Emotion processing: Relevance to psychotic-like symptoms

Devon Spaapen

BPsych

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ABSTRACT

Rationale: Studies show that negative emotions are highly prevalent in psychosis, and that they play a key role in the onset and maintenance of psychotic symptoms. Emotions and emotion processing, however, have not received much attention in the context of psychotic-like experiences (PLE). PLE resemble the positive symptoms of psychosis, and are common experiences in the general population, although they do not cause high distress or loss of functioning. A better understanding of emotional vulnerabilities in individuals with PLE may be used to put in place interventions aimed at reducing the risk for transition into psychosis.

Research aims: This thesis aimed to explore different aspects of emotion processing (emotion perception, regulation, and negative affect) in people with and without PLE. Before this relationship could be explored however, the psychometric properties of emotion processing scales were investigated to determine their reliability and suitability so that they could be used with confidence. 

Methods: Two large community samples from Australia (N = 575) and the United Kingdom (N = 597) completed a set of questionnaires. The questionnaires included: the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), Emotion Processing Scale (EPS; Baker, 2009), and the Depression, Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995). PLE were assessed using the Psychosis Screening Questionnaire (PSQ; Bebbington & Nayani, 1995). First, the psychometric properties of the ERQ and EPS were explored using Confirmatory Factor Analysis (CFA). Then the relationships between the measures of emotion processing and PLE were investigated with SEM analysis.

Results: Adequate model fit was not established for the original ERQ (10 items), but with a minor adjustment, a revised version of the scale (ERQ-9) presented with strong model fit. In contrast, the original EPS factor structure was not supported and attempts to refine the factor structure were unsuccessful. In the final analyses, the relationship between PLE, ERQ-9 and DASS was examined. PLE were linked to negative affect assessed with
DASS (only through the shared variance between depression, anxiety and stress), but not to poorer emotion regulation (ERQ-9). **Conclusion:** PLE are linked to negative affect. However, PLE were not linked to poorer emotion regulation as assessed with the current measures. It is recommended that future studies exploring emotion processing and PLE include a wider range of validated emotion processing/regulation tasks, and analyse the extent to which unique and shared variance of depression, anxiety and stress explain the relationship between emotion processing and PLE.
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Statement of Original Contribution

The work contained in this thesis has not previously been submitted for a degree or diploma at any other higher education institution. This thesis is entirely my own work and has been accomplished during enrolment in the degree of Masters of Science (Psychiatry). All external sources have been acknowledged.

Data collection was conducted in collaboration with other researchers or institutions, as part of a larger study titled "Emotions across the Lifespan", directed by Professor Romola Bucks (RSB) as outlined in the Acknowledgements section. However, the design of the current project, data analysis, and the preparation of this thesis have been completed by the candidate alone with guidance from his supervisors.

The articles that were published or submitted as a result of the work undertaken for this thesis are included in chapters 2 (published), 3 (submitted). Chapter 4 will be submitted as soon as the thesis has been marked.

_The student completed all analyses, formulated and wrote the papers. The other authors on the papers provided intellectual input, data collection, advised on the analyses and interpretation, and assisted with formulation and editing of the papers._ More specifically, in chapter 2, the authors A/Prof Flavie Waters (FW) and RSB provided intellectual input into the conceptualisation of the concept, conducted quality assessment, statistical advice, and edited the manuscript. Additional statistical guidance, and advice regarding analysis and interpretation was provided by Patrick Dunlop (PD) and Mark Griffin (MG). Data was collected by RSB, Lusia Stopa (LS) and Laura Brummer (LB). LS and LB also reviewed the chapter. In chapters 3, the authors RSB, FW and PD provided intellectual input, advised on the analyses and interpretation, and assisted with editing the manuscript. Additional statistical
guidance was provided by MG. Data was collected by RSB, LS and LB. LS and LB also reviewed the chapter.

In chapter 4, the authors FW, RSB and DP provided intellectual input, advised on the analyses and interpretation, and assisted with editing the manuscript. Data was collected by RSB, LS and LB.
Manuscripts and publications generated from this thesis.

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Conference Presentations


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Without the guidance and large contributions of Patrick Dunlop, particularly in relation to statistical analysis, I’m not sure what direction the thesis or the three papers for publication would have taken. The in-depth guidance through my exploration of structural equation modelling, exploratory and confirmatory factor analysis has been invaluable. Whilst learning CFA and SEM in AMOS and MPlus was testing at times, I feel like this exploration of statistical analyses has left me with a far better understanding of the fundamentals of research, and a wealth of skills for the future that I can’t imagine being without. I’m very grateful to have you in my life. As one of my closest friends, you have always been an inspiration and role model to me.

I would also like to thank Mark Griffin for statistical guidance with the ERQ and EPS statistics. At a time when I was lost and how to progress, your help was very timely and provided direction at a critical moment.
Preamble

This thesis sought to evaluate the presence of emotional processing difficulties in people with psychotic-like experiences (PLE) without the need for care. Because individuals with PLE are thought to be at ‘high risk’ to make a transition to psychosis, the identification of the specific type of emotion processing dysfunctions in PLE is likely to be informative when putting in place intervention strategies aimed at reducing the vulnerability of the individuals in developing psychosis.

The methods for this thesis include a set of questionnaires. The choice of measures was driven by a theoretical framework which suggests that emotion processing is better understood as a family of processes, comprising emotion perception, regulation and negative emotions. Tasks were chosen because they were well known, frequently used, and generally accepted in the emotion literature. With the exception of measures of negative mood (such as the DASS), however, many measures of emotion perception and regulations have not been fully validated. This is the case for two of the measures included in this thesis: the Emotion Regulation Questionnaire (ERQ) and the Emotion Processing Scale (EPS).

Establishing the psychometric properties of an instrument is an important step in assessing the responsiveness of measurement instruments (Nunnally, 1967). For this reason, my first task was to begin this investigation by assessing the psychometric properties of the ERQ and EPS. By validating these tasks, I hoped to use the best tasks possible to examine the relationship between PLE and emotion processing. This process allowed a refinement of the ERQ (Chapter 2); Unfortunately, I was not able to find any satisfactory fit for the EPS (Chapter 3), despite best efforts to optimize its factor structure. Therefore, the measure could not be used for the further analyses of emotion processing difficulties in PLE. In the final chapter (chapter 4), the only suitable emotional processing tasks were the ERQ and DASS.
This narrowed the scope of examination of emotional processing in PLE, but is still able to provide useful information regarding the relationship between emotion processing and negative mood in the context of PLE.

This thesis is presented as a collection of papers in a format suitable for publication. At the time of submission, Chapter 2 has been published, and Chapter 3 has been submitted for publication (revise and resubmit). Chapter 4 will be submitted after this thesis has been examined.

References

CHAPTER 1: Introduction

1.1 Schizophrenia and psychosis

The prototype for psychosis as an illness has often been schizophrenia. Schizophrenia is a chronic mental illness with severe social, economic and health consequences. Along with other psychotic disorders, schizophrenia is associated with poor self-care, low employment rates (Marwaha & Johnson, 2004; Thornicroft et al., 2004), increased work absenteeism, diminished social relations (including social mistreatment and isolation) trouble with the law, and higher mortality rates (mostly through suicide and accidents; Access Economics, 2002; Harris & Barraclough, 1998; Jablensky et al., 1999). Schizophrenia also has high comorbidity with other mental disorders, including mood (Birchwood, Zaffer, Chadwick, & Trower, 2000), anxiety (Berman, Kalinowski, Berman, Lengua, & Green, 1995; Mueser et al., 1998; Turnbull & Bebbington, 2001), substance abuse (Jablensky et al., 2000), and personality disorders (Keown, Frank, & Kuipers, 2002; Keown, Holloway, & Kuipers, 2005), as well as some physical disorders, including HIV, cancer, and hepatitis (Lawrence, Holman, & Jablensky, 2001), increasing the likelihood of negative outcomes (Drake, Mueser, Clark, & Wallach, 1996). The direct health cost of schizophrenia in Australia was approximately $660 million in 2001, and is projected to be over one billion in 2011 (Access Economics, 2002). In addition, the indirect costs associated with schizophrenia are thought to be about double the direct costs when including productivity. It is clear why it is considered to be a global leading cause of disability and the overall disease burden (World Health Organisation, 2001).

Schizophrenia is a type of psychotic disorder. ‘Psychosis’ is characterised by a set of symptoms (particularly positive symptoms like hallucinations, delusions, and disorganisation), that are common features of schizophrenia (American Psychiatric Association, 2000). Depending on the severity, these symptoms can be accompanied by abnormal behaviour and impairment in social interaction and daily functioning. The lifetime
prevalence estimates of all psychotic disorders is approximately 3% (Perala et al., 2007), with schizophrenia accounting for about a third of cases (American Psychiatric Association, 2000). Variations in the diagnostic instruments used, and methods of case-finding are considered the reasons for varying prevalence estimates (Perala et al., 2007).

Unfortunately, research examining possible mechanisms that underlie psychotic symptoms is challenging due to the confounds associated medication, comorbidity with other mental illnesses, heterogeneous clinical symptom presentation, the challenges of working with individuals who are often acutely mentally ill (Modinos, Renken, Ormel, & Aleman, 2011).

To discount these extraneous features of mental illness, a frequently adopted method is the examination of people who show similar symptoms, but without the confounds associated with clinical populations. These methods allow investigations into the mechanisms of psychosis without confounds such as anti-psychotic medications, chronicity, multiple symptoms (comorbidity), and lack of insight (McCreery & Claridge, 1996). In regards to schizophrenia, this involves the examination of people in the general community who have Psychotic-Like Experiences (PLE).

1.2 Psychosis-like experiences (PLE)

A detailed review of PLE is provided in chapter 4 so it is not repeated here. Briefly, PLE refer to group of psychotic experiences that are found in the general population, which occur below the clinical threshold, and that are not associated with high levels of distress or functional disability. PLE are less frequent, intense and intrusive than psychotic symptoms, and are typically not associated with strong emotional reactions. PLE are sometimes referred to as ‘schizotypy’ or ‘anomalous perceptual experiences’ although these have their own
conceptual tradition which means that the overlap is not complete (Laroi, Raballo, & Bell, in press).

PLE include a range of experiences, including: hearing a few words, or one’s name when the person is alone, seeing shapes, animals or faces when there is nothing in the environment to account for it, the experience of paranoia and that people wish them harm, the belief in magical powers or that they can read other people’s mind or move objects with their minds. These experiences are relatively common, with estimates ranging between 8% to 43%, depending on the population sample, measure, and symptom criteria (Loewy, Johnson, & Cannon, 2007; van Os, Linscott, Myin-Germeyis, Delespaule, & Krabbendam, 2009; Wiles et al., 2006). In a recent meta-analysis, and using strict symptom definitions, van Os and colleagues (2009) made a distinction between psychotic symptoms with clinical relevance (i.e. associated with distress and help-seeking behaviour) and psychotic experiences that are associated with neither distress nor help-seeking behavior. The prevalence rates were 4% versus 8% respectively (see Figure 1).

Findings that these experiences differ as a function of degree across both healthy and psychiatric ill populations has led to a ‘psychosis continuum’ view. This dimensional view proposes psychopathological symptoms of psychosis (psychotic phenotype) occur on a continuum of severity, ranging from psychotic-like experiences in the general community to full-blown clinical psychosis (van Os, Hanssen, Bijl, & Ravelli, 2000; van Os et al., 2009), with people falling somewhere along this continuum of psychosis expression (Allardyce, Suppes, & Van Os, 2007). According to this conceptualization, symptoms may change from sub-clinical symptoms to its clinical manifestation in the form of psychosis, with a corresponding increase in symptom intensity, frequency, persistence, and functional impairments.
These distribution findings have been proposed as evidence that PLE are part of a general vulnerability for schizophrenia. Other evidence tends to support this proposal. First, longitudinal studies show that PLE may predict the future transition to psychosis. Hanssen, Bak, Bijl, Vollebergh, and van Os (2005), for example, reported that 8% of individuals with PLE had developed psychosis after a 2-year follow up, and this figure increases to 25% after 15 years (Poulton et al., 2000). Second, the relationship between psychiatric disorders and demographic characteristics (e.g. male gender, ethnic minority, being unemployed and unmarried) is also observed in people with PLE (McGrath et al., 2004; van Os et al., 2009). Third, there is biological overlap, as shown in co-clustering of clinical and subclinical psychosis phenotypes in families (Kendler, Mcguire, Gruenberg, O'hare, & Walsh, 1993; van Os et al., 2009). In sum, many now view this phenotype as an underlying liability for psychosis (Rössler, Hengartner, Ajdacic-Gross, Haker, & Angst, 2013).
A different view suggests a more careful examination of the evidence is warranted (De Leede-Smith & Barkus, 2013). For instance, Larøi (2012) proposed that the continuum of (symptom) experiences must be distinguished from that of a continuum of risk. Specifically, there is strong evidence that symptom experiences vary on a continuum: for example, auditory hallucinations vary from indistinct sounds (scratching, buzzing) to increasingly audible and complex voices. Similarly, visual hallucinations start as shadows in the corner of the visual field, or a sensation that objects in the environment look “different” or changed, all the way through to fully formed and complex visions. Finally, delusions vary on a continuum of bizarreness and strength of conviction. By contrast, a continuum at the level of risk has been proposed, albeit with less consensus. Accordingly, Larøi argued that the symptom-continuum may not necessarily dovetail with risk mechanisms.

