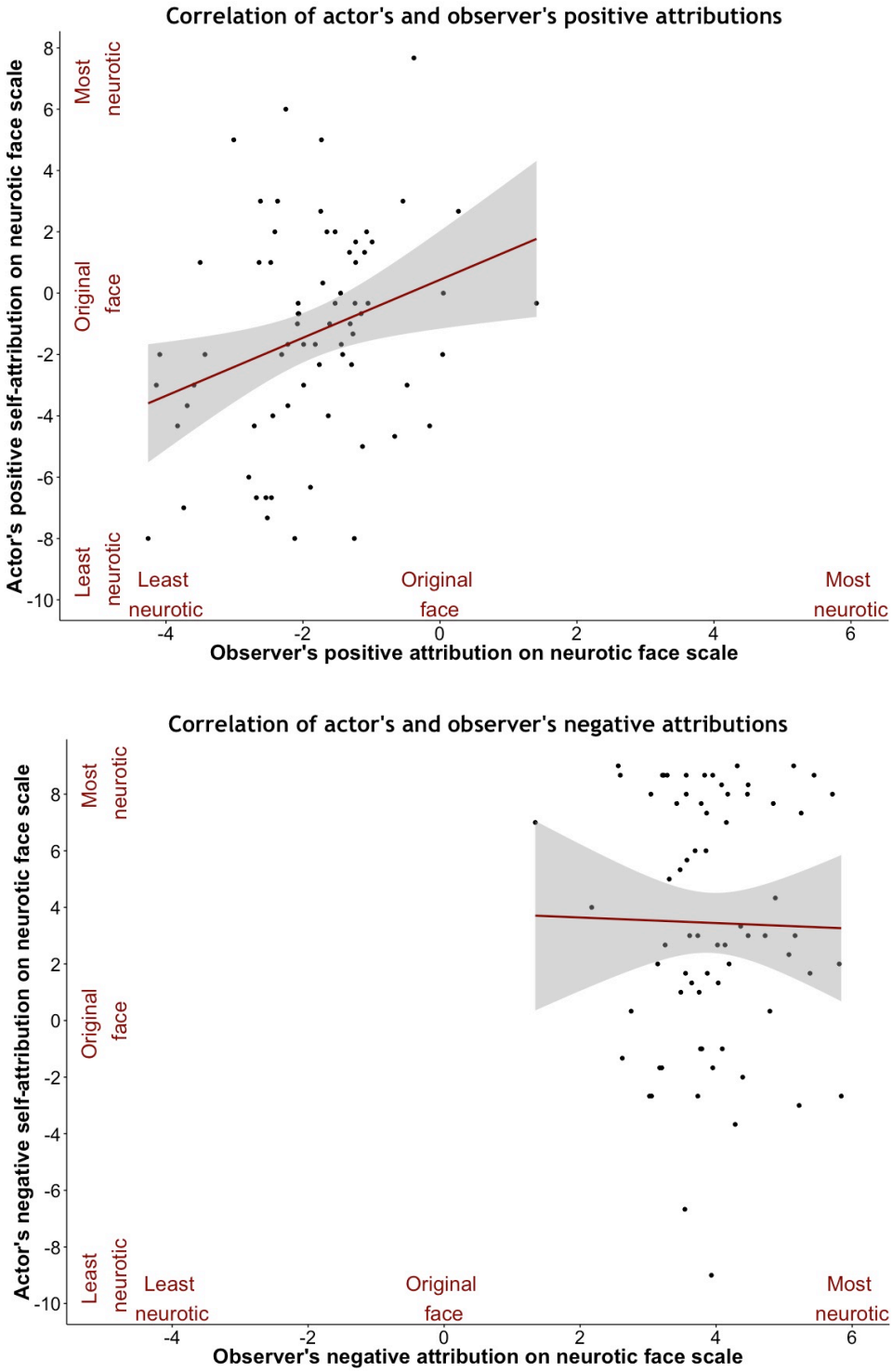


Figure 7.2. The graphs show a positive correlation of observer's positive attribution with actor's positive self-attribution but a similar correlation was not observed for negative attributions. The underlying bias of observer's positive attribution towards emotionally stable appearance and negative attribution towards neurotic appearance is obvious here. Similar underlying bias of actors is observed mainly for negative attribution towards neurotic appearance. Otherwise, actor's attributions are dispersed along the emotionally stable-neurotic scale indicative of state- and trait-modulated misattributions.

Despite the consistency of actor-observer positive attributions suggested by the positive correlation, the differentiating biases are apparent. The observers' attributions are clearly driven by their positive bias towards emotionally stable facial appearance, because their responses on the graph are gathered more towards the emotionally stable part of the scale, with scores ranging between 2 and -4. In contrast, the actors display varying attribution biases with their responses scattered across the full scale between scores of 8 and -9. There are clearly some actors who demonstrate positive bias towards emotionally stable cues similar to the observers; however, there are some actors who exhibit negative bias. Reflecting on the result from the self-attribution study in Chapter 5, we can say that the actors with increasing depression demonstrated the misattributions relating to negative bias of self-exaggeration towards more neurotic appearance. Actors with increasing depression would have displayed facial cues of neuroticism or depression on their original image; however, they chose an image that displayed more neurotic appearance than their original image. Previous studies have reported exaggerated perception of self in individuals with depression (Chen et al., 2006; Kohler, Hoffman, Eastman, Healey, & Moberg, 2011; Liu et al., 2012) and other psychotic disorders (Uono et al., 2015). In addition to self-exaggeration, the results also indicate distorted perception (Bilderbeck et al., 2011; Blackwood et al., 2003) relating to negative bias with depression.

Observer's negative attribution of actors was not significantly correlated with actor's negative self-attribution. When visually analysing the graph however, it is clear that observer's demonstrated a negative bias for neurotic facial appearance because their responses were gathered towards the neurotic part of the scale between the scores of 2 and 6. Majority of actors displayed similar negative bias but some actors again displayed varying attribution biases.

By comparing actor-observer attributions, we have gained insight into their complex relationship. Despite appearing to have consistency between positive attributions of actors and observers, there are obvious inconsistencies. While actor's depressed mood state modulated their positive self-attribution, it was emotionally stable – neurotic appearance on the Neurotic Face Scale that modulated the observer's attribution of actors. In Chapter 6, we reported the consistency between actor's positive attributions of self and others, which was also modulated by actor's depressed mood state. By triangulating self, social, and observer attributions provides a better picture of mood, affecting self and social attributions but not observers' attribution of actors.

7.4 Discussion

In this chapter, I discuss the association of observers' attribution with actors' mood, wellbeing, and neuroticism as well as actors' self and social attributions. A total of 50 independent observers rated each of the 70 selected actors. Observers' individual responses for positive and negative attributions were averaged to obtain attributions that were comparable with respective self and social attributions. Observers' positive attributions were negatively associated with their negative attribution indicating contrasting facial cues of high and low neuroticism were well differentiated.

The main question in this study was whether actor's mood state, wellbeing state, and neuroticism trait would modulate observer's attribution of the actors. Previous evidence supports observer's attributions being influenced by actor's mood state (Crisp et al., 2000; Link et al., 1999). Our results show that unlike self and social attributions, observer's attributions were not modulated by actor's mood state,

wellbeing state, or neuroticism trait. It therefore appeared that observers did not stigmatize actors on the basis of their depression; however, observer's attributions were, in actuality, modulated by the neurotic appearance of actor's face. The results demonstrated observer's positive bias of emotionally stable appearance and negative bias of neurotic appearance on the Neurotic Face Scale, which suggests stigma associated with mental health as previously reported (Link et al., 1999; Phelan & Basow, 2007; Scott et al., 2013).

As with any cognitive processes, stigma exists at implicit and explicit levels (Monteith & Pettit, 2011). Existing evidence highlights the importance of using explicit and implicit paradigms to measure observer's attributions, because they can tap into the different mechanisms (Monteith & Pettit, 2011). Monteith and Pettit (2011) reported more negative attitudes about depression compared to physical illness on implicit but not explicit measures. Our measures demonstrate implicit signs of stigma associated with neurotic facial appearance, although we did not measure explicit stigma.

The correlations between the attributions across the three contexts highlighted interesting findings. We found that actors' positive self-attribution was positively correlated with their positive social attribution as well as observers' positive attribution of actors. From visually analysing the graph, however, it was clear that unlike actors, observers chose less neurotic images for positive attribution for majority of the actors demonstrating positive bias for emotionally stable appearance. Whilst making positive attributions some actors, especially those experiencing depression, chose more neurotic image of self and others for positive attribution, of whom observers made positive attributions by choosing the image closer to the actor's

original face. It therefore appears that actor's facial appearance on the Neurotic Face Scale does affect observer's attributions to some extent. The results here imply that despite the positive correlation between actor-observer positive attributions, the observers did not show the misattribution shown by those actors experiencing depression. From the self and social attribution studies, we have provided evidence that actors with greater depressive symptoms displayed greater misattributions of self and other's facial cues indicating negative bias. Prior research reported that individuals with current or past depressive experiences needed greater intensities of expression to recognise happy emotion accurately, which indicated negative attention bias relating to depression (LeMoult et al., 2009). The results from the first two attribution studies corroborate this evidence because we demonstrated depression-modulated misattributions mainly affecting positive attributions. The positive cues from a neutral looking face may be more ambiguous than the negative cues relating to high neuroticism.

Prior studies have reported dissociation of observer-actor attributions on the basis of the available information and differential salience between the actors and the observers (Jones & Nisbett, 1972; Jones, Worchel, Goethals, & Grumet, 1971). Jones and Nisbett (1972) proposed that actors tend to make situational attribution to their behaviour, while observers attribute it to stable behaviours of the actors. This study did not investigate situational or dispositional attributions, instead we focused on understanding the dynamics of attributions in self, social and observer context. We found observers' and actors' positive and negative attributions were differentially correlated, with significant positive correlation only for positive attributions. This differential correlation could be related to a lack of information available whilst

making attribution of unfamiliar individuals as reported in previous studies (Jones & Nisbett, 1972).

We could also explain the differential correlation on the basis that actors' positive attribution in self and social contexts had greater variance along the Neurotic Face Scale, a moderation of which was also seen in observers' attributions. The negative attribution of actors and observers, however, were similarly biased towards neurotic facial appearance. Each observer's attribution is in actuality an average of 50 responses and therefore on average they represent a generally accepted bias. On this basis, actor-observer consistency for negative bias provides evidence for actors' negative attributions to be more consistent with the generally observed negative bias than their positive attributions. This further supports the evidence that misattributions displayed by actors experiencing depression were specifically for positive attributions, whilst maintaining negative attributions consistent with observers. It appears that underlying bias and self-inference modulate positive attributions, and hence dependant on state or trait of the observing individuals, whilst negative attributions are more consistent because they are modulated largely by the underlying bias. In other words, actors experiencing depression were accurate for negative cues in self and social contexts indicating negative attention bias and misattribution of positive cues indicating misperceptions, which is consistent with existing evidence (Platt, Murphy, & Lau, 2015). Our attribution tasks were sensitive enough to measure these negative biases and misattributions relating to depressive disorder, corroborating previous evidence (Bourke, Douglas, & Porter, 2010; LeMoult et al., 2009; Maniglio et al., 2014; Webb & Ayers, 2015).