Regardless of this dissociation, the idea of a psychosis continuum implies that any underlying mechanisms associated with schizophrenia should also be detectable at the subclinical level. There is some evidence supporting this view, although some contradictory findings exists in cognitive and psychological mechanisms (Johns et al., 2014). There are also some differences in phenomenological characteristics, with differences in negative content and persistence (Larøi et al., 2012).

Altogether, the continuum view of psychosis has not altogether reached consensus. Nonetheless, research into the extended psychosis phenotype is important. First, it allows a better understanding of this subclinical group who may, potentially, experience general vulnerability for psychosis and schizophrenia. Secondly, it allows the identification of risk, and protective factors that determine whether this group might develop a diagnosable psychotic illness.

In recent years, emotion processing has emerged as an important area of research in schizophrenia. There is now recognition that dysfunctional emotion processing (including
emotion perception, regulation and negative affect) is a core component of schizophrenia, directly influencing symptom frequency, content, and severity (Badcock, Paulik, & Maybery, 2011; Serper & Berenbaum, 2008; Tien & Eaton, 1992). It also significantly impacts individuals’ quality of life (Baslet, Termini, & Herbener, 2009), as well as social and functional outcomes, including work functioning and living independently (Henry, Rendell, Green, McDonald, & O’Donnell, 2008; Kee, Green, Mintz, & Brekke, 2003; Kimhy et al., 2012). However, substantially less research has been conducted in individuals with PLE. Compared to prenatal or early aetiological factors that contribute to schizophrenia onset and maintenance (Hanssen, Krabbendam, Vollema, Delespaul, & Van Os, 2006; Linney et al., 2003; Stefanis et al., 2004), emotion processing is an avenue for experimentation and intervention that is more amenable to change. In the pursuit of factors that place people at risk of developing schizophrenia, potentially preventing symptom onset, and mitigating the personal impact of schizophrenia symptoms, emotion processing may be an understudied, but valuable area of research. The link between emotion processing and schizophrenia is discussed further below. Its relationship to PLE symptoms is discussed in depth in Chapter 4.

1.3 What is emotion processing

The way we arrive at emotions, how they affect us, and how they are managed is determined by a set of interrelated processes (Koole, 2009). The application of these processes, that determine our experience of emotion, is commonly referred to as ‘Emotion Processing’. Whilst there has been considerable investment in emotion processing research in the last decade, these processes are still not fully understood. To refine the current
understanding of how aspects of emotion processing work, studies have conceptualised these
as how a person’s emotional response develops over time (Baumann, Kaschel, & Kuhl, 2007;
Davidson, Jackson, & Kalin, 2000; Gross, 1998b; Skinner & Zimmer-Gembeck, 2007). In
particular, studies tend to differentiate between a person’s primary emotional response
(emotion perception) and their secondary response (emotion regulation). This distinction has
been adopted due to the apparent functional differences between them.

In response to an emotionally salient stimulus, emotion perception serves to identify
the emotional significance of a stimulus and provide input for the generation of emotional
states and emotion regulation (Koole, 2009; M. L. Phillips, W. C. Drevets, S. L. Rauch, & R.
Lane, 2003b). Furthermore, emotion perception is thought to be largely automatic,
uncontrolled and unregulated. The generation/expression of affect states is also considered to
be part of emotion perception, but will be discussed separately in the following sections
better to articulate the relationship between emotion processing (including negative affect),
and psychosis. Emotion regulation (ER) is typically considered to be a controlled, deliberate
process that seeks to modify or override a person’s spontaneous emotion response (Koole,
2009). Understandably, the successful regulation of emotions is dependent on the initial
perception of an emotional stimulus (Füstös, Gramann, Herbert, & Pollatos, 2012).
Therefore, difficulty in identifying and expressing one’s emotions is thought to impede the
ability to regulate emotions (Gross, 1998b; Lane, Sechrest, Riedel, Shapiro, & Kaszniak,
2000; Taylor, Bagby, & Parker, 1997).

Not all ER strategies are adaptive (e.g. reappraisal; reframing how one thinks about an
event to be less negative or more positive), the excessive or dysfunctional use of some
strategies (e.g. expressive suppression; masking behaviour which expresses emotion) is
associated with individuals experiencing negative outcomes including negative affect
(Aldao, Nolen-Hoeksema, & Schweizer, 2010; Beevers & Meyer, 2004; Blalock & Joiner,
Negative affect refers to the experience of negative emotional states, for example, depression, anxiety, and distress. Studies have found that dysfunctional or maladaptive ER results in increased depression, anxiety and stress (Gross, 2002).

1.4 Neurobiological findings

In support of these psychological constructs, neurobiological studies have found structural and functional links in related brain networks. Aspects of emotion processing (specifically, emotion perception and affect) have been linked to activation in the amygdala, insula, ventral striatum, thalamus, anterior cingulate gyrus, and areas of the prefrontal cortex (M. L. Phillips & Young, 1997; Reiman et al., 1997; Shin et al., 2000). The use of ER strategies has been linked to activation in the prefrontal cortex (PFC), distal and subgenual anterior cingulate cortex (ACC), amygdala, insula, and hippocampus (Campbell-Sills et al., 2011; Goldin, McRae, Ramel, & Gross, 2008; Phan et al., 2005; Pitskel, Bolling, Kaiser, Crowley, & Pelphrey, 2011). Many of these areas of activation are similar in reappraisal and suppression, however, during reappraisal, activation of the PFC down-regulates the neural substrates in primary emotion processing areas (e.g. amygdala and insula), reducing the experience of negative emotion (Beauregard, Levesque, & Bourgouin, 2001; Goldin et al., 2008; Levesque et al., 2003; Ochsner, Bunge, Gross, & Gabrieli, 2002; Ochsner et al., 2004; Phan et al., 2005). In contrast, activation during suppression does not result in reductions of primary emotion processing areas (Goldin et al., 2008), and also increases sympathetic nervous system activity (Demaree et al., 2006; Gross & Levenson, 1993; Roberts, Levenson, & Gross, 2008). Whilst the brain areas involved in emotion processing and regulation appear largely to overlap, there is significant differentiation (M. L. Phillips et al., 2003b). There is evidence that the neural systems involved in emotion perception and affect (ventral system), ER (dorsal system for effortful ER) have a reciprocal functional relationship, suggesting that
deficits in functioning in a single emotion processing area may be associated with problems in other aspects of emotion processing (M. L. Phillips et al., 2003b). Several studies have found structural and functional abnormalities, in the neural areas required in emotion processing, in patients with schizophrenia (Hirsch & Weinberger, 2003; see Phillips, W. C. Drevets, S L. Rauch, & R. Lane, 2003a for review). These abnormalities have been associated with specific symptoms of schizophrenia, including hallucinations and persecutory delusions (M. L. Phillips et al., 2003a).

1.5 Emotion processing and negative affect

Several studies indicate that dysfunction in emotion perception/generation, and emotion regulation (ER), are related to negative affect (e.g. depression, anxiety). Research examining the relationship between negative affect and each of these aspects of emotion processing is described below.

1.5.1 Link between emotion perception and negative affect. The capacity to identify and express emotions (which are aspects of alexithymia) is an integral part of emotion perception. Previous research suggests that alexithymia is associated with anxiety (Karukivi et al., 2010), depression, decreased social functioning (Spitzer, Siebel-Jurges, Barnow, Grabe, & Freyberger, 2005; Vanheule, Desmet, Meganck, & Bogaerts, 2007), and reduced life satisfaction (Bamonti et al., 2010; Honkalampi, Hintikka, Tanskanen, Lehtonen, & Viinamaki, 2000; Mattila, Poutanen, Koivisto, Salokangas, & Joukamaa, 2007; Valkamo et al., 2001).
1.5.2 Link between emotion regulation (ER) and negative affect. Evidence suggests that some types of ER are associated with increased psychopathology, negative affect, and decreased quality of life (Berenbaum, Raghavan, Le, Vernon, & Gomez, 2003; Gross, 2002; Gross & John, 2003). For example, greater use of experiential suppression (suppression of thoughts/feelings) was associated with increases in depressive symptoms in college students (Beevers & Meyer, 2004; Wenzlaff & Luxton, 2003). Similar findings have been observed for studies of expressive suppression (inhibiting the expression of emotion; e.g. poker face), which suggest that individuals who predominantly use this regulation strategy are more susceptible to depression (Matheson & Anisman, 2003), have lower self-esteem, and are less satisfied with themselves and their relationships (Gross & John, 2003). Expressive suppression is also associated with greater levels of anxiety (Badcock et al., 2011) and decreased positive experiences (Kashdan & Breen, 2008). Furthermore, experimental and longitudinal studies of expressive and thought suppression suggest that maladaptive ER strategies result in increased negative affect (e.g. depression, anxiety, stress; Beevers & Meyer, 2004; Brans, Koval, Verduyn, Lim, & Kuppens, 2013; Gross, 2002). A meta-analytic review of ER research found that reappraisal was negatively associated with depression and marginally negatively associated with anxiety (Aldao et al., 2010).

Blalock and Joiner (2000) found that cognitive avoidance predicted increases in depression and anxiety symptoms over three weeks in college students, particularly in men. No significant effects were observed for behavioural avoidance. Finally, Holahan, Moos, Holahan, Brennan, and Schutte (2005) found that a combination of cognitive and behavioural avoidance predicted increases in depressive symptoms over 10 years in middle to older aged adults. This is important because it shows that dysfunctional emotional processing/regulation can have an enduring negative impact on mental health.
1.5.3 Link between emotion perception, regulation and negative affect. Despite the existing research on the relation between emotion perception, regulation, and negative affect, the exact nature of these relationships is still unclear. For example, it is possible that the relationship between perception and depression is moderated by ER. Specifically, difficulties in identifying and expressing one’s emotions (required for reappraisal) is thought to impede one’s ability to regulate emotions (Gross, 1998b; Taylor et al., 1997). In addition, it is possible that there is a feedback loop between negative affect and processing. For example, findings from Honkalampi, Hintikka, Laukkanen, Lehtonen, and Viinamaki (2001) suggest that depression increases alexithymic traits. There is, as yet, no consensus in the literature about these issues. Negative affect may also influence cognitive biases (such as negative self and interpersonal schemata and attentional biases; Foland-ross & Gotlib, 2012; Mogg & Bradley, 2005) and regulation (M. L. Phillips et al., 2003b).

In summary, dysfunctional emotion perception and regulation are associated with negative affect. This is highly pertinent for psychosis given that negative affect is prominently featured in individuals with the disorder. This points to the possibility that emotion processing difficulties may be an antecedent to the onset of psychosis, representing a vulnerability, and possibly a maintaining factor for psychosis.

1.6 Schizophrenia and emotion processing

Studies have shown a strong relationship between schizophrenia and negative affect, emotion perception, and ER.

1.6.1 Negative affect in schizophrenia. Studies have consistently found that people with schizophrenia have increased levels of depression, anxiety, and stress. Associations have also been shown between increased negative affect (depression, anxiety, stress) and psychotic
symptoms (Birchwood et al., 2000; Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001; Turnbull & Bebbington, 2001). Results from Smith et al. (2006) suggest that individuals who are more depressed, have lower self-esteem, and more negative self-beliefs, and tend to experience more frequent and intense auditory hallucinations with negative content. Furthermore, individuals who experience psychosis appear to experience negative emotions more frequently than healthy controls, irrespective of whether they are diagnosed with or without affective symptoms (Suslow, Roestel, Ohrmann, & Arolt, 2003).

The role of negative affect has also been cited as a key factor in the transition to psychosis. Large-scale studies focusing on negative affect well before symptom development have consistently shown that individuals with poor social adjustment (including greater social anxiety) in adolescence were significantly more likely to develop schizophrenia in later years (Jones, Murray, Jones, Rodgers, & Marmot, 1994; Kugelmass et al., 1995; Malmberg, Lewis, David, & Allebeck, 1998). An early study by Tien and Eaton (1992) also found that anxiety was associated with increased likelihood of positive symptoms a year later. In addition, studies of the prodrome phase of psychosis reveal that depression, anxiety and irritability precede symptom onset in 60-80% of cases (see reviews by Docherty, Van Kammen, Siris, & Marder, 1978; Yung & McGorry, 1996). Altogether, negative affect is often considered to be a key factor in the development and maintenance of symptoms, albeit it may not be sufficient as an initiating factor (Freeman & Garety, 2003).

1.6.2 Emotion perception in schizophrenia. Deficits in emotion perception have been found in studies of psychosis and schizophrenia. In particular, problems with emotional awareness, recognition, and expression have been associated with positive and negative symptoms of psychosis/schizophrenia in several studies (see Tremeau, 2006 for review). A study by Cedro, Kokoszka, Popiel, and Narkiewicz-Jodko (2001) found that outpatients with
schizophrenia reported greater difficulty in identifying their emotions (emotion perception), and exhibited a more externally oriented thinking style (suggesting less attention to their emotions), when compared to a control group. Serper and Berenbaum’s (2008) study suggests that emotional awareness is associated with delusions and hallucinations in psychosis. For the schizophrenia spectrum disorder group, lower levels of attention to emotion were associated with more severe hallucination ratings. In the other psychosis group (mood and substance abuse), higher levels of attention to emotion were related to higher ratings of delusion. Baslet et al. (2009) also found that schizophrenia-spectrum patients exhibited a less complex understanding of emotions in other people, when compared to a healthy control group (even after accounting for premorbid intelligence). Overall, this suggests that individuals with psychosis and schizophrenia have difficulties in emotion perception, particularly with recognising and understanding emotions in themselves and others.

1.6.3 Emotion regulation in schizophrenia. Deficits in ER have also been found in studies of psychosis and schizophrenia. Recent studies indicate that individuals with schizophrenia are less likely to use cognitive reappraisal and more likely to use expressive suppression than non-patient control groups (Livingstone, Harper, & Gillanders, 2009; van der Meer, van ’t Wout, & Aleman, 2009). However, this finding is not unanimous, with others not observing a significant difference in reappraisal and expressive suppression between schizophrenia patients and a healthy control group (Henry et al., 2008). Nevertheless, the latter authors did find that problems with up-regulating emotion expression were related to blunted affect. Badcock et al. (2011) reported that greater use of expressive suppression was related to increased severity of hallucinations in people with schizophrenia (who are currently experiencing hallucinations).
1.7 PLE and emotion processing

To date, there are limited studies exploring differences in emotion perception, emotion regulation (ER), and negative affect based on levels of psychosis-proneness. However, the studies so far suggest there may be a relationship. These findings will be examined by (i) negative affect, emotion perception/generation, and ER.

1.7.1 PLE and negative affect. A relationship appears to exist between PLE and negative affect. For example, studies by Fowler et al. (2006) and Martin and Penn (2001) suggest that sub-clinical symptoms (including hallucination experiences and paranoid ideation) are linked to feelings of anxiety. Furthermore, results from a study by Mackie, Castellanos-Ryan, and Conrod (2011) suggest that adolescents with persistent PLE have higher levels of depression and anxiety, when compared to individuals with no psychotic-like experiences. Similar studies have found a strong association between the presence (and number of) PLE and distress and depressive symptoms, in secondary and tertiary students (Armando et al., 2010; Yung et al., 2009).

1.7.2 PLE and emotion perception. Tentative evidence exists for a link between PLE and emotion perception changes. A review of emotion processing deficits in individuals ‘at risk’ for psychosis (often identified by genetic risk and PLE with distress) suggests there are deficits in emotion perception in these individuals, however that such impairments varied depending on the severity subtype of clinical symptoms, with positive symptoms being linked to greater perception problems than negative symptoms, e.g. positive or negative; (L. K. Phillips & Seidman, 2008). Research by van Rijn et al. (2011) suggests that individuals with PLE tend to have specific emotion perception and social functioning deficits, particularly in identifying and expressing emotions, as assessed using the Bermond-Vorst Alexithymia
Questionnaire (BVAQ), when compared to individuals without PLE. These emotion perception difficulties were still significant after accounting for IQ. These findings are similar to those seen in clinical populations. It is worth noting, however, that van Rijn et al. (2011) used a small, adolescent only, sample ($N = 57$) comprised of two groups (a no-PLE control group and an ‘ultra-high risk’ group) representing the extreme ends of the sub-clinical spectrum. Furthermore, using the BVAQ, a previous study by van ’t Wout, Aleman, Kessels, Larøi, and Kahn (2004) found individuals with high psychosis-proneness were more sensitive to emotional arousal, compared to low psychosis-prone individuals. Additional studies are required to confirm the reliability and generalizability of emotion perception changes in PLE.

1.7.3 PLE and emotion regulation (ER). There are mixed and hard-to-interpret findings regarding the relationship between ER and PLE. There appears to be a trend that ineffective ER is associated with PLE (Modinos, Ormel, & Aleman, 2010; Westermann, Kesting, & Lincoln, 2012; Westermann & Lincoln, 2011), however – unexpectedly - these findings are not present for maladaptive ER strategies (e.g. suppression Henry et al., 2009; Westermann et al., 2012). For example, a recent experimental study by Modinos et al. (2010) found that reappraisal in high PLE individuals required more activation in pre-frontal areas, and was less successful, compared to individuals with low PLE, pointing to poor ER. Westermann et al. (2012) expanded on these results, showing that, in stressful social situations, reappraisal predicted paranoia expression in individuals with high paranoia proneness. This is unexpected given reappraisal is generally an adaptive ER strategy (Aldao et al., 2010). One explanation is that successful reappraisal makes situations less stressful, however, in high PLE individuals (particularly with high distress), cognitive biases including (e.g. jumping to conclusions; Fine, Gardner, Craigie, & Gold, 2007; Lincoln, Lange, Burau, Exner, & Moritz, 2010), pre-existing delusional beliefs (Freeman, Garety, Kuipers, Fowler, &
Bebbington, 2002; Garety et al., 2001), negative interpersonal schemata (Lincoln, Mehl, Kesting, & Rief, 2011), and aberrant salience (a hyperdopaminergic state leading to the assignment of inappropriate importance and motivational significance to stimuli; Kapur, 2003) disrupt normal reappraisal, resulting in ineffective ER and greater distress (see Westermann et al., 2012). Overall, the mechanistic processes between ER and PLE maybe complex and are not well understood.

In contrast to (mixed) findings for reappraisal, no relationship has been observed between expressive suppression (generally considered a maladaptive strategy) and PLE (Henry et al., 2009; Westermann et al., 2012). Another study by Westermann and Lincoln (2011), using the CERQ, found difficulties in impulse control to be related to paranoia (persecutory delusions), however, this measure does not measure specific ER strategies.

Overall, it is difficult to synthesize the literature in this area because the studies vary considerably in symptom focus (e.g. Westerman, Kesting & Lincoln, 2012, measured paranoia only, rather than general PLE), and the nature of the study samples investigated (some particularly small N = 34, Modinos, 2010; as well as undergraduates; Modinos, 2010; Henry et al., 2009, rather than community samples; and the selection of participants presenting high-low extreme scores; Modinos, 2010, Henry, et al., 2009). Given the limited number of studies examining ER and PLE, with only a few types of ER strategies addressed, additional studies are required to explain the relationship between ER and PLE.

1.8 Summary of PLE and emotion processing literature

Overall, emotional processing deficits (emotion perception, regulation, and negative affect) are common features of psychosis. By contrast, evidence of the relationship between some aspects of emotion processing and PLE is more inconsistent. Specifically, there is a link between PLE and negative affect (depression, anxiety and stress), although limited evidence
exists for dysfunction in emotion perception and regulation. In addition, there are few systematic and rigorous studies of PLE. Furthermore, the findings are mixed and at times contradictory, pointing to the need for a re-examination of this topic.

According to models of emotion processing a relationship *should* exist between emotion perception, regulation and affect. On the basis of negative affect in PLE, one might expect emotion perception and regulation deficits. This type of information would be key in developing targeted interventions in social and cognition therapies. In addition, the finding of emotional regulation and emotion perception deficits in PLE would support the view that negative affect predates psychosis, and may be key to the transition to clinical status.

1.9 Aims of this thesis

The main objective of this thesis was to investigate the relationship between PLE in the general community, and emotion processing, using a set of questionnaires. The measures chosen had some preliminary validity and reliability and were frequently used in the emotion literature. However, some of the measures designed to assess aspects of emotion processing, specifically the Emotion Regulation Questionnaire (ERQ) and the Emotion Processing Scale (EPS), were not fully validated. Given that establishing the psychometric properties of an instrument is an important step in assessing the responsiveness of measurement instruments, this thesis began by assessing the psychometric properties of the ERQ and EPS. By validating the measures, I endeavoured to use the best tasks possible to examine the relationship between PLE and emotion processing.

In Chapter 2, the psychometric properties of the ERQ were examined, and in Chapter 3, the EPS. In Chapter 4, I examine emotional regulation and negative affect in PLE, and the relationship between emotional regulation and negative affect.
1.10 References


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1.11 Foreword to Chapters 2 and 3.

Before evaluating the presence of emotion processing difficulties in people with psychotic-like experiences (PLE), it was important to validate the emotion processing scales in this study that have not been extensively validated (the Emotion Regulation Questionnaire; ERQ, and the Emotion Processing Scale; EPS). Establishing the psychometric properties of measures is essential before we can have any confidence in inferences based on a scale’s scores (Nunnally, 1967). For this reason, Chapter 2 is dedicated to assessing the psychometric properties of the ERQ, whilst Chapter 3 focusses on the assessment of the EPS.
Chapter 2: The Emotion Regulation Questionnaire: validation of the ERQ-9 in two community samples

Abstract

The 10-item Emotion Regulation Questionnaire (ERQ) was developed by Gross and John (2003) to measure the habitual use of two emotion regulation strategies – reappraisal and suppression. Several studies using student samples have provided validation for the ERQ, although the only paper (Wiltink et al. 2011) that evaluated the ERQ in a community sample was unable to replicate the original factor structure. Before using the ERQ in non-student samples it is important to validate the scale in a sample broadly representative of the adult population and determine the influence of demographic variables. The current study examined the psychometric properties of the ERQ in two community samples (Australia, N = 550; United Kingdom, N = 483, aged 17-95) using confirmatory analysis. The original ERQ factor structure was not supported by either the Australian or UK samples. However, with the removal of one item, a strong model fit was obtained for both samples (9-item ERQ). Using measurement invariance tests, the revised 9-item ERQ was found to be equivalent across the samples and demographics (age, gender, education). Gender, depression, anxiety and stress (DASS) were the only factors which were significantly associated with reappraisal and suppression use. Overall, the ERQ-9 provides better fit of the data than the ERQ-10. The utility of this measure is enhanced by the provision of normative data for males and females.

Keywords: Emotion Regulation, Questionnaire, Processing, Validation, Psychometric Properties

Emotion regulation is a key mechanism for our survival, and is at the core of successful social interactions. Emotion regulation is a controlled process that is used to change a person’s spontaneous emotional response (Koole, 2009). Indeed, it is required to attain desired affective states and intentional goals (Gross, 2002). Dysfunctional cognitive emotion regulation is linked to increased psychopathology and negative affect (Aldao et al., 2010; Beevers & Meyer, 2004; Matheson & Anisman, 2003; Wenzlaff & Luxton, 2003), decreased quality of life and well-being (Gross & John, 2003), impaired memory (Nielson & Lorber, 2009; Richards & Gross, 2000), and increased sympathetic nervous system activity (Demaree et al., 2006; Gross, 1998a).

There are several ways people may modulate their emotions, commonly referred to as emotion regulation strategies (Gross & John, 2003). Contemporary models propose that, at the broadest level, emotion regulation strategies are distinguished by whether they are ‘antecedent’ or ‘response-focused’ (Gross & John, 2003), referring to when these cognitive events occur along the timeline of information processing. The use of antecedent and response-focussed strategies are considered to differ in their consequences to health and well-being (Gross, 1998a). To examine these differences, studies commonly compare two types of emotion regulation strategies, cognitive reappraisal (antecedent) and expressive suppression (response-focussed) (Gross & John, 2003).

The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) was originally designed to measure the habitual use of reappraisal and suppression strategies. It is now a widely accepted and commonly used measure of emotion regulation. ERQ studies have
consistently found that habitual suppression is associated with increased depression, anxiety, and stress symptoms (negative affect), while habitual reappraisal is associated with greater positive emotion and less negative emotion (Gross & John, 2003; Joormann & Gotlib, 2010; Moore, Zoellner, & Mollenholt, 2008; Wiltink et al., 2011). Compared to the use of suppression, reappraisal is also associated with better interpersonal functioning, positive well-being (Gross & John, 2003), better social adjustment and decision making (Heilman, Crisan, & Houser, 2010; Magar, Phillips, & Hosie, 2008). The ERQ is therefore useful in identifying groups vulnerable to negative physical and psychological outcomes, as well as factors with an important influence on emotional wellbeing.