So far, our studies provide specific evidence of the negative facial cues of self and others being misconstrued as positive with increasing depression. The misperceptions observed in this study, may be limited to neurotic appearance of face but this perforates into social interactions and malign social functioning. Park et al. (2016) reported how mood modulated misperceptions affected the perceived quality of social communications on social media, which is a snap shot of how misperceptions translate into dysfunctions in real life. On this basis, we propose that developing interventions to target re-training, correcting or realigning positive perceptions, would be greatly beneficial to individuals exhibiting negative bias.

7.5 Conclusion

We conclude that actors' mood, wellbeing and neuroticism were associated with their self and social attributions but were dissociated with observers' attributions. With increasing depression, actors chose neurotic facial cues as positive in self and social contexts, but actor's depression did not affect observers' attributions. Both actors and observers, however, showed consistent underlying positive and negative bias towards emotionally stable and neurotic facial appearance respectively. The results also support that with increasing depression actors' negative attributions were more consistent with the observer's negative attributions, unlike actor's positive attributions with greater variance demonstrating misattribution. Future interventions could target to re-train and reduce the overly negative perception affecting misattributions and to increase positive perception.

PART D – The clinical application of self-attributions of facial appearance

In Chapter 1, I discussed the neurocognitive model of depression that explained the series of neurobiological and behavioural changes that precede the experience of depressive mood state. This provided the rationale for developing a new attribution task to target implicit cognitive processes in order to measure the subtle behaviour changes that could be early predictors of change in depression. In Part B and Part C of this thesis, I discussed the development of our attribution task using face stimuli, and how it was adapted to measure self, social and observer attributions. I further discussed the relation of self, social, and observer attributions with severity of actor's depressive state, wellbeing and neuroticism.

Having demonstrated, in particular, the sensitivity of self-attribution to depressive state in a non-clinical sample, I want to extend my investigation with a clinical population. A longitudinal study can assess the dynamic relation between self-attribution and depression. I will discuss this clinical study, its results and its future implications in Chapter 8.

CHAPTER 8 – Self-attributions of facial appearance: An early predictor and monitor of reducing depression

Abstract

Neurocognitive model of depression suggests that neurobiological changes can produce behavioural changes in individuals, before they experience a mood change. On this basis, we propose that subtle behavioural changes could predict intervention response. Using the self-attribution task, we investigate the behavioural changes that could be early predictors of mood change. Individuals with current experience of depressive symptoms, but without manic or psychotic symptoms, participated in this study. In this longitudinal study, with five time points across 11 weeks, we found gradual changes in self-negativity, self-positivity and self-discrepancy. In addition, decrease in self-negativity and increase in self- positivity in the first week, were significant predictors of depression score at Week 11, indicating early behavioural predictors of intervention response.

8.1 Introduction

Neurocognitive model of depression explain how changes in neurobiology affects changes in cognitive abilities. Tryptophan depletion paradigms are based on this model and provide evidence of changes in tryptophan levels affecting imminent changes in cognitive abilities, even before individuals experience any changes in mood (Ward, Sreenivas & Rogers, 2016; (Harmer & Cowen, 2013; Hornboll et al., 2013; Passamonti et al., 2012). This evidence indicates potential behavioural predictors of mood change that could be harnessed to predict intervention response for depression. Such predictors can help to identify effective interventions faster and

reduce the trial and error period. The trial and error period is consequential because there is no single medication or treatment for depression that is effective for all; hence having to go through a period of trials to identify the intervention that works for each individual.

Clinical trials such as Texas Medication Algorithm Project and STAR*D tried to identify processes to reduce this trial and error period. The resultant advice from these trials included, bi-weekly monitoring using Quick Inventory for Depressive Symptomology – self report or Patient Health Questionnaire – 9 (PHQ-9) and reviewing treatment plan, if PHQ-9 scores were greater than or equal to nine at the start of week four (Thase, Entsuah, & Rudolph, 2001; Thase, 2014). These reports suggest at least three weeks to confirm treatment response for depression. It also shows that, the traditional methods of interviews and self-reports are effective in confirming symptoms of depression and remission, but limited in identifying early behavioural changes or making early prognosis.

Patient reported data from STAR*D, were later used to gather the variables that were most predictive of antidepressants-treatment outcomes. Through a machine learning approach, this study identified a model with 25 variables. This model was, however, limited to predicting outcomes of citalopram after two weeks of treatment (Chekroud et al., 2016). Another study investigating leukocyte mRNA expression levels of genes belonging to glucocorticoid receptor, reported to have identified a biomarker for antidepressant response (Cattaneo et al., 2012). Screening for such a marker could be an important pre-emptive measure for improving treatment plans and thereby reducing the trial and error period for antidepressants, but leaves the gap in identifying response to other interventions. The PReDICT randomised controlled trial

proposed, in their study protocol, to explore an array of potential predictors of remission, including demographics, personality, functional neuro-connectivity, neuroendocrine function, immune markers and DNA. These would be entered into complex algorithms to identify predictors of treatment(s) and recurrence or remission (Dunlop et al., 2012). Their results are yet to be published. Evidently, there is a lack of understanding regarding early predictors and how we might measure them.

Neural imaging studies provide evidence of early behavioural changes relating to changes in neurobiology (Hornboll et al., 2013; Passamonti et al., 2012). Tryptophan depletion studies demonstrate increased emotional bias (Hornboll et al., 2013) and reduced accuracy for face signals of emotion (Harmer et al., 2003b) and traits (Ward, Sreenivas & Rogers, 2016), prior to experiencing change in mood. Such biases seem to be modulated by wider neural networks involved in attention (parietal cortex, visual cortex, fusiform gyrus), self-referential processing (medial PFC, precuneus) and memory (hippocampus) (Harmer & Cowen, 2013; Lemogne et al., 2010; Lemogne et al., 2012). Even though the neurobiological bases of depression appear to be very broad, some evidence converges on the prefrontal functions.

Changes in prefrontal signals, after one week of antidepressant treatments, were consistently related to response and remission in depression (Cook, Espinoza, & Leuchter, 2014; Harmer, 2014; Leuchter et al., 2010). Similarly, changes in prefrontal activations were associated with improvements in mood following psychological therapies including cognitive behaviour therapy (Roiser et al., 2012; Yoshimura et al., 2014). The fronto-limbic networks were also consistently associated with changes in cognitive and emotional biases following improvements in mood (Elliott et al., 2011; Fossati, 2008; Tahmasian et al., 2013). It would, therefore, be useful to target those

behaviours that rely on prefrontal networks, in order to measure the changes following wider range of medical and psychosocial interventions. Evidence supports the prefrontal activations being linked to self-referential processes (Keenan et al., 2000; Nejad, Fossati, & Lemogne, 2013; Tahmasian et al., 2013). By targeting changes in the self-referential processing, we might be able to measure the early changes in the prefrontal networks: providing an early behavioural marker.

The self-attribution task is an ideal candidate to measure subtle self-referential processing. Using this task, we previously measured individual differences in self-attributions that were sensitive to subjective mood, wellbeing and traits (Chapter 5). Furthermore, we measured participant's own mental self-representations, which were referred to as separation indices (SIs). The SIs were measured as the magnitude of discrepancy between two basic self-attributions, details of which are explained in the self-attribution study (Chapter 5). These measures were sensitive to mood and wellbeing, and even differentiated behaviour patterns relating to neuroticism and agreeableness.

In our self-attribution study (Chapter 5), we measured SIs relating to self-negativity, self- positivity and self-discrepancy. We demonstrated that self-negativity increased with increasing severity of depression. Self-negativity is a measure of individual's distinction between perceived actual self and perceived negative self. The 'current self' and negative self, has the potential to change over time because mood and perception about self might change over time. From the self-attribution study, we found the pattern of increasing self-negativity and self-discrepancy with increasing depression and decreasing wellbeing. We were also able to identify greater self-positivity as an adaptive behaviour relating to increasing hedonic wellbeing and

agreeableness. Such changes in biases towards self could have a predictive quality. Evidence suggests early increase in positive bias could predict the ultimate improvement in depressive symptoms (Gollan et al., 2015; Gollan et al., 2016; Warren et al., 2015). Thus, the SIs might be the ideal measures to tap into the self-referential processes as well as the shifting biases towards self, in relation to mood change.

In this study, we investigate self-attributions of individuals with depression and its dynamics over time. We focus on individual's mental representations of self-facial appearance, that is, SIs referring to self-negativity, self-positivity and self-discrepancy. We hypothesis that decreasing self-negativity and self-discrepancy, as well as increasing self-positivity, will overlap decreasing severity of depressive symptoms, over the study period. We further investigate, whether a change in these behavioural measures in the first week can predict reduced depression score at the final time-point. That is, changes in self-representation will precede and predict mood changes. On the basis of the neurocognitive theory, we propose an early reduction in self-negativity and increase in self-positivity would predict mood. Reduced depression at the final follow up will be taken as the proxy measure for intervention response.

8.2 Methods

We recruited 29 individuals who were experiencing depression through self-referrals and referrals from General Practitioners (GPs) and mental health professionals, of which 17 (11 females) participants completed the study with mean age 27.94±14.59. This study was approved by the Ethics Committee at School of Psychology, Bangor University and the North Wales Research Ethics Committee and

the Research & Development Office, Betsi Cadwaldr University Health Board [IRAS ref. 115281, MREC ref. 13/WA/0197].

All potential participants were provided with Participant Information Sheet, and those who gave informed consent were screened before entering into the study. After the first session, the participants were provided with information regarding medical and psychological support available in North Wales. In case of any risk during the study, the risk protocol prepared for the study was to be followed. Depending on the imminence of risk, the support would be available from the G.P., or a Consultant Psychiatrist or the emergency services. All participants were debriefed at the end of the study.

8.2.1 Inclusion criteria: Individuals currently experiencing depression were included in the study. We did not provide or control for the interventions received for depression; details of which are provided later. Participant's ability to see faces and read from a computer screen was confirmed. The measures and behavioural task used in this study were presented only in English, and therefore participant's consent to communicate in English was also confirmed.

8.2.2 Exclusion criteria: Individuals experiencing manic-depressive symptoms and symptoms of psychotic disorder were excluded from the study.

Participants were initially screened for both inclusion and exclusion criteria. The semi-structured interview using Structured Clinical Interview for DSM VI (SCID) for Axis I disorders (First et al., 2002), confirmed both inclusion (current depression) and exclusion (manic-depression and psychotic disorders) criteria.

8.2.3 Study design: This was a longitudinal study over 11-12 weeks period, with five time-points. Once confirmed eligible and entered in the study, the participants were seen at baseline and four follow-ups (Week 1, Week 3, Week 5-6 and Week 11-12). An extensive SCID interview was conducted only at baseline for confirming diagnosis, but Module A of SCID that focus on mood disorder was repeated at the last two time-points. The 14-Item Resilience Scale (RS-14) (Damásio, Borsa, & da Silva, 2011) and a demographic questionnaire were used only at baseline.

RS-14 contains five items referring to "self-reliance", three items referring to "meaningfulness", two items referring to "equanimity", two items referring to "perseverance", and two items referring to "existential aloneness". The response scale was from 1 (strongly disagree) to 7 (strongly agree). The sum of the responses gave the total score that ranged from 14 to 98 with low resilience scoring 73 or below and high resilience scoring 91 or above.

Patient Health Questionnaire – 9 items (PHQ-9) (Kroenke, Spitzer, & Williams, 2001), Hamilton Depression Rating Scale -17(HDRS) (Hamilton, 1960), EQ visual analogue scale (EQ VAS) (Oppe, Devlin, & Szende, 2007; Rabin & Charro, 2001), IDS (Zimmerman, Sheeran, & Young, 2004), FS, SPANE (Diener et al., 2010), and the self and social attribution tasks, were repeated at all time-points. Three different measures of depression were used to investigate the sensitivity of the self-attributions to depression, measured by different inventories.

The IDS was used for continuity from our previous studies. The HDRS was rated by the interviewer and provided a proxy measure of depression. It has 17 items relating to depressive symptoms with responses from 0 (none) to 4 (maximum symptom) for nine items; 0 (none) to 3 (maximum symptom) for two items related to

weight gain or loss, of which only one should be answered; and 0 (none) to 2 (maximum symptoms) for seven items. A sum of these responses provided the total score that ranged from 0 to 52. Depression severity was rated as follows; 0-7 as None, 8-16 as Mild, 17-23 as Moderate, and 24-52 as Severe (Hamilton, 1960; Zimmerman et al., 2004).

The PHQ-9 was recommended for routine monitoring to aid treatment plan review (Thase et al., 2001; Thase, 2014). In the UK, the GPs commonly use PHQ-9 (Cameron, Crawford, Lawton, & Reid, 2007) and therefore our investigation focused on the association of the SIs with this self-rated measure. In addition, PHQ-9 focuses on the key depressive symptoms providing depression specific scores, unlike the IDS and the HDRS that include associated anxiety and somatic symptoms as well. The PHQ-9 has nine items relating to occurrence of depressive symptoms in the seven days prior to the assessment; with responses from zero (Not at all) to three (Nearly every day). The sum of the responses gave the total score that ranged from 0 to 27. Depression severity was assessed accordingly; 0-4 as None, 5-9 as Mild, 10-14 as Moderate, 15-19 as Moderately severe, 20-27 as Severe (Kroenke et al., 2001).

The EQ VAS measured participant's self-rated health on a vertical, visual analogue scale with endpoints of 100 labelled as 'Best imaginable health state' and 0 as 'Worst imaginable health state'. This measure helped to understand the participant's own feeling about their overall health, at each time-point.

The self-attribution task is explained in Chapter 5, in Part C. To explain briefly, the self-attribution task was set up using individual's own photograph. A series of 19 images created using their photographs, changed in gradual increments from emotionally stable face to high neurotic face. The images were presented one at

a time, in the middle of a computer screen. When participants pressed either the right or left arrow keys, the images changed through a looped sequence, back and forth, in their order on the implicit neurotic face scale. This gave the impression of the presented face changing, as controlled by the participant. The presentation of looped sequence of images made it difficult for the observer to understand the lateral representation of the scale. Participants selected one image for each instruction by pressing the spacebar.

The instructions were to choose their actual ('Choose your actual face'), ideal ('Choose your ideal face'), positive self and negative self. The instructions for positive self were, 'Make the face look most happy and content', 'Make the face look calm stable and well-balanced', and 'Make the face look most attractive'. The instructions for negative self were, 'Make the face look unhappy and least content', 'Make the face look anxious and emotionally unstable', and 'Make the face look least attractive'.

The social attribution task is adopted from the social attribution study; the procedures and presentation is explained in Chapter 6. To briefly explain, faces of unfamiliar 'others' were used to set up the task and the instructions were limited to those appropriate whilst making attributions of others. Hence, the instructions were limited to basic positive (happy, calm, attractive) and negative (unhappy, anxious, least attractive) attributions.

8.3 Data Analysis

The method for measuring SIs is explained in the self-attribution study (Chapter 5). We measured self-negativity (SI_{an}), self-positivity (SI_{ap}), and self-discrepancy (SI_{ai}). Self-negativity referenced perceived actual self against perceived

negative self, self-positivity referenced perceived actual self against perceived positive self, and self-discrepancy referenced perceived actual self against perceived ideal self. All the measures except self-discrepancy had inverse scales, that is, greater scores of SI_{an}, SI_{ap}, indicated lesser negativity and positivity respectively. These inverse scales were reverse scored to reflect increasing scores relating to increasing self-negativity, self-positivity and self-discrepancy. We explored the longitudinal dynamics of the SIs using graphs. The SIs with increasing or decreasing linear trends was further analysed.

In further analysis, the changes of SIs in the first week were computed as the difference (subtraction) of the respective SIs at baseline and Week 1. The scores ranged between -20 and 20. Since this was a measure of difference (baseline – Week 1), a score of zero meant no difference in the individual's mental representation in the first week. A negative score meant lesser self-negativity, self-positivity and self-discrepancy at Week 1 compared to baseline. While a positive score meant greater self-negativity, self-positivity and self-discrepancy at Week 1 compared to baseline. Thus, they reflected the quality of change in the first week; for example, decrease or increase in self-negativity at Week 1 compared to baseline. Correlations of these behavioural changes in the first week with depression score at final time point were assessed, to identify potential early behavioural predictors. Finally using regression analysis, we identified the changes in SIs in the first week that predicted the PHQ-9 score at Week 11 and the change in the PHQ-9 score from baseline to Week 11.

The basic positive and negative social attributions were also explored visually, to understand the longitudinal changes. This provides evidence of changes in attribution in the social context that overlaps with changes in self-attribution.

8.4 Results

A total number of 45 participants had telephone discussions about the study, of which 29 completed the initial screening. A total of 21 participants entered the study. Three participants were excluded after completing the SCID because of meeting exclusion criteria. One participant withdrew at Week 5 due to ill health. A total of 17 (11 female) participants completed the study. One participant missed the third follow up, but completed the final follow up which was delayed by two weeks. The group had mean age, $M = 27.94$, $SD = 14.59$, age range = 19 – 63, and mean resilience, $M = 52.35$, $SD = 12.46$. The group mean scores of the rest of the measures, changed over the five time points and are given in Table 8.1. The mean scores at each time point indicate gradually decreasing depression, improving wellbeing and perceived physical health. Importantly, the severity of depression measured using PHQ-9 decreased across the five time points, as shown in Figure 8.1. This was despite participants receiving some or no interventions.

8.4.1 Interventions

All the participants who completed the study were experiencing depression (for the past 2 weeks). At the beginning of the study, 11 participants received antidepressants (two participants started their treatment more than one week prior to the baseline), one participant received therapy and five participants received no interventions. Through the 11 weeks, three participants receiving antidepressants also received therapy, and from those with no intervention, one participant received antidepressants and two participants received therapy.

Table 8.1. Mean and standard deviation of all the measures across the five time-points.

	Baseline	Week1	Week 3	Week 5-6	Week 11-12
IDS	42.82 (11.41)	36.24 (14.73)	29.65 (15.74)	29.75 (17.96)	22.59 (15.97)
PHQ-9	18.18 (5.31)	14.59 (5.36)	11.71 (5.84)	11.62 (6.41)	8.59 (6.54)
HDRS	21.82 (7.99)	18.24 (9.39)	11.41 (7.68)	12.31 (8.32)	6.94 (5.33)
EQ VAS	46.35 (16.14)	45.41 (19.95)	50.00 (21.83)	49.06 (21.68)	64.65 (20.81)
FS	28.35 (7.95)	28.53 (8.66)	30.65 (10.06)	31.69 (11.54)	36.18 (10.45)
SPANE					
Positive	12.82 (2.86)	14.35 (4.11)	14.82 (5.13)	15.50 (5.56)	18.18 (5.81)
Negative	22.65 (3.62)	20.41 (4.70)	20.53 (4.90)	18.19 (5.17)	17.41 (4.50)
Balanced	-9.82 (5.39)	-6.06 (8.26)	-5.71 (9.65)	-3.69 (10.00)	0.76 (9.80)

Note. Descriptive statistics are reported as mean (standard deviation). IDS, Inventory of Depressive Symptomology; PHQ-9, Patient Health Questionnaire-9; HDRS, Hamilton Depression Rating Scale; EQ VAS, EuroQol Visual Analogue Scale; FS, Flourishing Scale; SPANE, Scale of Positive and Negative Experiences

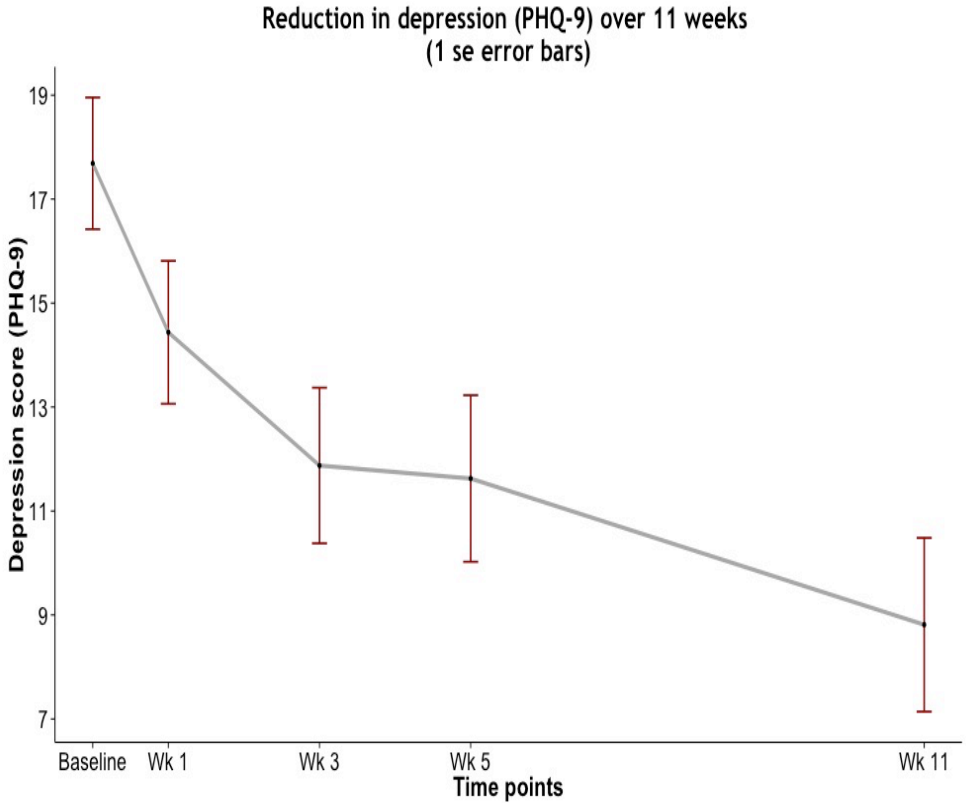


Figure 8.1. The graph shows the group mean depression scores decreasing across the five time points. PHQ-9, Patient Health Questionnaire - 9

8.4.2 Dynamics of SIs (self-attribution) over time

The group means of the SIs were used graphically, to visualise the trends across the five time points. The three graphs are shown in Figure 8.2, and they demonstrate the gradual changes in self-negativity, self-positivity and self-discrepancy. To be more precise, the group had decreasing self-negativity and self-discrepancy, as well as increasing self-positivity across the five time points. In Figure 8.1, we have already demonstrated an overlapping decrease in the group's depression score over the same period. Together, these results demonstrate decreasing depression related to decreasing self-negativity and self-discrepancy, as well as increasing self-positivity. This further validates the self-attribution task and its relationship to depression, within a small longitudinal study.