When Gross and John (2003) first developed the 10-item ERQ scale, a principal-components analysis (PCA) on the scores of 1483 students (across four samples) revealed a 2-factor solution. Together, the two factors (represented by reappraisal and suppression) accounted for over 50% of the variance in all four samples. Further studies in student samples have replicated this 2-factor solution using exploratory (Chen, 2010; D'Argembeau & Van der Linden, 2006) and confirmatory factor analyses (Balzarotti, Gross, & John, 2010; Matsumoto, Yoo, Nakagawa, & Altarriba, 2008; Melka, Lancaster, Bryant, & Rodriguez, 2011). Few studies, however, have examined the psychometric properties of the ERQ outside student samples. Two exceptions include Moore et al. (2008), who, in addition to a student sample ($N = 289$) recruited a small ($N = 67$) all-female, trauma-exposed group and Wiltink et al. (2011) who tested a German sample using a German translation of the ERQ (Abler & Kessler, 2009) ($N = 2524$, 55.5% female).

Moore et al. (2008) found an overall good fit using the original ERQ factor structure when combining their student and community samples. Their results however, may have been heavily skewed by the inclusion of both a student sample ($N = 289$), and a clinical group, in the analysis. In contrast, Wiltink et al. (2011) failed to replicate the original ERQ factor
structure. Instead, they proposed a modification of the scale in which item 8 (I control my emotions by changing the way I think about the situation I’m in) was allowed to load onto both reappraisal and suppression factors equally, and was freed from equality constraint with other item factor loadings. This raises the question whether this deviation in factor structure stems from cultural differences, the use of a German translation of the original scale, or demographic differences between student and community samples (e.g. age, education). These questions are important, because the ERQ is increasingly used in research with non-undergraduate samples (Henry et al., 2008; Perry, Henry, & Grisham, 2011), when it has not yet been validated for such use. Establishing the psychometric properties of an instrument is an important step in assessing the responsiveness of measurement instruments, particularly for measures that are frequently used.

The primary objectives of the current study were to test the original two factor structure fit of the ERQ (Gross & John, 2003) on two large community samples (Australian and United Kingdom), and to determine the influence of demographic variables. The focus was on variables which are generally homogeneous in student samples – age and education, as well as other variables such as gender, depression, anxiety and stress.

There are mixed findings in the literature about the relationship between emotion regulation strategies and demographic variables. With regard to age, some studies show a link between ageing and a decrease in negative emotions and an increase in positive emotions (Gross et al., 1997; Helson & Klohn, 1998). According to some theories (including the Socioemotional Selectivity Theory, SST; Charles & Carstensen, 2007), this may be due to the increased use of antecedent strategy in older adults, specifically selective attention, situation selection and situation modification to modulate emotion. In conjunction with this theory, Gross (1998b) suggests this increased use of antecedent strategies also includes cognitive reappraisal. This is consistent with results from Folkman, Lazarus, Pimley & Novacek’s
(1987) study, which found that older participants reported greater positive reappraisal and distancing, and less confrontational coping, compared to younger participants. These results, however, stand in contrast to Wiltink et al.’s (2011) German study, in which age was not a significant predictor of reappraisal or suppression use, after controlling for other demographic and clinical variables (e.g. gender, depression, and anxiety).

There is limited research into how education is related to emotion regulation strategy use. Wiltink et al. (2011) found that individuals with a tertiary degree reported lower suppression scores (but not reappraisal) compared to those without. In contrast, Moore et al. (2008) did not find any relationship between education and reappraisal or suppression. However Moore et al.’s sample was largely homogenous with respect to education, possibly explaining the lack of significant association. Further research using an independent community sample is needed to clarify this relationship.

The association between the 10-item ERQ, gender differences, and clinical symptoms has been examined previously. Studies show that males report a greater use of expressive suppression compared to females (Balzarotti et al., 2010; Chen, 2010; Gross & John, 2003; Melka et al., 2011; Wiltink et al., 2011). For reappraisal, no gender differences have been observed in any ERQ validation studies, with the exception of Chen (2010), who found that female students use reappraisal more often than males.

As mentioned above, with regards to psychological symptoms, individuals who habitually use reappraisal tend to have lower levels of depression and anxiety (with greater positive functioning e.g. life satisfaction), whereas individuals who habitually use suppression show the reverse pattern with decreased positive functioning (Gross & John, 2003; Wiltink et al., 2011).

In summary, this study a) examined the psychometric properties of the ERQ in two separate community samples (Australia, N = 550; United Kingdom, N = 483, age 17-95), b)
conducted invariance tests by demographic variables, and c) examined the relationships between the ERQ scales, demographics and clinical variables. We hypothesised that habitual reappraisal would be associated with reduced psychological symptoms, and be more prevalent in older individuals. In contrast, we predicted that suppression would be associated with increased psychological symptoms, and show greater prevalence in males, younger, and less (formally) educated individuals.

2.1 Method

2.1.1 Participants

Participants were drawn from Australian (AUS) and United Kingdom (UK) community samples (aged 17-95). Sample characteristics are presented in Table 1. Questionnaires were distributed via broad community advertising which asked for volunteers to take part in an “Emotions across the Lifespan” study. Volunteers were given the choice to complete the questionnaires online, or on hardcopy mailed out with a reply-paid envelope. This approach was considered acceptable due to evidence that online and printed versions of questionnaires give similar results (Ritter, Lorig, Laurent, & Matthews, 2004). Participation was voluntary and completion of the questionnaires was taken to indicate consent. This project was granted approval from the UWA Human Research Ethics Committee (Project No RA/4/3/1247) and from the University of Southampton School of Psychology-Research Ethics Committee (Project No ST/03/90).

Table 1.

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<thead>
<tr>
<th>Items</th>
<th>AUS</th>
<th>UK</th>
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40
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<th>M</th>
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<td>Gender (N, %)</td>
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<td>M: 183, 34.3%</td>
<td>F: 380, 79.8%</td>
<td>M: 96, 20.2%</td>
<td>F: 731, 72.4%</td>
<td>M: 279, 27.6%</td>
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<td>20.7</td>
<td>18 - 91</td>
<td>39.1</td>
<td>20.5</td>
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<td>Education (years)</td>
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<td>4 - 27.2</td>
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<td>3.1</td>
<td>6 - 25</td>
<td>14.2</td>
<td>3.2</td>
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<td>8.7</td>
<td>0 – 40</td>
<td>8.7</td>
<td>9.0</td>
<td>0 – 42</td>
<td>8.8</td>
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<td>7.6</td>
<td>0 – 42</td>
<td>6.1</td>
<td>7.4</td>
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<td>7.5</td>
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<td>DASS - Stress</td>
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<td>Western</td>
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<tr>
<td>Other</td>
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<td>(29.8%)</td>
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<td>(1.0%)</td>
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41
Note. DASS (Lovibond & Lovibond, 1995)

2.1.2 Materials

The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is a 10-item, self-report measure of habitual expressive suppression (4 items) and reappraisal (6 items). The ERQ uses a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Example questions include “I control my emotions by changing the way I think about the situation I’m in” (reappraisal) and “I control my emotions by not expressing them” (suppression). Internal consistency has been adequate and consistent across studies (Balzarotti et al., 2010; Gross & John, 2003; Melka et al., 2011; Wiltink et al., 2011).

The Depression, Anxiety and Stress Scale 21 (DASS-21) is a shortened version of Lovibond and Lovibond’s (1995) 42-item self-report measure of depression, anxiety, and stress (DASS). Previous studies have found the DASS-21 yields satisfactory reliability estimates (Antony, Bieling, Cox, Enns, & Swinson, 1998; Clara, Cox, & Enns, 2001; Henry & Crawford, 2005).

2.1.3 Data analysis plan

AMOS 20 (Arbuckle, 2011) was used to conduct the CFA. The current study’s multivariate critical ratio (22.97), which calculates overall non-normality across all items, exceeded Bentler’s (2005) recommended critical value of 5, suggesting that the data were not normally distributed. To address this issue, asymptotic distribution free (ADF) estimation was adopted for single group CFAs. The ERQ’s factor structure was examined using chi-square, the Standardised Root Mean-square Residual (SRMR; Jöreskog & Sörbom, 1993) the comparative fit index (CFI; Bentler, 1990), Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), and root mean square error of approximation (RMSEA; Steiger & Lind, 1980). Chi-
square non-significance, SRMR values below .08, TLI and CFA values above .95 and RMSEA values below .06 are recommended (Hu & Bentler, 1999). In addition, modification indices (M.I) and parameter estimates were examined as they provide more specific information about model misfit than the standard measure of overall goodness of fit (Brown, 2006). As recommended by Jöreskog and Sörbom (1993), we examined the items with the highest M.I and, if there was a theoretical, conceptual or practical reason for doing so, we removed that item (see Brown, 2006).

For demographic invariance testing, calculations of effects size were used instead of measures of statistical significance. This was chosen because when dealing with such large sample sizes (1000+), the chance of finding non-equivalence even when there is equivalence (Type-I error), is almost a certainty when using statistical significance tests. In these circumstances of extreme statistical power, it is more appropriate to assess the practical significance (effect size) of the non-equivalence tests. The calculations of effect size (by item) were generated by Mean and Covariance Structure Analysis (MACS) using a program (dMACS) freely available online - see Nye and Drasgow (2011). Measurement invariance (by statistical significance) was assumed if the change in CFI (ΔCFI < .002) was below the cut-off (Meade, Johnson, & Braddy, 2008). Effect size was compared to Cohen’s (1988) guidelines (.20 = small, .50 = medium, .80 = large). For analyses of the relationship between ERQ subscales and gender, a multiple analysis of variance (MANOVA) was used. Correlation analysis was used to examine the relationships between demographic variables (age and education), clinical variables (depression, anxiety and stress) and the ERQ subscales. Missing data by variable ranged from .2 to 3.7%. Little's MCAR revealed that the data were missing completely at random, $\chi^2(346, N = 1033) = 379.19, p = .106$. Missing data were handled using pair-wise deletion.
2.2 Results

2.2.1 Factor Structure

Results of the AUS and UK single-group CFAs suggested barely adequate fit (see Table 2). A significant chi-square, coupled with \( \chi^2/df \), TLI and CFI statistics beyond the recommended cut-off values, suggests that the original two factor structure of the ERQ was not an adequate representation of the response behaviour observed either in the Australian or the United Kingdom community samples.

The M.I revealed high covariance between Items 1 and 3 in both samples (AUS: M.I = 19.294, Parameter Change = .374; UK: M.I = 9.272, Parameter Change = .225). Arguably, both items tap very similar aspects of reappraisal. They both refer to changing one’s thoughts to increase positive (Item 1 – When I want to feel more positive emotion (such as joy or amusement), I change what I’m thinking about) or decrease negative (Item 3 – When I want to feel less negative emotion (such as sadness or anger), I change what I’m thinking about) emotion experience. Item 3 was dropped due to a lower factor loading, and the finding that negatively worded items can introduce method effects (DiStefano & Motl, 2006). Computation after removing Item 3 (revised 9-item ERQ) produced strong model fit for both the Australian and United Kingdom samples. All indicator values were within the acceptable range, with the exception of the chi-square statistic. However, the chi-square statistic is known to be inflated by large samples and skewed distributions, increasing the possibility of rejecting an otherwise good fitting model. Based on all other fit statistics, the revised 9-item ERQ measure is a strong model for both samples.

Table 2.
Single group CFA – Australian and United Kingdom samples

<table>
<thead>
<tr>
<th>Model</th>
<th>Df</th>
<th>( \chi^2 )</th>
<th>Sig.</th>
<th>( \chi^2/df )</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>LO 90</th>
<th>HI 90</th>
</tr>
</thead>
</table>

44
<table>
<thead>
<tr>
<th>Model</th>
<th>Df</th>
<th>$\chi^2$</th>
<th>Sig.</th>
<th>$\chi^2$/df</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>LO 90</th>
<th>HI 90</th>
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<tbody>
<tr>
<td><strong>Single group solutions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (10-item)</td>
<td>34</td>
<td>79.396</td>
<td>&lt;.001*</td>
<td>2.335</td>
<td>.060</td>
<td>.890</td>
<td>.917</td>
<td>.049</td>
<td>.035</td>
<td>.064</td>
</tr>
<tr>
<td>United Kingdom (10-item)</td>
<td>34</td>
<td>75.023</td>
<td>&lt;.001*</td>
<td>2.207</td>
<td>.062</td>
<td>.850</td>
<td>.887</td>
<td>.050</td>
<td>.035</td>
<td>.065</td>
</tr>
<tr>
<td>Australia (9-item)</td>
<td>26</td>
<td>52.152</td>
<td>.213</td>
<td>1.208</td>
<td>.033</td>
<td>.984</td>
<td>.989</td>
<td>.019</td>
<td>0</td>
<td>.041</td>
</tr>
<tr>
<td>United Kingdom (9-item)</td>
<td>26</td>
<td>41.712</td>
<td>.026*</td>
<td>1.604</td>
<td>.048</td>
<td>.936</td>
<td>.954</td>
<td>.035</td>
<td>.012</td>
<td>.055</td>
</tr>
</tbody>
</table>

**Note.** SRMR = standardised root mean-square residual, RMSEA = root mean square error of approximation, CFI = comparative fit index, TLI = Tucker-Lewis Index, LO 90 and HI 90 = lower and upper boundary of 90% confidence interval for RMSEA. Asympotically distribution-free estimation (ADF) was used.

Coefficients for reappraisal, before (AUS: Cronbach’s $\alpha = .79$, UK: $\alpha = .82$) and after (AUS: Cronbach’s $\alpha = .76$, UK: $\alpha = .80$) Item-3 removal, and suppression (AUS: $\alpha = .78$, UK: $\alpha = .74$) indicate adequate internal consistency of test scores for both subscales.

2.2.2 Between Samples Invariance Testing

Measurement invariance (MI) analysis examines the extent to which a scale measures the same construct/s across groups. The 9-item ERQ was found to be equivalent across the AUS and UK samples when the factor loadings, mean and intercepts were constrained (metric and scalar invariance). Results are presented in Table 3. As strong, between-group invariance was established between the samples, it was considered viable to combine the samples for subsequent analyses.

Table 3.

*Multi-group analysis (9-item) - invariance test between Australian and United Kingdom community samples.*
In summary, data from our AUS and UK community samples did not adequately fit the original 10-item, two-factor structure, ERQ (Gross & John, 2003). However, a revised, 9-item ERQ was a good fit for both samples. These findings raise the question, why do the current community samples differ from the many student samples previously used successfully to validate the original 10-item ERQ? One hypothesis is that variations in demographic variables (e.g. age, education and gender) between student and community samples influence the model.

2.2.3 Demographic Invariance Testing

To examine the effect of demographics on the ERQ-9 model fit, age and education were divided into two groups (both by median split). Age was divided into younger (17 – 29

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1In response to a reviewer’s comments regarding median-split analyses, we re-analysed the demographic invariance tests for age and education, increasing the number of groups (Age – quintile split – groups: 17 – 20, 21 – 25, 26 – 41, 42 – 61, 62 – 95 years; Education - high school (Years 4 – 12), undergraduate/tertiary (Years
and older (30 – 95 years) age groups: Education into lower (4 – 13.5) and higher (14 – 27.2) years of education. Separate invariance tests were conducted comparing age, education and gender (see Table 4). For all invariance tests, all indices of fit exceeded critical values (statistically significant). All measures of effect size (by item) for age (.09 - .49), education (.06 - .39) and gender (.05 - .38) were small to medium, however the factor-level effect size due to differential item functioning (DIF) for demographics (.04 to .17) was relatively small. Given the general purpose of the ERQ as a research tool, this level of invariance is considered acceptable. Therefore, the demographic variables are considered to have equivalence on the ERQ, allowing for subsequent analysis.

Table 4.

Multi-group analysis (9-item ERQ) - invariance test for Age, Education and Gender with the combined Australian and United Kingdom community sample.

<table>
<thead>
<tr>
<th>Model</th>
<th>df</th>
<th>( \chi^2 )</th>
<th>Sig.</th>
<th>( \chi^2/df )</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA 90% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unconstrained</td>
<td>52</td>
<td>121.913</td>
<td>&lt;.001*</td>
<td>2.344</td>
<td>.032</td>
<td>.965</td>
<td>.975</td>
<td>.036 - .028</td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>59</td>
<td>133.145</td>
<td>&lt;.001*</td>
<td>2.257</td>
<td>.037</td>
<td>.968</td>
<td>.973</td>
<td>.035 - .027</td>
</tr>
<tr>
<td>Equal means/intercepts</td>
<td>68</td>
<td>157.736</td>
<td>&lt;.001*</td>
<td>2.320</td>
<td>.036</td>
<td>.966</td>
<td>.968</td>
<td>.036 - .029</td>
</tr>
<tr>
<td>Equal covariance</td>
<td>71</td>
<td>160.223</td>
<td>&lt;.001*</td>
<td>2.257</td>
<td>.040</td>
<td>.968</td>
<td>.968</td>
<td>.035 - .028</td>
</tr>
<tr>
<td>Equal Error</td>
<td>80</td>
<td>174.617</td>
<td>&lt;.001*</td>
<td>2.183</td>
<td>.039</td>
<td>.970</td>
<td>.966</td>
<td>.034 - .027</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unconstrained</td>
<td>52</td>
<td>122.978</td>
<td>&lt;.001*</td>
<td>2.365</td>
<td>.038</td>
<td>.965</td>
<td>.974</td>
<td>.037 - .029</td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>59</td>
<td>139.7314</td>
<td>&lt;.001*</td>
<td>2.361</td>
<td>.042</td>
<td>.965</td>
<td>.971</td>
<td>.037 - .029</td>
</tr>
<tr>
<td>Equal</td>
<td>68</td>
<td>168.728</td>
<td>&lt;.001*</td>
<td>2.481</td>
<td>.042</td>
<td>.962</td>
<td>.964</td>
<td>.038 - .031</td>
</tr>
</tbody>
</table>

12.5 – 16), and postgraduate (Years 16.5 – 27.25). Findings were comparable to the median-split findings. Details of these additional analyses are available upon request.
### Table 5

<table>
<thead>
<tr>
<th>Model</th>
<th>df</th>
<th>$\chi^2$</th>
<th>Sig.</th>
<th>$\chi^2$/df</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>LO 90</th>
<th>HI 90</th>
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<tbody>
<tr>
<td>means/intercepts</td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td>Equal covariance</td>
<td>71</td>
<td>182.901</td>
<td>&lt;.001*</td>
<td>2.576</td>
<td>.049</td>
<td>.959</td>
<td>.960</td>
<td>.040</td>
<td>.033</td>
<td>.047</td>
</tr>
<tr>
<td>Equal Error</td>
<td>80</td>
<td>210.497</td>
<td>&lt;.001*</td>
<td>2.631</td>
<td>.044</td>
<td>.958</td>
<td>.953</td>
<td>.040</td>
<td>.034</td>
<td>.047</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unconstrained</td>
<td>52</td>
<td>121.109</td>
<td>&lt;.001*</td>
<td>2.329</td>
<td>.049</td>
<td>.965</td>
<td>.974</td>
<td>.036</td>
<td>.028</td>
<td>.045</td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>59</td>
<td>130.884</td>
<td>&lt;.001*</td>
<td>2.218</td>
<td>.053</td>
<td>.968</td>
<td>.973</td>
<td>.035</td>
<td>.027</td>
<td>.043</td>
</tr>
<tr>
<td>Equal means/intercepts</td>
<td>68</td>
<td>165.679</td>
<td>&lt;.001*</td>
<td>2.436</td>
<td>.053</td>
<td>.962</td>
<td>.964</td>
<td>.038</td>
<td>.030</td>
<td>.045</td>
</tr>
<tr>
<td>Equal covariance</td>
<td>71</td>
<td>169.908</td>
<td>&lt;.001*</td>
<td>2.393</td>
<td>.058</td>
<td>.963</td>
<td>.963</td>
<td>.037</td>
<td>.030</td>
<td>.044</td>
</tr>
<tr>
<td>Equal Error</td>
<td>80</td>
<td>201.935</td>
<td>&lt;.001*</td>
<td>2.524</td>
<td>.057</td>
<td>.959</td>
<td>.955</td>
<td>.039</td>
<td>.032</td>
<td>.046</td>
</tr>
</tbody>
</table>

**Note.** SRMR = standardised root mean-square residual, RMSEA = root mean square error of approximation, CFI = comparative fit index, TLI = Tucker-Lewis Index, LO 90 and HI 90 = lower and upper boundary of 90% confidence interval for RMSEA. Maximum Likelihood (ML) estimation was used. Maximum Likelihood (ML) estimation was used because it is a more thorough method to examine the extent of invariance (compared to asymptotic distribution free - ADF).

### 2.2.4 The 9-item ERQ, Demographics, and Negative Affect

Spearman’s Rho correlations were conducted to analyse the relationships between age, education, the ERQ scales, and negative affect (see Table 5). Age was not significantly associated with either ERQ scale. However, there was a weak, negative correlation between age and all measures of negative affect. A very weak, negative association was observed between education and suppression. In contrast, education was not related to measures of negative affect. Very weak, negative relationships were observed between reappraisal and depression, anxiety and stress. In contrast, very small to small positive relationships were observed between suppression and all measures of negative affect.
Table 5.
Correlations between ERQ, Demographics, and Negative Affect – Combined Sample

<table>
<thead>
<tr>
<th>Measure</th>
<th>Education</th>
<th>Reappraisal (5-item)</th>
<th>Reappraisal</th>
<th>Suppression</th>
<th>Depression</th>
<th>Anxiety</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-.149**</td>
<td>.054</td>
<td>.043</td>
<td>-.014</td>
<td>-.223**</td>
<td>-.260**</td>
<td>-.241**</td>
</tr>
<tr>
<td>Education</td>
<td>-</td>
<td>.023</td>
<td>.021</td>
<td>-.109**</td>
<td>-.061</td>
<td>-.053</td>
<td>.022</td>
</tr>
<tr>
<td>Reappraisal (5-item)</td>
<td>-</td>
<td>.973**</td>
<td>-.098**</td>
<td>-.136**</td>
<td>-.087**</td>
<td>-.086**</td>
<td></td>
</tr>
<tr>
<td>Reappraisal</td>
<td>-</td>
<td>-.091**</td>
<td>-.126**</td>
<td>-.069*</td>
<td>.065*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suppression</td>
<td>-</td>
<td>.256**</td>
<td>.157**</td>
<td>.118**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>-</td>
<td>.538**</td>
<td>.611**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>-</td>
<td></td>
<td>.617**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * p < .05** p < .01 (2-tailed). Spearman’s rho correlation coefficient. Education = total years of education; Depression, Anxiety and Stress - DASS (21 item) short version (Lovibond & Lovibond, 1995); Reappraisal (5 items) and Suppression (4 items) - ERQ (9 – item) (Gross & John, 2003).

A MANOVA was conducted using reappraisal and suppression as dependent variables, and gender as the independent variable. A significant omnibus effect was observed for gender, $F (2, 1007) = 10.00, p < .001$, partial $\eta^2 = .02$. Inspection of the univariate tests by gender revealed a significant effect for reappraisal, $F (1, 1008) = 4.534, p < .05$, partial $\eta^2 < .01$ and suppression, $F (1, 1008) = 16.50, p < .001$, partial $\eta^2 = .02$. Males ($M = 14.2, SD = 5.1$) reported using expressive suppression more than females ($M = 12.7, SD = 5.0$). Conversely, females ($M = 25.0, SD = 5.2$) reported higher reappraisal scores than males ($M = 24.3, SD = 5.6$).

Population based norms for the 9-item ERQ are provided in Table 6. Norms were calculated using percentiles (cumulative percentages), and presented separately for gender because it was the only demographic variable significantly associated with both ERQ scales.
Table 6.

*Population based norms of the 9-item ERQ by Gender (N = 1010) from Australian and United Kingdom samples.*

<table>
<thead>
<tr>
<th>Score</th>
<th>Reappraisal (cumulative %)</th>
<th>Suppression (cumulative %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
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<tr>
<td>5</td>
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<td>7</td>
<td>0.7</td>
<td>14.6</td>
</tr>
<tr>
<td>8</td>
<td>21.3</td>
<td>15.8</td>
</tr>
<tr>
<td>9</td>
<td>0.8</td>
<td>1.1</td>
</tr>
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<td>10</td>
<td>1.1</td>
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<td>11</td>
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<td>9.0</td>
</tr>
<tr>
<td>17</td>
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<td>10.4</td>
</tr>
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<td>18</td>
<td>10.3</td>
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<td>15.1</td>
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<tr>
<td>20</td>
<td>17.4</td>
<td>22.2</td>
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50
<p>| | | | | |</p>
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<th></th>
<th></th>
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<tbody>
<tr>
<td>21</td>
<td>21.2</td>
<td>29.0</td>
<td>94.9</td>
<td>94.3</td>
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<td>22</td>
<td>26.7</td>
<td>34.8</td>
<td>96.7</td>
<td>95.7</td>
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<td>38.4</td>
<td>97.5</td>
<td>97.1</td>
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<td>41.7</td>
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<td>98.9</td>
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<td>26</td>
<td>59.8</td>
<td>65.2</td>
<td>99.3</td>
<td>100</td>
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<td>66.6</td>
<td>73.8</td>
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<td>93.5</td>
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<tr>
<td>34</td>
<td>97.5</td>
<td>98.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>100</td>
<td>100</td>
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</tr>
</tbody>
</table>
2.3 Discussion

2.3.1 CFA properties

The present study presents, for the first time, an examination of the psychometric properties of the original 10-item ERQ in samples broadly representative of the adult community population. Another strength of our study included independent validation of the ERQ in two English-speaking community samples (AUS and UK). The results showed that the original model obtained by Gross and John (2003) did not present an adequate fit for either community sample. The inadequate model fit may be due to minor problems with the original factor structure. Given the high covariance between Items 1 and 3 in both AUS and UK samples, one (Item 3) was removed as there appeared to be redundancy. This produced a substantial improvement in model fit, resulting in a revised 9-item ERQ.