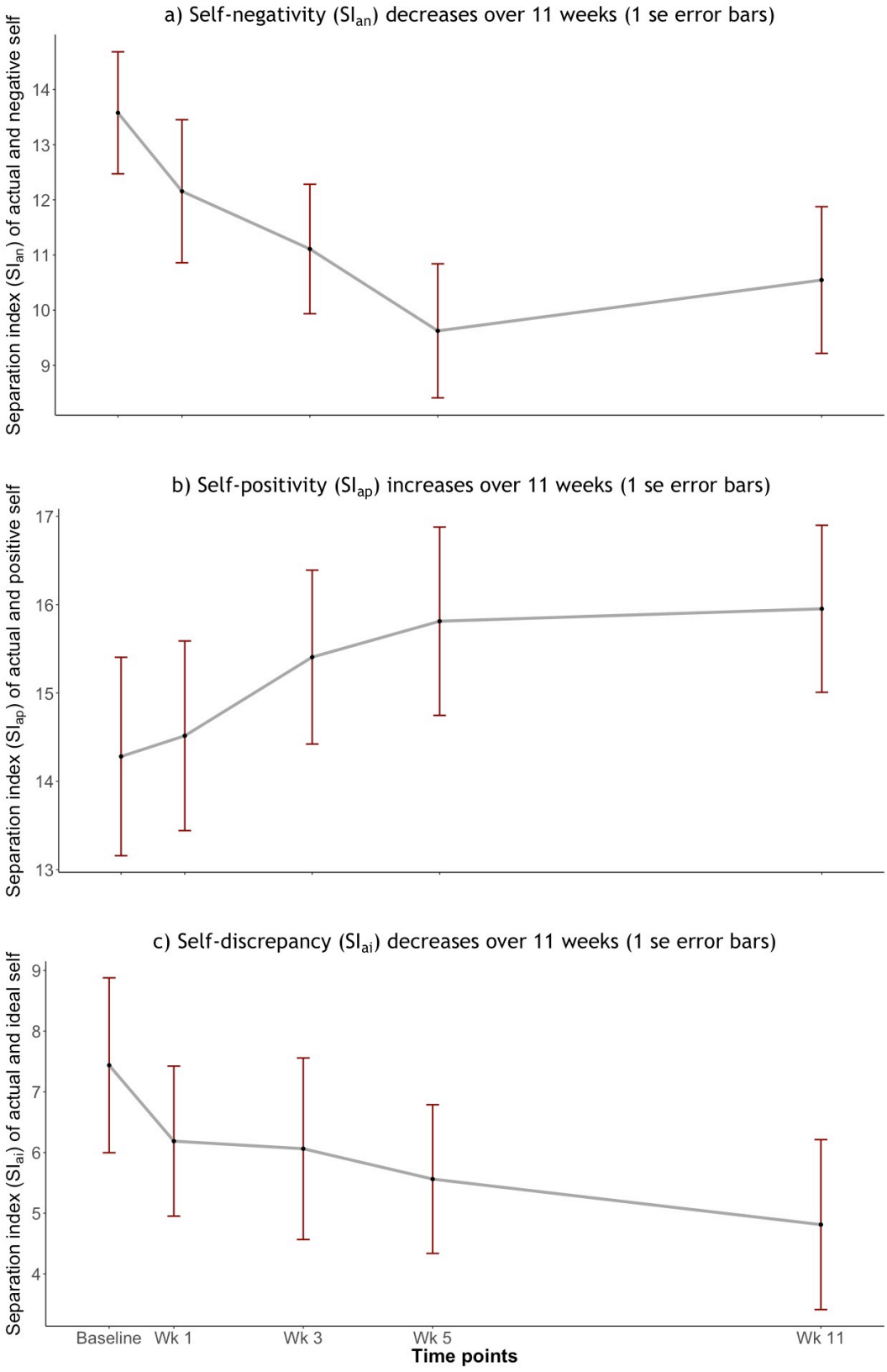


Figure 8.2. The graphs show a) Decrease in SI_{an}, b) Increase in SI_{ap}, and c) Decrease in SI_{ai}, across the five time-points in 11 weeks. The group had decreasing self-negativity, increasing self-positivity and decreasing self-discrepancy that overlapped with decreasing depression scores (Figure 8.1).

8.4.3 Correlations of the change in SIs in the first week

We next sought to see whether changes in self-attribution measures might predict future changes in depression. For this, changes in the three SIs during the first week, were computed as a difference of the respective scores at Week 1 and baseline. A score of zero meant no change in the individuals' mental self-representation, in the first week. A negative score meant lesser self-negativity, self-positivity, and self-discrepancy at Week 1 compared to baseline; while a positive score meant greater self-negativity, self-positivity, and self-discrepancy at Week 1 compared to baseline.

Change in self-negativity in the first week was negatively correlated with changes in self-positivity in the first week, $r = -.553$, $p = .02$. This shows that in the first week a decrease in self-negativity was related to increase in self-positivity, displaying an inverse relationship between the two self-attributions.

The key results showed that changes in self-negativity during Week 1, related to participants' mental state at Week 11. Decreases in self-negativity in the first week were correlated with PHQ-9 (depression) at Week 11, $r = .551$, $p = .02$ and FS (eudemonic wellbeing) at Week 11, $r = -.491$, $p = .04$. Decrease in self-negativity in the first week also had a non-significant correlation with balanced experience (hedonic wellbeing) at Week 11, $r = -.419$, $p = .094$. Consistent with these results, changes in self-positivity during Week 1 were associated with the participants' mental state at Week 11. Increases in self-positivity in the first week were significantly correlated with depression, $r = -.520$, $p = .03$, and eudemonic, $r = .542$, $p = .02$ and hedonic, $r = .541$, $p = .02$ wellbeing at Week 11. Changes in self-discrepancy during Week 1, however, did not correlate significantly with depression ($r = .246$, $p = .34$) or wellbeing (eudemonic, $r = -.398$, $p = .11$; hedonic, $r = -.248$, $p = .34$) at Week 11.

A partial correlation analysis controlling for change in depression in the first week (computed as the difference in depression score between baseline and Week 1) showed changes in self-negativity in the first week maintained the significant correlation with depression at Week 11, $r = .650$, $p = .009$ and eudemonic wellbeing at Week 11, $r = -.615$, $p = .01$. Similarly, changes in self-positivity in the first week maintained the significant correlations with eudemonic wellbeing at Week 11, $r = .571$, $p = .03$ and hedonic wellbeing at Week 11, $r = .523$, $p = .04$. These results suggest that changes in self-attributions in the first week were significantly associated with mood and wellbeing state of individuals at Week 11, even after controlling for the change in mood in the first week.

Besides the above correlations, the changes in self-attribution in the first week correlated with changes in depression and hedonic wellbeing across the study period; computed as the difference between scores at baseline and Week 11. Changes in self-negativity in the first week was positively correlated with changes in depression, $r = .506$, $p = .046$, whereas changes in self-positivity in the first week was correlated with changes in hedonic wellbeing, $r = .507$, $p = .038$. These correlations show that decrease in self-negativity in the first week related to decrease in depression over 11 weeks, and increase in self-positivity in the first week related to increase in hedonic wellbeing over 11 weeks.

No other significant correlations were found between changes in self-attribution and changes in depression or wellbeing within the first week. Interestingly, even the change in depression in the first week did not correlate significantly with change in depression over 11 weeks, $r = .383$, $p = .143$, highlighting the potential

sensitivity of early changes in self-attributions over early changes in depression or wellbeing as predictors of mood.

Beyond mood and wellbeing, we found other measures that correlate with the early changes in self-attribution. Increasing age was correlated with decreases in self-negativity, r = -.526, p = .03 and positively with increases in self-positivity, r = .474, p = .05 (non-significantly) in the first week. Similar trends were observed for resilience; decreases in self-negativity, r = -.481, p = .05, and increases in self-positivity, r = .418, p = .09. No other significant correlations were found.

8.4.4 Change in SIs in the first week as predictors of mood

In the next analysis, the changes in self-negativity and self-positivity in the first week were used in regression models, to predict PHQ-9 at Week 11. In the linear regression analyses, PHQ-9 at Week 11 was the dependent variable. The independent predictor variable in Model 1 was change in self-negativity and in Model 2 was change in self-positivity. Both models were significant predictors of PHQ-9 at Week 11: self- negativity, R^2 = .304, $F(1, 15) = 6.55$, p = .02, and self-positivity, R^2 = .270, $F(1, 15) = 5.56$, p = .03. This meant that changes in self-negativity and self-positivity in the first week could independently predict depression at Week 11. The results show that, decreasing self-negativity, β = .551, $t(16) = 2.56$, p = .02, or increasing self-positivity, β = -.520, $t(16) = -2.36$, p = .03, in the first week predicted depression at Week 11 (see Figure 8.3).