It is noteworthy that the other community study using a German translation of the scale (Wiltink et al., 2011) also reported inadequate model fit compared to Abler & Kessler’s (2009) student study. In contrast to the current findings, however, the revised ERQ factor solution by Wiltink et al. (2011) involved modifications to Item 8, requiring it to cross-load equally on the reappraisal and suppression factors, where cross-loading is not to be recommended (Brown, 2006).

To validate the revised 9-item model, an invariance test comparing both AUS and UK samples was conducted. Findings suggest the revised 9-item model is valid and equivalent across countries. Matsumoto et al. (2008) reported a 23 country-level CFA analysis and also found equivalence. Whilst ethnically diverse, the current samples were insufficient in size (by ethnicity groups) for invariance testing to be conducted. However, Melka et al. (2011) examined invariance by ethnicity in a US sample and showed equivalence. Given the failure to find either country-level differences in both this study and Matsumoto et al. (2008), and
the evidence of a lack of ethnicity differences in Melka et al. (2011), this suggests to us that Wiltink et al.’s (2011) German study may have suffered from translation effects.

To further examine the external validity of the 9-item ERQ, we explored whether differences in demographics could be responsible for influencing model fit. Item-level measures of effect size for non-equivalence for all items by age, education and gender were small to medium, but at the scale-level the influence of DIF was small. That is, the effect of this non-equivalence was minimal. Thus, the 9-item ERQ was considered to be stable across age, education and gender. This allowed us to explore whether age, education and gender differences were present in reappraisal and suppression assessed with the 9-item ERQ.

2.3.2 Age differences

Contrary to expectation, no significant age differences were observed for reappraisal or suppression strategy use. This stands in contrast to the literature that suggests that older people shift towards using more antecedent strategies (including reappraisal) than their younger counterparts (Charles & Carstensen, 2007; Folkman, Lazarus, Pimley, & Novacek, 1987; Gross et al., 1997). Differences between studies may be due to differences in methodologies, sample characteristics, or methods of analysis. For example, the differences between the current study and that of Folkman et al. (1987) could be due to a different measure of reappraisal (a 1-item measure in Folkman et al.’s study) or sample characteristics (only married couples of middle to older age). The current results, however, are consistent with Wiltink et al. (2011) who also found no age differences.

2.3.3 Education differences

Similarly to age, and again not as predicted, there were no differences in reappraisal and suppression use based on level of education. These findings are consistent with Moore et
al. (2008), in a student sample using the ERQ-10 but divergent from Wiltink et al.’s (2011) community study which indicated that people with a college/university (tertiary) degree reported lower suppression scores (but not reappraisal) compared to those without. Again, translation effects may account for this.

2.3.4 Gender differences

Males reported greater use of suppression compared to females: a finding consistent with previous studies (Balzarotti et al., 2010; Gross & John, 2003; Matsumoto et al., 2008; Melka et al., 2011; Wiltink et al., 2011). The current study also found that women reported higher reappraisal scores compared to males. This finding is in contrast to most previous ERQ studies – which failed to find gender effects in reappraisal (only Chen, 2010 found higher reappraisal in females). Population norms using our community sample were thus created for the 9-item ERQ based on gender alone (Table 6), as no other demographics were related to ERQ scale scores. It is important to note that until these findings are replicated in other countries (e.g. US samples), these norms may only be suitable for Australian and United Kingdom samples.

2.3.5 Negative affect

Depression, anxiety and stress were all positively associated with suppression. This finding is consistent with previous community (Wiltink et al., 2011) and student (Abler & Kessler, 2009; Gross & John, 2003) studies, and other studies using comparable constructs (emotional containment) (e.g. Matheson & Anisman, 2003). For reappraisal, there was a significant negative association with all measures of negative affect. This finding underscores that of Wiltink et al. (2011), who found a negative association between reappraisal and negative affect (depression and anxiety). It also shadows previous research showing a link
between suppression and negative affect, and reappraisal with greater positive affect (Gross & John, 2003; Wiltink et al., 2011).

In summary, the original 10-item ERQ did not provide good fit for Australian and United Kingdom community samples, which suggests that the scale is not ideal in its original form. However, the minor modification of removing one item produced a significant improvement and strong model fit. This revised 9-item ERQ was equivalent across countries (Australia and UK), across age, education and gender, suggesting that the revised measure is preferable when measuring reappraisal and suppression in community samples. Exploration of ethnicity effects is warranted, as is establishing test-retest reliability, predictive and concurrent validity of the ERQ-9.
2.4 References


2.5 Acknowledgements

We thank Mark A. Griffin and Patrick D. Dunlop for statistical analysis guidance.
Chapter 3: Assessment of emotion processing: Analysing the psychometric properties of the EPS-25

Abstract

Objective: The Emotion Processing Scale (EPS-25) was developed by Baker et al. (2010) to identify difficulties in the processing of emotions. It is currently being used as a clinical and research tool, yet no known studies to date have independently evaluated its psychometric properties since its publication. The aim of this study was to examine the psychometric properties of the EPS-25. Methods: The EPS-25 was assessed across two community samples (Australia, N = 575; United Kingdom, N = 597, age 17-95) using confirmatory factor analysis (CFA). Results: The original EPS factor structure was not supported either in the Australian or United Kingdom samples, based on overall model fit indices. Efforts to refine the scale by removing problematic items by analysing localised misfit, while retaining the original essence of the 5-factor model, were not viable due to widespread significant standardised residual covariances. A re-specification of an optimal measurement model was then attempted using an exploratory factor analysis (EFA) on the UK sample, resulting in a 22-item, two factor EPS. However, this revised model was also not supported in either sample when tested using CFA. Conclusion: In summary, acceptable levels of model fit could not be found for either the original 5-factor model by Baker et al. (2010), or the EFA model optimised for the current samples. It is suggested that the EPS-25, in its current form, is not suitable for use in healthy (i.e. non-clinical) individuals until further scale refinement or redevelopment with subsequent validation is achieved.

Keywords: Emotion Processing, Scale, Psychometric Properties.

Emotions refer to the complex set of physiological, cognitive and behavioural reactions that occur in response to the appraisal of a situation with personal significance. Required for functional and adaptive social interactions, emotions are a key mechanism for our survival. Briefly, the term ‘emotion processing’ refers to a set of interrelated processes that include emotion perception (how we perceive emotions and identify the emotional significance of stimuli), emotion regulation (how they are managed), and emotion experiences (how they affect us) (Koole, 2009; Phillips, Drevets, Rauch, & Lane, 2003). Together, these processes help the brain and body to manage the smooth transition and change of emotions, so that other mental experiences and behaviours can remain relatively unaffected by rapid changes in emotions (Rachman, 1980).

According to Rachman (1980), failures at any stage of emotion processing can result in faulty cognitive processing which are subsequently experienced as intrusive thoughts, rumination, obsessions and fears, and, over time, the emergence and maintenance of psychological disorders. In support, dysfunctions in emotion perception, regulation, and experience have been linked a wide range of clinical disorders including, panic disorder (Baker, Holloway, Thomas, Thomas, & Owens, 2004), post-traumatic stress disorder (Kumpula, Orcutt, Bardeen, & Varkovitzky, 2011; Rachman, 2001), obsessive-compulsive disorder (Kang, Namkoong, Yoo, Jhung, & Kim, 2012), eating disorders (Bydlowski et al., 2005), psychosis (Baslet, Termini, & Herbener, 2009; Serper & Berenbaum, 2008), borderline personality disorder (Beblo et al., 2010), and depression (Honkalampi, Hintikka, Tanskanen, Lehtonen, & Viinamaki, 2000; Joormann & Gotlib, 2010).
Whilst there are many scales that examine aspects of emotion processing, e.g. *perception* (Toronto Alexithymia Scale-20 - TAS-20; Bagby, Parker, & Taylor, 1994; Levels of Emotional Awareness Scale – LEAS; Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990), *regulation* (Emotion Regulation Questionnaire – ERQ; Gross & John, 2003) and *experience* (Depression Anxiety and Stress Scale-21 - DASS-21; Lovibond & Lovibond, 1995); (Hospital Anxiety and Depression Scale – HADS; Zigmond & Snaith, 1983), there are few scales which draw together the multiple dimensions of emotion processing. To address this, the Emotion Processing Scale (EPS) was developed by Baker, Thomas, Thomas, and Owens (2007) as a measure of emotion processing dysfunction that incorporates aspects of perception, regulation and experience.

The EPS was originally developed as a 38-item 8 factor measure (EPS-38; Baker et al., 2007) using exploratory factor analysis (maximum likelihood) on a sample of individuals with psychological problems, psychosomatic disorders, physical disease, and healthy individuals ($n = 460$). The scale was later refined into a 25-item (EPS-25; Baker et al., 2010), five factor measure using exploratory factor analysis (59.4% of variance explained - $n = 690$, comprising mental health patients, healthy controls, pain patients and general medical practice attendees).

Though the EPS-25 is increasingly used as a clinical and research tool (Elbeze Rimasson & Gay, 2012; Johansson et al., 2013; Kealy, Ogrodniczuk, & Howell-Jones, 2011; Wilkins, 2012), to the best of our knowledge, no studies have formally validated its psychometric properties beyond Baker et al.’s (2010) original investigation. Establishing the psychometric properties is an important step towards assessing the responsiveness of measurement instruments, particularly for measures that are frequently used (Nunnally, 1967). Further, much of the published empirical literature on the EPS-25 has been based on clinical samples, and as such it remains uncertain if the EPS-25 functions in an equivalent
manner when administered to non-clinical samples. This may be problematic if the scale is used to make inferences about emotion processing, because if the EPS functions differently when used in non-clinical populations, then judgements based on scale scores may be misguided.

The aim of this study was therefore to psychometrically evaluate the EPS-25 using two large community samples from Australian and the United Kingdom. We do so by using confirmatory factor analyses to examine the factor structure of the EPS-25.

3.1 Method

3.1.1 Participants

Participants were drawn from Australian (AUS) and United Kingdom (UK) community samples (aged 17-97). Sample characteristics are presented in Table 1. Questionnaires were distributed via broad community advertising which asked for volunteers to take part in an “Emotions across the Lifespan” study. Volunteers were given the choice to complete the questionnaires online, or in a hardcopy form, mailed out with a reply-paid envelope. This approach was considered acceptable due to evidence that online and printed versions of questionnaires give similar results (Ritter, Lorig, Laurent, & Matthews, 2004). Participation was voluntary and completion of the questionnaires was interpreted to indicate consent. This project was granted approval from the UWA Human Research Ethics Committee (Project No RA/4/3/1247) and from the University of Southampton School of Psychology-Research Ethics Committee (Project No ST/03/90).

Table 1.

<table>
<thead>
<tr>
<th>Items</th>
<th>AUS</th>
<th>UK</th>
<th>Total</th>
</tr>
</thead>
</table>

Table 1.

Sample Characteristics
<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
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<th>M</th>
<th>SD</th>
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<tbody>
<tr>
<td>Sample Size</td>
<td>575</td>
<td>597</td>
<td>1172</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (N, %)</td>
<td>F: 369, 66.2%</td>
<td>M: 188, 33.8%</td>
<td>F: 481, 81.8%</td>
<td>M: 107, 18.2%</td>
<td>F: 850, 74.2%</td>
<td>M: 295, 25.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>39.8</td>
<td>20.9</td>
<td>17 - 97</td>
<td>36.7</td>
<td>20.3</td>
<td>18 - 91</td>
<td>38.3</td>
<td>20.6</td>
<td>17-97</td>
</tr>
<tr>
<td>Education (years)</td>
<td>13.4</td>
<td>3.1</td>
<td>4 - 27.2</td>
<td>14.1</td>
<td>5.5</td>
<td>8 - 21</td>
<td>13.7</td>
<td>2.8</td>
<td>4 - 27.2</td>
</tr>
<tr>
<td>DASS - Depression</td>
<td>8.8</td>
<td>8.9</td>
<td>0 - 42</td>
<td>8.8</td>
<td>9.2</td>
<td>0 - 42</td>
<td>8.8</td>
<td>9.1</td>
<td>0 - 42</td>
</tr>
<tr>
<td>DASS - Anxiety</td>
<td>6.7</td>
<td>7.7</td>
<td>0 - 42</td>
<td>6.3</td>
<td>7.7</td>
<td>0 - 42</td>
<td>6.5</td>
<td>7.7</td>
<td>0 - 42</td>
</tr>
<tr>
<td>DASS - Stress</td>
<td>13.2</td>
<td>9.2</td>
<td>0 - 42</td>
<td>13.4</td>
<td>9.4</td>
<td>0 - 42</td>
<td>13.3</td>
<td>9.3</td>
<td>0 - 42</td>
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<tr>
<td>Ethnicity</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
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<td>Australian</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboriginal/Torres Strait Islander</td>
<td>15 (2.6%)</td>
<td></td>
<td></td>
<td>520 (87.1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western European</td>
<td>228 (39.7%)</td>
<td></td>
<td></td>
<td>41 (6.9%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern or Eastern European</td>
<td>34 (5.9%)</td>
<td></td>
<td></td>
<td>11 (1.8%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>75 (13.0%)</td>
<td></td>
<td></td>
<td>6 (1.0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African</td>
<td>8 (1.4%)</td>
<td></td>
<td></td>
<td>12 (2.0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>167</td>
<td></td>
<td></td>
<td>Declined to say</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(29.0%) | (1.2%)
---|---
Declined to say | 48
(8.4%)

*Note.* DASS (Lovibond & Lovibond, 1995) – DASS scores are doubled to replicate DASS-42 scoring standard.