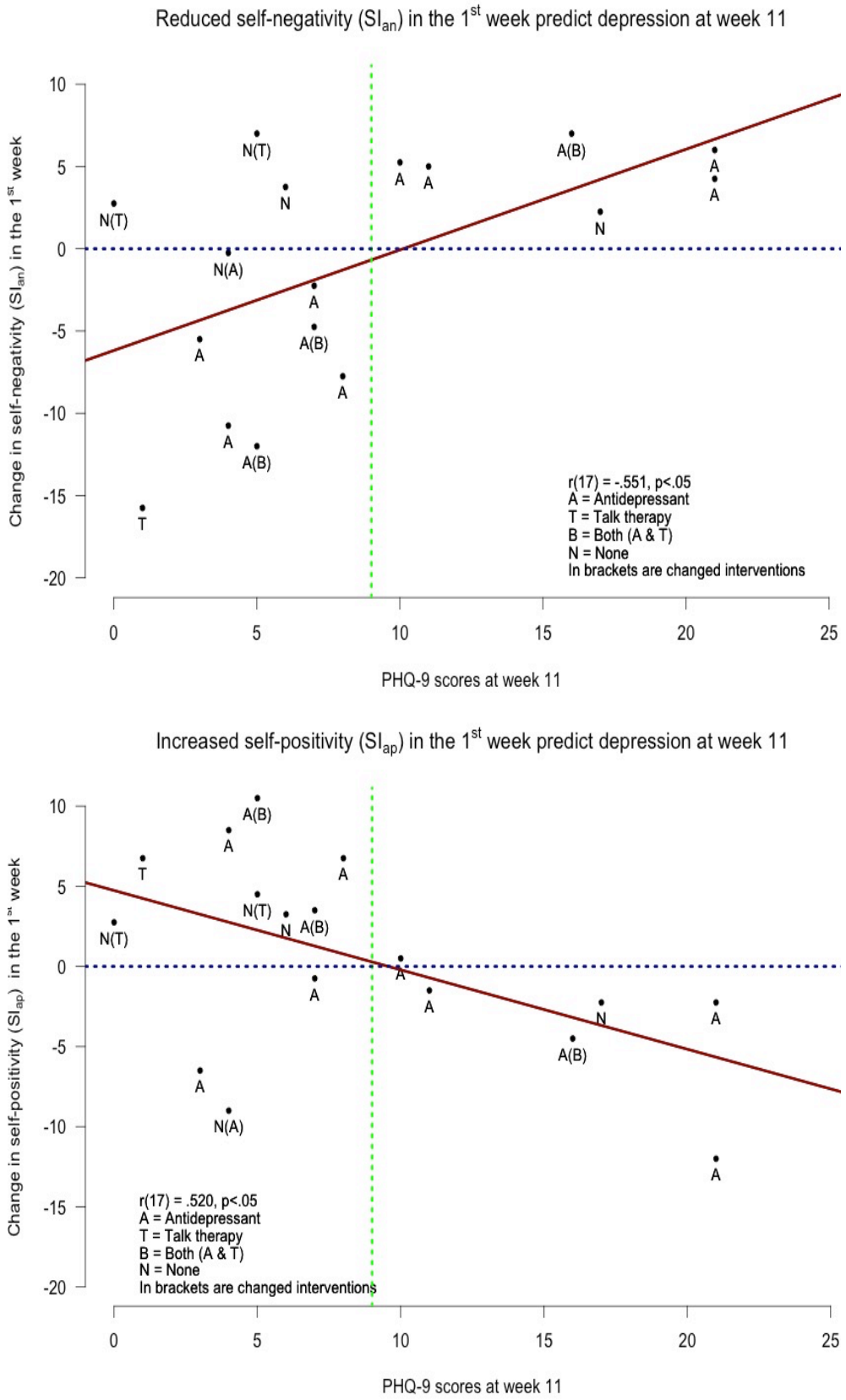


Figure 8.3. The graphs show the change self-negativity (SI_{an}) and self-positivity (SI_{ap}) in the first week as predictors of Patient Health Questionnaire-9 (PHQ-9) in the final follow up at week 11. The score below 0 on the y-axis indicate decrease in self-negativity and self-positivity in the first week and scores below 9 on the x-axis indicate mild to not depressed state.

Additional regression analysis followed the significant positive correlation between change in self-negativity in the first week and change in depression across the study period. Change in self-negativity in the first week was a significant predictor of change in depression across the study (difference between baseline and Week 11), $R^2 = .256$, $F(1, 15) = 4.81$, $p = .046$. The result shows that a decrease in self-negativity in the first week, $\beta = .506$, $t(16) = 2.19$, $p = .046$, predicted decrease in depression over 11 weeks. However, change in self-negativity in the first week did not predict change in depression during the first week, $r = .330$, $p = .196$, suggesting that changes in self-attribution could be preceding changes in mood.

The group mean depression scores at the five time-points could be explored to understand the extent of the change. Although there is a significant difference in the group mean depression in the first week, $t(16) = 3.34$, $p = .004$, the mean score of 14.59 at Week 1 range between 'moderate' to 'moderately severe' depression according to PHQ-9 classification of depression severity. This shows that the significant decrease in mean depression in the first week does not actually account to improved mood-state, which would otherwise be classified as 'not depressed' or 'mildly depressed'. Only the group mean depression of 8.59 at Week 11 meets the classification of 'mildly depressed'. All the results so far suggest that changes in self-attributions in the first week might be more sensitive to intervention response and hence a better predictor of mood change.

This is interesting because the study was not controlled for interventions. Some participants received mono or combination treatments of antidepressants and psychological therapies, while some received no treatments at all. Those who did not receive any treatments were also among the participants who showed increased self-

positivity and decreased self-negativity in the first week. The early changes in attribution could therefore be related to other protective factors, which predict decreasing depressive experience at Week 11. These protective factors could include resilience and changing cognitive and emotional biases relating to self.

8.4.5 Change in SIs in the first week as predictors of wellbeing

The models used in the previous analyses to predict depression at Week 11, were also used to predict wellbeing at Week 11. As might be expected, we saw similar patterns of results. Change in self-negativity, R^2 = .241, $F(1, 15) = 4.77$, p = .04, and self-positivity, R^2 = .294, $F(1, 15) = 6.24$, p = .02, in the first week were significant predictors of eudemonic wellbeing at Week 11. The results showed that decreasing self-negativity, β = -.491, $t(15) = -2.18$, p = .04, and increasing self-positivity, β = .542, $t(15) = 2.49$, p = .02, in the first week, predicted improved eudemonic wellbeing at Week 11. Hedonic wellbeing was, however, related only with self-positivity. Change in self-positivity, R^2 = .292, $F(1, 15) = 6.19$, p = .02, in the first week was a significant predictor of hedonic wellbeing at Week 11. Consistent with the pattern so far, increasing self-positivity in the first week (β = .541, $t(15)$ = 2.49, p = .02), predicted hedonic wellbeing at Week 11. Therefore, changes in self-attribution predict wellbeing as well as depression at a later time.

Change in self-positivity, R^2 = .257, $F(1, 15) = 5.19$, p = .038, in the first week was a significant predictor of change in hedonic wellbeing over 11 weeks. This result shows that increasing self-positivity in the first week (β = .507, $t(15) = 2.28$, p = .038) predicted increasing hedonic wellbeing over 11 weeks.

8.4.6 Changes in social attribution over 11 weeks

Participant's positive and negative basic social attributions were also observed to change over the 11 weeks, as illustrated in Figure 8.4. As explained previously, the neurotic face scale ranged from -9 (emotionally stable) through 0 (original face) to +9 (neurotic). The graph shows decreasing scores for positive attribution, indicating that more emotionally stable images were being identified as positive, over the 11 weeks. Similarly, increasing scores for negative attribution indicates that more neurotic images are being identified as negative, over the 11 weeks. The results here indicate, increasing alignment of positive and negative biases with emotionally stable traits and neurotic traits respectively, which is consistent with the results in Chapter 4. We could therefore explain, that with improving mood and wellbeing, participants' attributions align more accurately with the respective traits. Further analysis, however, showed that changes in positive or negative social attributions did not predict depression at Week 11.

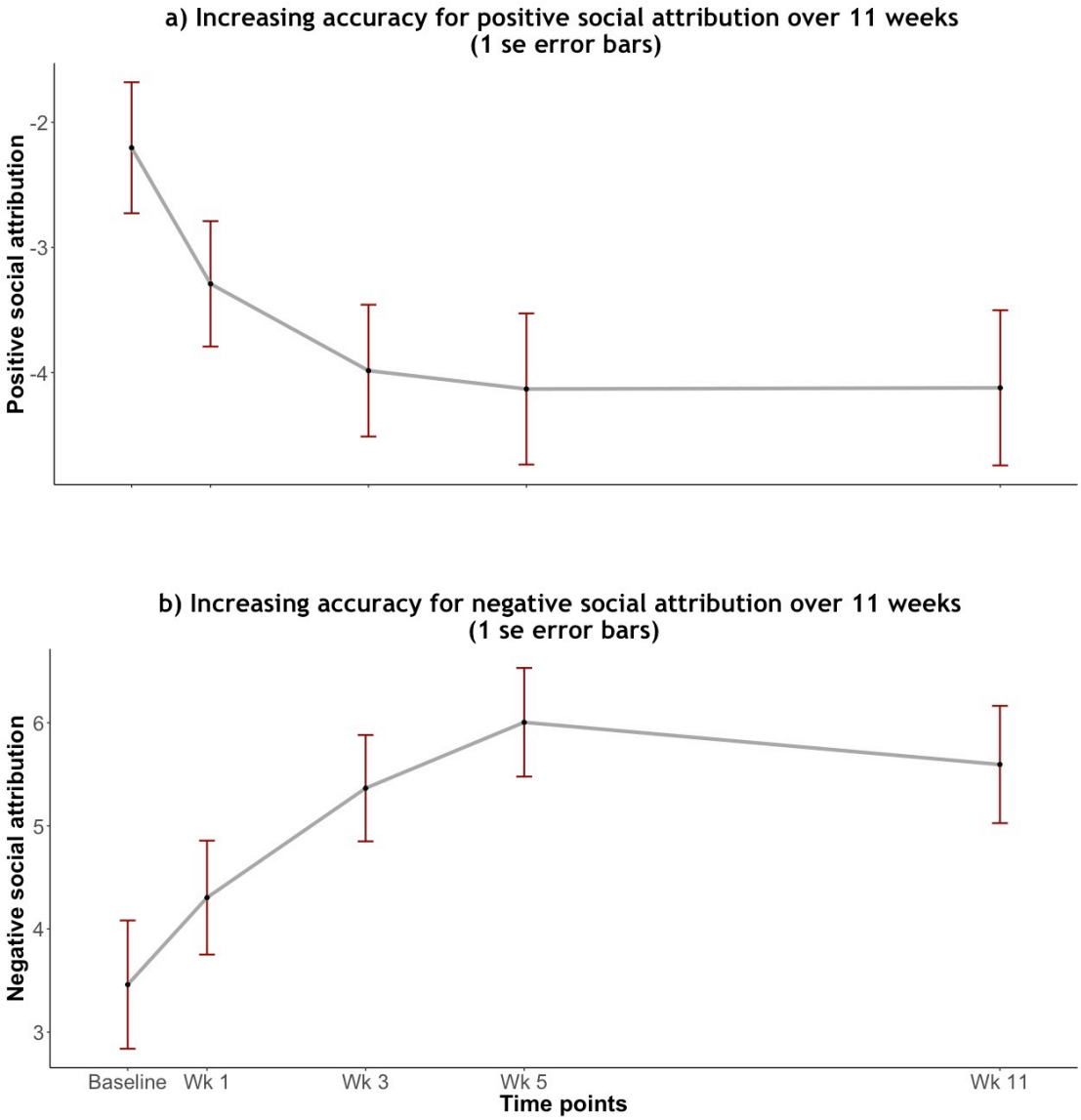


Figure 8.4. The graphs show a) Decrease in positive social attribution, and b) Increase in negative social attribution across the five time-points in 11 weeks. On average the group had increasingly positive bias for emotionally stable traits and negative bias for neurotic traits over 11 weeks.