### 3.1.2 Materials

The **Emotion Processing Scale** (EPS-25; Baker et al., 2010) is a 25-item, self-report measure of dysfunctional emotion processing that comprises five 5-item subscales. Two subscales relate to dysfunctional emotion regulation (Avoidance and Suppression). The three other subscales, Unregulated Emotion, Signs of Unprocessed Emotion and Impoverished Emotion Experience measure emotion experience. However, the Impoverished Emotion Experience subscale also measures elements of perception, in that people who have trouble identifying their feelings as emotions also exhibit a deficit in perception. Participants respond to the 25 items on a 9-point Likert scale ranging from 1 (*completely disagree*) to 9 (*completely agree*). Internal consistency of the EPS-25 was adequate (three subscales α > .80, two subscales α > .70) in the original paper by Baker et al. (2010).

### 3.2 Results

Before factor analysis, patterns of missingness, distribution and outliers of the data were examined to determine its suitability using SPSS version 21. Missing data by variable ranged from 0.5 to 2.3%. Little’s MCAR test revealed the data were missing completely at random. Missing data was handled using pair-wise deletion. Multivariate normality was assessed using DeCarlo’s (DeCarlo, 1997) SPSS macro. The omnibus test of multivariate normality, based on Small’s (Small, 1980) statistics (see Looney, 1995, for add-on information) was significant, suggesting the data departed substantially from multivariate...
normality, $\chi^2(26, N = 1061) = 8698.26, p < .001$. Internal consistency of test scores for the EPS-25 factors (combined AUS and UK sample) were was .87 for Suppression, .84 for Unprocessed, .73 for Unregulated, .68 for Avoidance, and .76 for Impoverished.

### 3.2.1 Original confirmatory factor analysis

Initially, a five factor confirmatory factor analytic model was specified, with each factor representing the EPS-25 subscales proposed by Baker et al. (2010). Mplus version 6.1 was used to conduct the factor analyses, using Maximum Likelihood Robust (MLR) estimation to account for the non-normality of the data (Muthén & Muthén, 2010). The EPS’s factor structure was evaluated using the Standardised Root Mean-square Residual (SRMR; Jöreskog & Sörbom, 1993) the comparative fit index (CFI; Bentler, 1990), Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), and root mean square error of approximation (RMSEA; Steiger & Lind, 1980). Chi-square non-significance, TLI and CFA values above 0.95, SRMR below .08, and RMSEA values below .06 are commonly recommended criteria for good fit (Hu & Bentler, 1999).

To first identify the model, a five-factor CFA using both samples was run several times, each time with a different allocated indicator variable for each factor to assess which indicator factor loading differed the least across the samples (see Brown, 2006). The item within each factor that exhibited the most equivalent factor loading across the two samples was then chosen to be the marker indicators (marker items were, 16, 2, 8, 9, 25); that is the indicators with factor loadings to be fixed at 1.00 in subsequent analyses. Selecting the most equivalent items as marker indicators is particularly important when examining if a scale functions in the same way across samples (multi-group invariance analysis) (Brown, 2006). If the marker items’ factor loadings are not equivalent between the samples, the scale may function differently between samples and go undetected because the differences in the
indicator items is being masked by their unstandardized factor loadings being fixed to 1. Additionally, it is possible that observed differences in scale scores between samples may be an artefact of scaling the latent variable with an indicator which has a different relationship to the factor based on the sample (Brown, 2006).

Following the selection of marker indicators, the five-factor model was then specified separately for the two samples. Table 2 shows the fit statistics of these analyses, and fit indices were generally indicative of poor model fit. The RMSEA (UK & AUS = .062) values were moderate but generally within an acceptable range, and SRMR values (UK = .060, AUS UK = .056) were within the recommended cut-offs by Hu and Bentler (1999). In contrast, however, Chi-square, PCLOSE, CFI and TLI values all suggest poor model fit. With the majority of fit indices indicating poor model fit, it was concluded that the original five factor structure of the EPS-25 was not considered an adequate representation of the response behaviour in the Australian and United Kingdom samples.

Lack of fit could be attributed to items loading onto multiple factors or items of a common factor being more or less related to some items than others. Indeed, it may be that the EPS-25 is a generally well-fitting model in this case, but that the fit diagnostics are being unduly influenced by a small number of problematic items. If so, it is possible that the factor structure might be preserved by trimming statistically problematic items. To assess the degree of localised (item) misfit, the standardised residual covariances for both the AUS and UK CFAs were examined (Brown, 2006). Based on J. Reskog & S. R. Bomm's (1993) recommended cut-off value of 2.58 for standardised residual covariances (which corresponds to a statistically significant score at a $p$-value of < .01)², both samples presented several significant residual covariances whilst using a conservative cut-off value is considered strong evidence for widespread model misfit.

² Whilst standardised residual scores are inflated with large samples (Brown, 2006), the large number of significant residual covariances whilst using a conservative cut-off value is considered strong evidence for widespread model misfit.
statistically significant residual covariances for every item. The pattern of high covariances by item was also not consistent in both samples (number of problematic covariances unique to AUS sample = 36, number unique to UK = 40, number common to both samples = 33).

Table 2.
Single group confirmatory factor analyses (25 and 22-item) with Australian and United Kingdom community samples.

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>LO 90</th>
<th>HI 90</th>
<th>P-CLOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK Five-Factor model (25-item)</td>
<td>867.278</td>
<td>265</td>
<td>&lt;.001*</td>
<td>.060</td>
<td>0.865</td>
<td>0.881</td>
<td>.062</td>
<td>.057</td>
<td>.066</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>AUS Five-Factor model (25-item)</td>
<td>843.910</td>
<td>265</td>
<td>&lt;.001*</td>
<td>.056</td>
<td>0.858</td>
<td>0.875</td>
<td>.062</td>
<td>.057</td>
<td>.066</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>UK Two-Factor Model (22-item)</td>
<td>821.367</td>
<td>208</td>
<td>&lt;.001*</td>
<td>.061</td>
<td>0.848</td>
<td>0.863</td>
<td>.070</td>
<td>.065</td>
<td>.075</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>AUS Two-Factor Model (22-item)</td>
<td>750.562</td>
<td>208</td>
<td>&lt;.001*</td>
<td>.058</td>
<td>0.855</td>
<td>0.869</td>
<td>.067</td>
<td>.062</td>
<td>.073</td>
<td>&lt;.001*</td>
</tr>
</tbody>
</table>

* = $p < .05$, Models: SRMR = standardised root mean-square residual, RMSEA = root mean square error of approximation, CFI = comparative fit index, TLI = Tucker-Lewis Index, LO 90 and HI 90 = lower and upper boundary of 90% confidence interval for RMSEA.

Maximum Likelihood Robust (MLR) estimation was used.

After respecifying the model, removing the most problematic items (to a maximum of one item per factor), we still did not obtain adequate model fit.

Though it might be possible to establish good fit with the further removal of items, we elected to stop at this point as we felt that the original essence of the five factor model...
proposed by Baker et al. (2010) would be unrecognisable with the continued removal of items. As such, we concluded that the EPS-25 did not exhibit a recoverable five factor structure. The above conclusion raised the question of what factor structure exists within the EPS-25.

3.2.2 Exploratory factor analysis

To investigate this, we turned to exploratory factor analytical techniques. Initially, the EFA was conducted with the UK sample alone to identify items that may be causing misfit. The UK sample was selected as a starting point because this was the country where the measure was originally developed. We conducted an EFA using MLR extraction and geomin rotation using Mplus version 6.1. MLR extraction was chosen because it is appropriate for ordinal variables, and provides standard errors appropriate for a more comprehensive examination of factor structure and individual parameters (Schmitt, 2011). Obtained eigenvalues for the current sample $^3$ and are presented in Table 3. The eigenvalues obtained by Baker et al. (2010) in their original maximum likelihood analysis are also shown in Table 3 for comparison purposes.

The decision around how many factors to extract was based on Horn’s (Horn, 1965) Parallel Analysis, a method which repeatedly undertakes EFAs of randomly generated data of the same size as the study data to set as a benchmark (using ViSta-PARAN software; Ledesma & Valero-Mora, 2007). If a factor eigenvalue from an EFA is greater than the 95% probability cut-off of factors obtained from randomly generated data (i.e. less than 5% of being obtained from randomly-generated data) then it is considered suitable for extraction. The eigenvalues generated from 500 randomly generated datasets are therefore also shown in

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$^3$ We also undertook a maximum-likelihood EFA, as per Baker et al.’s (Baker et al., 2010) original approach, and the eigenvalues were very similar to those obtained when MLR was used - 8.65, 2.20, 1.42, 1.33, 1.11.
Table 3. Based on the Parallel Analysis, the current UK sample presents two factors that exceeded the benchmark (at 5% probability). Clearly, based on this factor retention method, the present data do not support a five factor structure for the UK sample. Indeed, if the same technique were to be applied to Baker et al. (2010) data, two factors would have been extracted. We therefore suggest here that Baker et al. (2010) original results also do not support a five factor structure, and suspect that the problems we encountered in the CFA might be due to the five factor model being inappropriate.

Table 3.

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>8.81</td>
<td>2.23</td>
<td>1.41</td>
<td>1.33</td>
<td>1.06</td>
</tr>
<tr>
<td>Baker et al. (2010)</td>
<td>8.70</td>
<td>2.30</td>
<td>1.40</td>
<td>1.29</td>
<td>1.10</td>
</tr>
<tr>
<td>Parallel Analysis</td>
<td>1.57 (1.66)</td>
<td>1.48 (1.55)</td>
<td>1.41 (1.46)</td>
<td>1.35 (1.40)</td>
<td>1.30 (1.34)</td>
</tr>
</tbody>
</table>

Note. Extraction Method for UK was Maximum Likelihood Robust (MLR) with direct oblimin rotation (results were comparable when using Maximum Likelihood). Extraction Method for Baker and Parallel Analysis samples was Maximum Likelihood. Parallel analysis was based on a randomised normal distribution of 500 samples. All EFA and simulation data was conducted with 25 items. For the Parallel Analysis, unbracketed values represent the mean eigenvalue for a given factor. Bracketed values represent an upper-bound eigenvalue that there is only a 5% chance of obtaining, given a random sample.

Given the above, we decided that two factors would be extracted from the UK sample for further analysis. The first factor appeared to capture similar content to the original five-item Suppression factor (i.e. the same five items loaded onto this factor, but not the other). The second factor captured almost all of the remaining items though two items, 4 and 14, did not load greater than .30 onto either factor, and item 5 loaded on both factors (factor 1 = .33,
factor 2 = .38). These three items were dropped and this resulted in a new proposed 2 factor, 22 item (5 and 17 items) model.

3.2.3 Revised 2-factor confirmatory factor analysis

The new two-factor model, proposed on the basis of the EFA results above, was specified for CFA analysis on the UK and AUS samples. Overall goodness of fit measures for this revised 22-item EPS did not indicate acceptable model fit (see Table 2) in the UK or AUS samples. Once again, we examined localised model fit to examine whether any items were disproportionately affecting what might otherwise be a good fitting model. Examination of the standardised residual covariances revealed widespread residual covariances between items in both samples (number of problematic covariances unique to AUS sample = 24, number unique to UK = 37, number common to both samples = 27), suggesting the poor model fit could not be explained just by the presence of a few problematic items as opposed to poor overall specification. Therefore, we concluded that the 2 factor model which appeared to represent suppression and an overarching measure of unprocessed emotions was also not supported by the data.

3.3 Discussion

The aim of this study was to psychometrically evaluate the EPS-25 (Baker et al., 2010) using two large community samples from Australian and the United Kingdom. The original EPS factor structure did not exhibit adequate model fit for either the Australian or United Kingdom community sample, and thus the results observed here are inconsistent with the model proposed by Baker et al. (2010).