8.4.6 Supplementary information

All participants reported having a white ethnic background. Of the 17 participants, two were married (one going through marriage break up), two were divorced (one living with partner), one participant was living with partner and the rest were single. Three participants had dependent children. Five participants were employed; two participants were on benefits and the rest were on student loan. Four participants were educated at postgraduate level, two at diploma level and the rest

were current degree students, four of whom were mature students returning after a period of employment. Eight participants spoke more than one language.

Seven participants experienced childhood trauma from infancy (earliest memories) to 15 years; this relating to issues of physical, mental, sexual and financial nature. One participant experienced homelessness in the past. Fourteen participants experienced comorbidities along with current depression, which between them included anxiety, social phobia, panic attacks, self-harm, alcohol misuse, compulsive disorder, body-dismorphia and post traumatic stress disorder. Two participants had multiple past depressive episodes, which one described as 'too many to count' and the other as 'since the age of 29'. Other's experience varied from a single episode to maximum of five episodes. The age of first onset of depression ranged from seven to 28 years, with an early onset for the majority. Four participants had onset before they were aged 10, seven had onset before they were aged 16, four had onset before they were aged 19.

All participants reported experiencing reduced severity of depression, improved wellbeing and health state, at the final time point of the study. Some participants had PHQ-9 scores below 10 at Week 11, indicating they were either 'not depressed' or 'mildly depressed', regardless of their intervention types. Majority in this group did not express improved mood at an early time point, although two participants expressed 'feeling better' by the third time point. All participants reported having positive experience with the study and some even suggested this making a difference in their experience of depression. The extensive SCID interview conducted at baseline was especially appreciated. We could explain this positive experience of participants, as a factor for reducing depression during the study period, which was

observed even in those who were not receiving any intervention. The in-depth interview and longitudinal monitoring could have emulated a feeling of being cared about, however, we do acknowledge this is only anecdotal evidence.

8.5 Discussion and conclusion

In this longitudinal study running over a period of 11 weeks, we used our self-attribution task to investigate the changes in self-perceptions of individuals who were clinically depressed. This was the first study to use the self and social attribution tasks in a longitudinal study with clinical population. The focus here is on the separation indices (SIs) of self-attributions. The SIs referred to the magnitude of separation between two basic self-attributions, on the Neurotic Face Scale and relates to the participant's mental representation of self-facial appearance.

The three SIs, i.e. self-negativity, self-positivity and self-discrepancy, changed across the 11 weeks. During this period, self-negativity and self-discrepancy decreased while self-positivity increased. These changes in SIs overlapped with decreasing severity of depression and increasing wellbeing. This substantiates our hypothesis for changes in mental representations of self-facial appearance, in response to changes in depressive symptoms.

So far, we have consistently demonstrated the association between self-negativity and severity of depression. In the self-attribution study (Chapter 5), we discussed depressive symptoms correlating with negative self-representation at a single time point. The current study, demonstrates similar relation between depressive symptoms and self-representation over multiple time points. Such consistency emphasises the quality of the Neurotic Face Scale.

The longitudinal changes in self-representation, in the current study, include increasing self-positivity and decreasing self-negativity, which overlapped with decreasing depressive symptoms. These changes highlight the shift in positive and negative perceptions relating to improving mood state. This is consistent with previous reports of increased positive bias and decreased negative bias, following antidepressant treatment for depression (Capitão, Murphy, Browning, Cowen, & Harmer, 2015; Chen et al., 2014; Warren et al., 2015). Imaging studies have previously, provided evidence for the underlying neural networks associated with such changes in perception. Fronto-limbic networks were shown to have increased activation whilst processing positive information and decreased activation whilst processing negative information, post treatment (Jaworska, Yang, Knott, & MacQueen, 2015; Ma et al., 2014; Outhred et al., 2014).

It has been proposed that early increase in positive and decrease in negative biases have predictive value for ultimate improvement in depressive symptoms (Anderson et al., 2011; Gollan et al., 2015; LeMoult et al., 2009; LeMoult, Ordaz, Kircanski, Singh, & Gotlib, 2015; Münkler et al., 2015; Roiser, Elliott, & Sahakian, 2011a; Warren et al., 2015). Corroborating such propositions, in the current study we demonstrated that decrease in self-negativity and increase in self-positivity in the first week predicted reduced depression at Week 11. These predictive values were observed, despite controlling for the change in depression in the first week. Furthermore, decrease in self-negativity in the first week was a significant predictor of the change in depression across the eleven weeks. These results highlight the sensitivity of the changes in self-attribution as an early predictor of mood.

It should be noted that, this predictive quality exists even when not controlling for the interventions received by our participants or ensuring their consistent commencement. This could be considered as a limitation of this study or interpreted as the sensitivity of the SIs in monitoring behavioural changes regardless of the intervention. The key point however, is the change in individual's perception preceded their subjective experience of improved mood state, i.e. mean depression score was not in the 'not depressed or mildly depressed' range. This is consistent with previous results, showing tryptophan depletion affecting changes in perception prior to experiencing changes in mood (Ward, Sreenivas & Rogers, 2016; Harmer et al., 2003b; Harmer et al., 2003). Thus, confirming the sensitivity of the self-attribution task to early behavioural changes, as described by the neurobiological model of depression.

Consistent with previous studies, our results also showed gradual changes in social attributions: with increasing positive bias towards emotionally stable images and negative bias towards neurotic images. This result suggests appropriate realigning of biases with improving mood, and gives a glimpse of how these changes might improve social interactions (Taylor & Brown, 1994; Taylor & Brown, 1988). Unlike self-attributions, however, the changes in social attributions did not predict depression at Week 11. We could therefore be looking at the time series of behavioural changes in response to mood change. The first change occurring in self-perceptions that gradually seeps into social attributions and therefore improving social functioning in due course. This concurs with the cognitive model of depression and relates to how changes in cognitive bias could transfer between self and social contexts (Beck et al., 1979; Beck, 2008; Beck & Bredemeier, 2016). This concept shows the therapeutic potential for cognitive modification trainings (Adams, Penton-Voak, Harmer, Holmes,

& Munafo, 2013; Blackwell et al., 2015; Browning, Holmes, & Harmer, 2010; Browning, Holmes, Charles, Cowen, & Harmer, 2012; Dunlop et al., 2012; Heeren, De Raedt, Koster, & Philippot, 2013; Murphy et al., 2015).

The key limitation of this study is the small sample size. The results based on a small sample risks loosing validity and reliability, although our longitudinal data does replicate similar associations at different time-points and those observed in the self-attribution study (Chapter 5). However, they do demonstrate the potential for applications in real world, if it can be replicated with bigger samples. Another aspect of the study is that, we only controlled for comorbidities of manic-depression and psychotic symptoms. This could be considered as a limitation, or as a demonstration of the sensitivity of the self-attribution task. The consistent results of changes in attribution relating to changes in depressive symptoms were demonstrated, despite the comorbidities.

To conclude, we demonstrated that early increases in self-positivity and decreases in self-negativity were predictors of reducing depression and improving wellbeing. This predictive quality of the self-attribution measures could have useful implications. Early predictors would be useful tools to identify effective interventions, which currently is identified through trial and error. By identifying early response to interventions, we can reduce the prolonged trial and error period, and improve quality of life faster. Finally, from a cost effective perspective, this can reduce the cost of treating depression as well as the total disease burden of depression on the National Health Service and society at large.

CHAPTER 9 – General discussion

In this section, I discuss the interesting outcomes from the previous experimental chapters, and their underpinnings on the wider theoretical frameworks. I further discuss some of the potential behavioural and clinical applications of self-attribution of facial appearance for future research.

The overarching focus of my thesis was to investigate attributions of facial appearance, how these are affected when experiencing depression and how changes in attribution could be used to predict improvements in mood. The idea of using subtle behaviours to predict mood change was driven by the neurocognitive model of depression, which suggests that neurobiology can effect early behavioural/cognitive changes prior to experiencing a change in mood.

9.1 Attributions of facial appearance with neurobiological change

Tryptophan depletion (TD) studies, including our previous study (Ward, Sreenivas & Rogers, 2016), provided evidence for early behaviour change following TD; supporting the neurocognitive model of depression. Previous TD studies have demonstrated reduced accuracy for facial expressions of emotions as evidence of early behavioural change (Harmer et al., 2009; Merens et al., 2008). Interestingly, the most consistent effect of TD occurred on reduced accuracy for facial expression of fear (Harmer et al., 2003b; Merens et al., 2008). We, however, used composite faces of personality traits and showed reduced accuracy only for neurotic facial cues following TD, which indicates overlapping face signals of fear like characteristics with traits of neuroticism.

9.2 Attributions of neurotic traits as fearful characteristics

The second study discussed in Chapter 4 (Part B) confirms the overlapping face signals of fear-related characteristics with neuroticism trait. The neurotic face composites used in this study were different to the pair used in our previous TD study (Ward, Sreenivas & Rogers, 2016). However, the systematic perception of neurotic traits as fear-related characteristics support our proposal of some overlapping face signals. It is natural to query why neurotic facial cues might be perceived as fear-related characteristics. We could relate this to the strong association of neuroticism trait with depressive and anxiety disorders (Eysenck, 1991; Roelofs, Huibers, Peeters, & Arntz, 2008), the facial cues of which would also be displayed on the composite faces. Depressive mood is consistently comorbid with anxiety (Arborelius, Owens, Plotsky, & Nemeroff, 1999; Mineka, Watson, & Clark, 1998), which is strongly linked to the 'fear of fear' relating to physical sensations associated with anxious arousal in all anxiety disorders and anxiety about the experience of sadness in depressive disorders (Liverant, Brown, Barlow, & Roemer, 2008; S. Taylor & Rachman, 1991; Taylor, 2014; Williams, Chambless, & Ahrens, 1997). Consistent with this account, the high neurotic composite face created from a number of faces selected on the basis of self-reported neuroticism displayed facial cues of fear-related characteristics as well, as demonstrated in Chapter 4. It is likely that this perception of fear-related characteristics on high neurotic face composites could also have mediated the consistent negative (anxious, unhappy and unattractive) attributions made to them, as observed in the first study discussed in Chapter 4. These negative attributions of the high neurotic cues were maintained in the neurotic face scale, as confirmed by the results of the pilot study discussed in Chapter 3, and further demonstrated in the key

experimental studies investigating self, social and observer's attributions as discussed in Chapter 4, 5, and 6 in Part C of this thesis.

9.3 Attributions on the neurotic face scale trigger systematic biases relating to depression

In Part C, we found systematic misattribution of neurotic images as positive by individuals (actors) experiencing depression. Such misattribution by actors was observed for self (Chapter 5) and others (Chapter 6), confirming depression driven misattribution and classic social projection respectively. Moreover, such misattributions were not found when others observed the actors, suggesting that the misattributions displayed by depressed actors were mood driven and not an artefact of the neurotic face scale. These results are interesting on two accounts. Firstly, we measure attributions made by an individual to self (self-attribution), others (social-attribution) and the attributions others make to this individual. This provides evidence of individual differences in attributions made to self, others, as well as when perceived by others. The respective three studies were designed to allow the triangulation of these three perspectives (self, social and observer) for each individual participant. Secondly, the self and social attributions were sensitive to the mood- and wellbeing- state of each participant, thus further demonstrating individual differences. The quality of our neurotic face scale could be related to the display of a neutral expression with the undertones of neurotic traits and fear-related characteristics.

I propose that the misattributions of self-facial appearance could be related to cognitive dissonance at an implicit level. Cognitive dissonance is explained as the psychological discomfort due to conflicting self-perceptions (Festinger, 1957; Steele, 1988a; Stone & Cooper, 2001). The results from the self-attribution study showed that

perceived actual-self and perceived positive-self were positively correlated, indicating processes of self-affirmation and self-preservation (Cohen & Sherman, 2014) at an implicit level. That is, *this is my actual image and it is similar to my perceived positive self*. It therefore appears that individuals experiencing depression perceive themselves as neurotic but attribute their actual self as positive, potentially because they have a positive self-perception at an implicit level. Such positive perceptions at an implicit level could be associated with implicit high self-esteem. Using our separation index (SI) of self-positivity, we could also be measuring the implicit high self-esteem because self-positivity shows the similarity or dissimilarity between perceived actual self and perceived positive self. Positive self-esteem, however, is seen as a protective factor that contributes to better health and positive social behaviour through its role as a buffer against the impact of negative influences (Mann, Hosman, Schaalma, & de Vries, 2004; Mikulincer, 1995; Murphy et al., 2015; Papakostas & Fava, 2008). So how can individuals experiencing depression display positive self-esteem, albeit at an implicit level?

Cognitive-experiential self-theory and such other dual-process models integrate the cognitive and the experiential systems by assuming the existence of two parallel, yet interacting modes of information processing (Akinci & Sadler-Smith, 2013; Epstein, 1994; Epstein, 1998; Smith & DeCoster, 2000; Wilson, Lindsey, & Schooler, 2000). Explicit self-esteem is largely a product of the cognitive system, which is based to some extent on logical analyses of self-relevant feedback and information, whereas implicit self-esteem has its origins in the experiential system, and be derived primarily from the overlearned and holistic processing of affective experiences (Bosson et al., 2003; Epstein, Pacini, Denes-Raj, & Heier, 1996; Zeigler-Hill, 2006a). This suggests that even though individuals experience the self as unitary,

it is possible that multiple sub-systems are operating simultaneously (Epstein, 1994; Epstein & Morling, 1995; Kuhl, 2011; Martin & Tesser, 2013; Martin et al., 1986; Zeigler-Hill, 2006b). Implicit high self-esteem when co-existing with explicit low self-esteem, is known to mediate depressive experience (Creemers et al., 2012; Franck, De Raedt, Dereu, & Van den Abbeele, 2007) and predict its recurrence (Franck, Raedt, & Houwer, 2007; Leeuwis, Koot, Creemers, & van Lier, 2015). Thus, the misattribution of neurotic images as positive, by those individuals experiencing depression in the self-attribution study, could be due to their implicit high self-esteem. Future research could investigate implicit and explicit self-esteem in relation to self-attribution of facial appearance.

Another interesting point is that the systematic misattribution of neurotic facial cues as positive, as observed in our studies (Chapter 4 & 5), could potentially explain the reduced accuracy for low intensity facial cues when experiencing depression or following TD. Studies have shown reduced accuracy for neutral or ambiguous emotion expressions when experiencing depression (Beevers, Wells, Ellis, & Fischer, 2009; Bouhuys, Bloem, & Groothuis, 1995; Harmer et al., 2002). Consistent with this pattern, studies have shown that when experiencing depression or following TD, an exaggerated or high intensity emotional expressions, including fear, had greater accuracy (Anderson et al., 2011; Harmer et al., 2003b; Merens et al., 2008; Stuhrmann et al., 2011). Our neurotic face scale display subtle cues of neuroticism gradually increasing from one end of the scale to the other, and therefore making attributions of them would have been difficult for those experiencing depression. We could equate the low intensity fearful expression to the more neurotic facial cues in our study, however, positive attributions of low intensity fearful expression would be inconsistent with an explicit task for fear recognition, and highlights the limitation of

such tasks being sensitive to mood-state. Thus the results discussed in Parts C and D of this thesis, provide evidence that the self-attribution task trigger responses that are more sensitive to a depressive mood-state compared to the emotional face tasks used in previous studies.

9.4 Clinical application of the self-attribution task

Following the results of the self-attribution study, showing greater sensitivity of the SIs (self-negativity, self-positivity, & classic self-discrepancy) to depression, we used them to assess longitudinal changes when experiencing clinical depression. As demonstrated in Chapter 8, self-negativity decreased and self-positivity increased with decreasing depression over an 11-week period; such changes were previously proposed as potential effects of antidepressants (Dunn et al., 2009; Harmer, 2014; Roiser et al., 2012). This longitudinal change in self-attribution could be reflecting the improvement in implicit high self-esteem, as well as the realignment of implicit and explicit self-esteem with improving mood.

Prior studies have reported reduced negative bias relating to reduction of depressive symptoms (Anderson et al., 2011; LeMoult et al., 2009; Münkler et al., 2015; Roiser, Elliott, & Sahakian, 2011b), and proposed their predictive value. Further evidence suggested the predictive quality of early increase in positive bias and decrease in negative bias (Gollan et al., 2015; LeMoult et al., 2009; Pringle, Browning, Cowen, & Harmer, 2011; Warren et al., 2015), which was demonstrated in our clinical study. The greater sensitivity of the SIs were demonstrated by their predictive value relating to behavioural change in the first week, with increasing self-positivity and decreasing self-negativity, to predict reduced depression at Week 11 and the change in depression across the study period. This relationship was

maintained even after controlling for changes in depression in the first week. The predictive value was observed, despite not controlling for interventions or their commencement, thus confirming the sensitivity of our measures specifically to subtle behavioural changes rather than specific effect of interventions. This shows the potential of our measures for wider application and adaptability across interventions.

9.5 Predictive value of behavioural measures

It is interesting that the same set of stimuli used in our clinical study was perceived differently with change in mood, and brings up the questions why we observe related changes in attribution, and how these stimuli were sensitive enough to be able to predict improvements in mood. Prior studies have used a variety of measures to predict mood improvement. Bouhuy et al. (2006) proposed greater risk for recurrence of depression when there is a coupling of high level of cortisol secretion and altered fear perception, while Chan et al. (2009) proposed enhanced neural response to fearful expressions as risk factor for depression. Consistent to this, reduced accuracy for neurotic facial traits (Ward, Sreenivas & Rogers, 2016) and fearful expression (Harmer et al., 2003b) was observed following TD, and improved accuracy for fearful expression after selective serotonin reuptake inhibitor treatment (Bhagwagar et al., 2004). These interesting results demonstrate that early but subtle changes in cognitive processes have the potential for predictive quality, however, fall short of providing a sensitive behavioural predictor irrespective of the treatments for depression. This limitation could be because the commonly used behavioural tasks explicitly measure accuracy for facial emotions, but have little explicit relevance to self-facial appearance or evaluation of the current mood-state through self-attributions. Another drawback could be related to the limited variance in the scale

used to measure responses. By allowing greater variance in responses, there is greater possibility of accounting for individual differences and therefore measures could feature greater sensitivity.

From the results of the clinical study in this thesis, it is evident that self-attributions changed across the study period and were sensitive to mood improvements, however, social attributions changed only non-significantly over the same period of time. We could infer a time-series of behavioural changes starting initially with self-perception, and later spreading into the social context, which echoes Beck's cognitive triad (Beck, 2008; Beck & Bredemeier, 2016). Such a behavioural time series could explain why the self-attributions measured in our study were sensitive to early implicit changes prior to mood improvement; unlike the tasks using emotional faces or faces of others'. The self-attribution task could be measuring the early changes in the self-negativity, which is a core symptom of depression, thus explaining the early changes observed in our clinical study. The fact that the predictive values of these measures were despite not controlling for interventions indicates its sensitivity for wider cognitive and neurobiological processes.

The predictive value of measures relating to early improvement in mood is not very commonly demonstrated. I propose the predictive quality of the self-attribution measures from our study is underpinned by a few factors. Firstly, we used individualised stimuli using self-face that would have inevitably warranted self-referential and self-evaluating processes, which is affected when experiencing depression. Secondly, our face stimuli combined ambiguous neutral expression with the subtle under tones of neurotic traits that were attributed to fear-like characteristics; the cognitive processing of which is affected when experiencing depression. Thirdly,

by using face stimuli, we would be tapping into the broad range of social processes, and thereby having the benefit of measuring changes in the related cognitive functions. Finally, all the three factors discussed here rely, to some extent, on the fronto-limbic network, which is closely associated with depression (Frye, Schaefer, & Alexander, 2007; Harmer, 2014; Keenan et al., 2000; Lemogne et al., 2012; Mayberg, 1997; Platek, Keenan, Gallup Jr., & Mohamed, 2004; Sheline, 2003; Warren et al., 2015). We might have measured the early behavioural changes reflecting the changes in this neural network in relation to early intervention response. The sensitivity of the self-attributions therefore, underpins its potential for future clinical applications.

9.6 Potential clinical and research implications of the self-attribution task

Innovative techniques are being introduced as interventions to modify maladaptive cognitions relating to affective disorders (Adams et al., 2013). Techniques such as emotion recognition or cognitive modification trainings are used to reduce cognitive biases, with the intention to improve adaptive behaviour, and consequently impact mood (Adams et al., 2013; Blackwell et al., 2015; Browning et al., 2010; Browning et al., 2012; Cisler & Koster, 2010; Heeren et al., 2013; Murphy et al., 2015). Various methods are used to target cognitive modification, and improve positive bias. One method is to present emotional faces, and to provide corrective feedback when the perceptions are inaccurate (Adams et al., 2013). Another method is to present positive and negative emotional faces or words immediately followed by dot probes appearing in the place of the positive stimuli to improve attention to positive cues (Hallion & Ruscio, 2011). A recent study compared the effects of cognitive modification paradigm using emotional faces, with the adaptation of the same using composite faces showing more naturalistic emotional expressions, and

reported greater generalizability of emotion recognition after using the latter (Dalili, Schofield-Toloza, Munafò, & Penton-Voak, 2016). Consistent with the theme of this thesis, it was proposed that cognitive modification training using composite faces could be used to reduce the negative cognitive biases affecting the perception of ambiguous faces, which is widely related to mental health disorders (Dalili et al., 2016).

On the basis of the evidence, I suggest that the self-attribution task could be adapted for cognitive modification training with corrective feedback to reduce self-negativity and improve self-positivity, as a complimentary therapy alongside the mainstream treatments. Besides, as demonstrated in this thesis, the early behavioural changes appear to originate from self before extending into the social domain, and therefore the potential for using self-stimuli could be rationalised. I further propose that, by completing the self-attribution task, individuals could have potentially experienced therapeutic effects, because the process of evaluating a series of self-images could realign self-perception through the natural process of self-evaluation. The neurotic face scale displays a series of self-images on a continuum that increase in neuroticism across the scale; explicitly giving a visual distinction of how one might look when experiencing emotional instability from when experiencing emotional calmness. Such stark visual distinctions of self could be a reminder to aim for greater emotional calmness or a reassurance, that *I could have been in a worse emotional state than my current self*.

The direct clinical implications of the results so far include, monitoring and predictive qualities of our self-attribution measures. The versatility of the attribution task opens up new avenues for developing potential applications that could directly

impact the real world. The process of setting up the self-attribution task could be automated to the level of individuals' selfie taken on their smartphone being used to automatically create the 19 images, and set up the task for self-administering as a phone app. Such a proposition is not impossible, and could mean the health care teams could remotely monitor the changes in self-attribution and manage interventions in real-time. Unlike the functional imaging techniques, using the self-attribution task could be cost effective yet ensure an individualised method of monitoring and predicting behavioural changes. Thus the sensitivity of the self-attribution task to subtle behavioural changes could be utilised extensively to benefit and improve quality of life by developing pragmatic applications.

Another potential for the self-attribution task is its application to improve social functioning of individuals with developmental disorders. Individuals within the autism spectrum are known to have social dysfunctions due to misreading of social cues (Frith, 1994). One of the behavioural interventions is to explicitly learn social cues including facial signals (Baron-Cohen, Golan, & Ashwin, 2009; Bellini & Peters, 2008). It is also proposed that self-perception will be altered in this population (Uddin, Kaplan, Molnar-Szakacs, Zaidel, & Iacoboni, 2005; Uddin et al., 2007), and therefore self and social attribution tasks could be adapted as social learning tools, as an alternative using natural looking facial cues to the widely used explicit emotions.

I have so far discussed, the potential use of our attribution task in providing assessments, monitoring, predicting mood-improvement, and utilising the self-face properties for devising complimentary therapies. Given these interesting findings so far, further research using self-attribution task is recommended to appreciate its full potential. It could be used to investigate other social and mental health issues.

Behavioural issues relating to body image, including the changes in physical appearance due to accidents, disease or side effects of treatments seem obvious topics that could be investigated using this paradigm. Social behaviours relating to interpersonal relationship could be investigated to understand change in partners' perception and its association with the quality of their relationship. Self-esteem, with implication for individual's adaptive behaviours and success, could similarly be investigated. To give a flavour of future research potential using the self-attribution task, I will briefly discuss two pilot studies to investigate the change in self-attributions following mindfulness practice, and a period of stress.

9.6.1 Changes in self-positivity with mindfulness practice and stress

We conducted two small pilot studies to investigate whether mindfulness practice improves self-attribution as measured using our self-attribution task, and whether stress can bring about an opposing change in self-attribution. Mindfulness practice adopts self-referential process to reduce judgmental thoughts about self in order to enhance positive self-perception (Kabat-Zinn, 2003; Kemeny et al., 2012). Stress, on the other hand, could have the opposite effect on self (Kubota et al., 2014).

In these studies, 10 (7 females) individuals who attended the eight weeks mindfulness course at Bangor University and 6 (4 females) university students who had exams within a period of eight weeks consented and participated. Consistent with the procedures of the self-attribution study (Chapter 5) we measured the basic self-attributions and computed the SIs (self-negativity, self-positivity and self-discrepancy) before and after the eight weeks of mindfulness practice, and exam period in the respective studies. We measured depression (Rush et al., 1996), wellbeing (Diener et al., 2010) and neuroticism (Donnellan et al., 2006) at both time-

points of the two studies. We further used Five Facets Mindfulness Questionnaire (Baer et al., 2008) and Experience questionnaire (Fresco et al., 2007) to measure mindfulness, and Undergraduate Stress Questionnaire (Crandall, Preisler, & Aussprung, 1992) to measure stress in the respective studies. Using paired samples *t* test, we compared the measures across the two time-points.

We found a significant increase in self-positivity after eight weeks of mindfulness practice, $t(9) = 2.314$, $p = .046$. Over the same period there was a significant decrease in depression and neuroticism, and increase in hedonic wellbeing and mindful behaviour. It was interesting to find reduced neuroticism after mindfulness practice. Neuroticism refers to the reactive behaviours, such as being moody, emotionally unstable and anxious, and is considered as a stable trait. Barnhofer, Duggan and Sriffith (2011) reported that mindfulness moderates the relation between neuroticism and depressive symptoms, which could explain the reduced depression score observed in our study, even though none of the participants were experiencing clinical depression. Thus, our results show that individuals were able to better control their emotional reactivity and anxiety, after eight weeks of mindfulness practice, which could be indicative of the related therapeutic effect.

In the other pilot study, self-attribution was not significantly different between the two time points, but interestingly neither was stress. Other measures including depression and wellbeing were also not significantly different across the two time-points. This null result is interesting because it shows that when there is no significant change in the mental state of individuals, their self-attribution does not change significantly either.

The results of these pilot studies, albeit with small sample size, further demonstrate the quality of our self-attribution task. Firstly, our self-attribution measures are sensitive to mood but remain unchanged if there was no significant change in mood and stress. Secondly, the changes in self-attribution are related to subtle changes in mood and wellbeing, and not just clinical symptoms. Finally, the change in self-attribution is not a natural by-product or artefact of time. Thus the quality of our self-attribution task with the neurotic face scale, is further confirmed and is recommended for future research.

9.7 Conclusion

I will conclude my discussion with a final reminder of the key aspects from this thesis. The main goals were to develop a behavioural task that provides individualised measures, which are sensitive to depression, wellbeing and neuroticism, and have monitoring and predictive values relating to depression.

The research presented herein, has succeeded in these goals by successfully developing an attribution task for measuring attributions of facial appearance in self, social and observer contexts. In Chapters 5, 6 and 7 we demonstrated the sensitivity of the attribution measures to individual's depression, wellbeing and neuroticism. Furthermore, the mental self-representation measures of self-negativity, self-positivity and self-discrepancy were especially sensitive to individual's transient mood and wellbeing state, but also had the quality to distinguish maladaptive and adaptive behaviours relating to the personality traits of neuroticism and agreeableness respectively. These studies also demonstrated classic social projection, with mood-state driving consistent misattributions in self and social context. The highlight of the

three main experimental chapters in Part C was the attribution measures of self, social, and observers' for each participant, demonstrating individual differences.

The monitoring and predictive values of mental self-representation measures were demonstrated in the clinical study discussed in Chapter 8. Specifically, we demonstrated decrease in self-negativity and increase in self-positivity, overlapping with decreasing depression, and increasing wellbeing longitudinally. Besides this monitoring quality, changes in these measures were found to be early predictors of reducing severity of depressive symptoms, which highlights its potential to identify early intervention response for depression.

Furthermore, results from the pilot studies demonstrated the sensitivity of our self-attribution measures to subtle changes in mental state, and not just clinical symptoms of depression. Increasing self-positivity after mindfulness practice substantiates the sensitivity of our measures to adaptive behavioural change, while no difference in attributions without change in stress levels or depression shows that the changes are not an artefact of time. Additionally, the work here demonstrates novel information regarding a complex nexus of mood, wellbeing and personality traits affecting individual's attributions of facial appearance. Our self-attribution task could, therefore, be used creatively to investigate other psychological disorders.

The self-attribution task has the potential in not just monitoring and predicting intervention response for depression, but also to improve visual attributions of self. This task could be adapted for assessing the response to treatments for depression at earlier time points than is currently the case. It could potentially confirm whether a treatment will be successful or otherwise, thus improving recovery time frame and quality of life. Supplementary interventions to reduce negative bias to self, relating to

affective disorders or similar paradigms could be adapted for training individuals with developmental disorders, to understand subtle facial cues.

– The End –

Appendix

Supplementary results

Self-attribution study

Table App.1. The correlations of individual's self-attributions with measures of depression, wellbeing, personality traits and attributional style

	Depression	Wellbeing				Big five personality traits					Attributional style							
		Eudemonic		Hedonic							Positive style				Negative style			
		FS	PE	NE	BE	A	C	E	N	O	Internal	Stable	Global	CP	Internal	Stable	Global	CN
Basic self-attributions																		
Perceived actual self	.219*	-.036	-.084	.188	-.140	.089	.006	-.014	.200*	.051	-.054	.038	-.018	-.016	.021	.081	-.059	.011
Perceived ideal self	.182	-.084	.053	.087	-.011	.197*	.083	.047	.232*	-.118	-.067	-.054	-.122	-.102	.146	-.041	.001	.052
Perceived positive self	.253*	-.110	-.071	.169	-.124	.246*	-.014	-.016	.277**	-.042	-.120	-.067	-.069	-.104	.075	-.165	-.069	-.061
Perceived negative self	-.138	.106	.142	-.110	.136	.002	.084	.149	-.108	.032	.052	.100	.147	.123	-.010	.204*	.105	.123
Separation Indices (mental self-representations)																		
Self-discrepancy (SI_{ai})	.153	-.128	-.282**	.182	-.253*	-.206*	-.193	.006	.094	-.117	-.012	-.088	-.064	-.064	.082	.017	-.018	.035
Self-positivity (SI_{ap})	-.055	-.026	.190	-.123	.171	.243*	.069	.059	-.014	.138	-.045	.039	-.005	-.005	.021	-.087	.035	-.005
Self-negativity (SI_{an})	.263**	-.121	-.165	.282**	-.233*	-079	-.036	-.057	.243*	-.134	-.091	-.122	-.130	-.130	.192	.034	.017	.109

Note. Pearson's *r* is reported here. ** $p < 0.01$; * $p < 0.05$. FS, flourishing score; PE, positive experience; NE, negative experience; BE, balanced experience; A, agreeableness; C, conscientiousness; E, extraversion; N, neuroticism; O, openness; CP, composite score of positive attributional style; CN, composite score of negative attributional style

Social-attribution study

Table App.2. The correlations of individual's social-attributions with measures of depression, wellbeing, personality traits and attributional style

	Depression	Wellbeing				Big five personality traits					Attributional style							
		Eudemonic		Hedonic							Positive style				Negative style			
		FS	PE	NE	BE	A	C	E	N	O	Internal	Stable	Global	CP	Internal	Stable	Global	CN
Basic social-attributions																		
Perceived positive	.239*	-.169	-.176	.199*	-.199*	.164	-.075	-.071	.065	-.088	-.015	-.072	-.102	-.078	.117	-.063	.134	.096
Perceived negative	-.134	.085	.057	-.092	-.078	-.113	.190	-.032	.022	-.130	.050	.039	.076	.069	-.212*	.059	-.147	-.148

Note. Pearson's *r* is reported here. * $p < 0.05$. FS, flourishing score; PE, positive experience; NE, negative experience; BE, balanced experience; A, agreeableness; C, conscientiousness; E, extraversion; N, neuroticism; O, openness; CP, composite score of positive attributional style; CN, composite score of negative attributional style

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