Initial efforts to revise the 25-item scale whilst generally retaining the essence of the original factor structure (by examining localised misfit) were unsuccessful due to many unusually high standardised residual covariances in both samples (with different item
covariance across the two samples). Final efforts to revise the 25 item scale via EFA methods further called into question the robustness of the 5-factor solution. Instead, a 22-item, two factor solution (suppression and a generalised dysfunctional emotion processing factor) was extracted. This 2-factor revised model also failed to exhibit sound fit when subjected to CFA. In summary, the EPS-25 items, a working model of emotion processing dysfunction, appears not to function psychometrically as first believed, when examined with two large community samples.

While the present results do call into question the general utility of the EPS-25 as a measure of emotion processing, there are a number of potential explanations that should be considered.

Firstly, the factor extraction method of the current study is different from Baker et al.’s (2010) study. Whilst Baker et al. (2010) did not explicitly state which extraction method they used, a reasonable guess would be that their selection criteria were similar to those employed in the previous EPS development paper (Baker et al., 2007), which involved a) Kaiser’s (1960) eigenvalue-greater-than-1 (K1) criterion, b) Cattell’s (1966) scree test, and c) subjective assessment of the interpretability of factor structures. Indeed, after analysing the results of both EPS development papers, it appears the only established extraction method which explains the extraction of five factors is the K1 criterion. This is concerning because, whilst Kaiser’s (1960) K1 criterion is still widely employed by researchers (probably because it has been the default extraction method in many statistical packages), it is generally recognised as being highly inaccurate, and consistently overestimates the number of factors, often by a severe margin (see Lance, Butts, & Michels, 2006 for comprehensive examination of EFA extraction methods and the shortcomings of the K1 criterion; Velicer, Eaton, & Fava, 2000; Zwick & Velicer, 1986). Whilst the extraction method used by Baker et al. (2010) is unknown, after considering the current EFA results and those of Baker et al.’s (2010) study,
and in light of contemporary techniques (parallel analysis), we suspect that the initial decision to extract five factors led to the misspecification of the EPS-25 model.

A second possibility is that our UK and AUS samples comprised random individuals from the community. In contrast, the EPS-25 was developed using samples which included participants with physical and psychological illness, as well as healthy samples. Differences in the results may have been due to differences in our samples which might have led to statistical differences in the manner in which the items behave in community and clinical samples. It is possible that the EPS-25 has adequate model fit for clinical samples (though Baker et al., 2010, did not report a CFA), but not in community adults. Nonetheless, we suspect this explanation is unlikely, particularly given the fact that the Eigenvalues observed in this study were very similar to those observed by Baker et al. (2010). If the factor structure of the EPS-25 is indeed unstable across clinical and community samples, it calls into question its general utility as a research tool.

There are important clinical implications to the current findings: firstly, the EPS is currently used in research settings in healthy samples when the current results do not support its continuing use in these settings. Therefore, any inferences based on scale scores in healthy populations might be misguided. Secondly, for similar reasons, it is recommended that the psychometric properties of the EPS-25 scale are examined in clinical populations before it is used as a research tool in clinical samples. If necessary, the scale could be further developed or expanded perhaps to include other existing measures. For example, ‘avoidance’ is successfully measured with the Cognitive Avoidance Questionnaire (CAQ; Sexton & Dugas, 2008) and with the Acceptance and Action Questionnaire (AAQ-II; Bond et al., 2011); ‘Expressive and thought suppression’ are assessed with the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) and White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994); ‘impoverished emotional experience’ has a large overlap with
measures of alexithymia such as the 20 item Toronto Alexithymia Questionnaire (TAS-20; Bagby et al., 1994) and the Bermond-Vorst Alexithymia Questionnaire (BVAQ; Vorst & Bermond, 2001). It is possible that the identification of dysfunctional emotion processing can be achieved by examining these scales, however, for the EPS-25, it appears that the items chosen to capture the factors have not been successful. The use of alternative items or scales might have helped in the identification of factors consistent with Baker et al.’s (2010) model. We suggest that subsequent EPS development or validation studies consider analysing the concurrent validity of subscales with existing comparable scales.

In summary, the EPS-25 factor structure could not be recovered in large Australian or United Kingdom community samples, and arguably was not supported in Baker et al.’s (2010) study, based on EFA results. We suggest that the EPS is not suitable for use in healthy samples until further scale refinement or redevelopment and subsequent validation is completed. For the purposes of constructing a working scale of dysfunctional emotion processing, the use of alternative, validated scales to replace the scale items established by Baker et al. (2010) study may be successful in subsequent validation studies.
3.4 References


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3.5 Acknowledgements

We thank Mark A. Griffin for statistical guidance.
3.6 Foreword to chapter 4.

By validating the Emotion Regulation Questionnaire (ERQ) and Emotion Processing Scale (EPS), I hoped to use the tasks that were robust and generalisable to a community sample, to examine the relationship between PLE and emotion processing. This process resulted in a refinement of the ERQ (Chapter 2). Inadequate model fit was obtained with the original scale, but with the removal of one item provided a substantial improvement to model fit, resulting in a strong, revised ERQ factor structure (ERQ-9). Unfortunately, I was not able to find any satisfactory fit for the EPS (Chapter 3), despite efforts to optimize its factor structure. Therefore, the measure could not be used for further analyses. In the final chapter (chapter 4), the only suitable emotional processing tasks were the ERQ and DASS. This narrowed the scope of examination of emotional processing in PLE, but is still able to provide useful information.
Chapter 4: The relationship between emotion processing and psychotic-like experiences

Abstract

A large body of evidence reveals that levels of psychosis are present in the general population, ranging from nonclinical (or subclinical) to full-blown clinical psychotic symptoms (see Van os et al., 2009, for meta-analysis). Psychotic-Like Experiences (PLE) refer to experiences that resemble the positive symptoms of psychosis, but which do not cause the levels of distress or impairment that would lead to clinical treatment, disability or loss of functioning (Laroi, 2012). Despite studies finding associations between psychosis and negative affect and maladaptive emotion regulation (ER), emotion processing has not received much attention in the context of PLE. The current study investigated the relationship between ER, assessed with the Emotion Regulation Questionnaire (Gross & John, 2003), negative affect (Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995), and PLE (Psychosis Screening Questionnaire) using a large Australian community sample ($N = 575$). Specifically, the unique and shared variance of the DASS negative affect constructs was assessed. It was hypothesised that ER would predict negative affect, which in turn, would predict PLE. Consistent with previous research, the results showed that more maladaptive ER (suppression) was related to negative affect, and that negative affect was positively related to PLE. In contrast, no direct or indirect relationship was observed between ER and PLE after accounting for demographics and negative affect. The current findings provide support for the hypothesis that negative affect is associated with PLE. It is recommended that future studies exploring ER, negative affect and PLE, examine a wider range of ER strategies, and analyse the extent to which unique and shared variance of depression, anxiety and stress (by Structural Equation Modelling) is related to ER and PLE.
Hallucinations and delusions are classic symptoms of schizophrenia and psychosis, but these (or similar) symptoms also occur relatively frequently in the general population. Further, there is evidence suggesting that mechanisms underlying these symptoms are common to both the general and psychiatric populations. Psychotic-like experiences (PLE) in people without a clinical diagnosis have increasingly assumed centre stage in schizophrenia research because they can provide a unique context for potential early intervention. Consequently, studies are conducted in the hope that vulnerable individuals are identified early, and guided towards simple and well-timed intervention before symptoms become distressing and disabling. In the present study, we consider emotion regulation (ER) deficits and negative affect as potential mechanisms towards PLE in non-clinical populations.

4.1 Psychotic-like Experiences

PLE resemble the positive symptoms of psychosis but do not cause high levels of distress or impairment (Larøi, 2012). The 1996 US National Comorbidity Study (n = 5,877), found that approximately of one-quarter (28.4%) of all individuals from the general population report one or more PLE (Kendler & Kessler, 1996). These findings are consistent with other studies that have found the prevalence to range between 10% and 50% of individuals in the community (Loewy, Johnson, & Cannon, 2007; Wiles et al., 2006), with estimates differing according to the population characteristics and inclusion criteria (e.g. help seeking behaviour). According to the ‘continuum hypothesis’ of psychosis (van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009), psychosis exists in nature as a distribution, ranging from nonclinical (or subclinical) to full blown clinical psychotic symptoms. According to this view, PLE are merely quantitatively different from acute psychotic symptoms, and are at the lower end of the spectrum with regards to distress and clinical need for care (van Os et al., 2009). Thus, PLE are a valuable focus of research.
because they are thought to reflect a general vulnerability for schizophrenia. For example, several longitudinal studies show that the presence of PLE predicts future transition to psychosis. Hanssen, Bak, Bijl, Vollebergh, and van Os (2005) showed that 8% of individuals with PLE develop psychosis within 2 years, and others have shown that figure increases to 25% after 15 years (Poulton et al., 2000). There is also evidence of common mechanisms giving rise to PLE in the general populations and in psychosis. Some are related to prenatal or early aetiological factors, such as genetics, family history, childhood experiences and family function (Hanssen, Krabbendam, Vollema, Delespaul, & Van Os, 2006; Linney et al., 2003; Stefanis et al., 2004). Others refer to behavioural, cognitive and psychological factors, such as coping skills (Janssen et al., 2004; Lataster et al., 2006; Spauwen, Krabbendam, Lieb, Wittchen, & van Os, 2006), drug use (Smith, Thirthalli, Abdallah, Murray, & Cottler, 2009; Tien & Anthony, 1990), and cognitive biases (Barkus, Stirling, Hopkins, McKie, & Lewis, 2007). This latter set of factors can arguably be better controlled than the former set, therefore are of most immediate clinical interest.

4.2 Emotion regulation and negative affect

ER and negative affect have received little research interest in relation to PLE. ER involves the control of a person’s initial emotional experience, to a more socially and personally adaptive form. However, all types of ER are not always adaptive or successful. When the employment of ER strategies is ineffective, individuals often experience negative emotional states such as depression, anxiety and stress (negative affect). Experimental and longitudinal studies of emotion regulation suggest that maladaptive ER strategies (e.g. expressive suppression; masking behaviour which expresses emotion) result in increased negative affect (e.g. depression, anxiety, stress; Beevers & Meyer, 2004; Brans, Koval, Verduyn, Lim, & Kuppens, 2013; Gross, 2002). In contrast, adaptive emotion regulation
strategies (e.g. reappraisal; interpreting events in a more positive or productive way) are often associated with reduced depression, anxiety, stress and greater personal well-being (Brans et al., 2013; Gross & John, 2003; Kemeny et al., 2012; Spaapen, Waters, & Stopa, 2014).

There is already much evidence showing that people with psychosis have dysfunctional emotion regulation (Henry et al., 2007; Livingstone, Harper, & Gillanders, 2009; van der Meer, van ’t Wout, & Aleman, 2009) and dysfunctional emotional experiences (Tremeau, 2006; although see Henry, Rendell, Green, McDonald, & O’Donnell, 2008). This is relevant because negative affect is not only one of the key features of psychosis, but it also thought to influence the content and frequency of psychotic symptoms (Freeman & Garety, 2003; Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001).

By contrast, there is very limited research regarding ER and negative affect in PLE, and questions remain about how, and exactly which types of, ER strategies and negative affect contribute to PLE expression. This information is important as a better understanding of the mechanistic pathways between ER and negative affect vulnerabilities may partially explain the link between PLE and psychotic symptoms, and provide an avenue for early intervention.

4.3 Negative affect influencing psychosis and PLE

Studies point to negative affect being present in individuals who are vulnerable to psychosis. For example, studies of individuals in the prodromal phase of psychosis show that depression, anxiety and irritability precede symptom onset in 60-80% of cases (Docherty, Van Kammen, Siris, & Marder, 1978; Yung & McGorry, 1996). Studies of children and adolescents have also demonstrated negative affect (particularly social anxiety) arises several years before schizophrenia onset (Jones, Murray, Jones, Rodgers, & Marmot, 1994; Kugelmass et al., 1995; Malmberg, Lewis, David, & Allebeck, 1998). Finally, the presence of
trauma and distress is also associated with imminent risk of psychosis (Krabbendam et al., 2002; Tien & Eaton, 1992). Overall, negative affect is considered to be a key factor in the development of psychosis, and maintenance of symptoms, albeit they may not be sufficient alone as an initiating factor (Freeman & Garety, 2003).

Several studies have shown a link between PLE and negative affect, with virtually all studies finding bivariate correlations between depression, anxiety, stress, and PLE (Armando et al., 2010; Cella, Cooper, Dymond, & Reed, 2008; Mackie, Castellanos-Ryan, & Conrod, 2011; Paulik, Badcock, & Maybery, 2006). However, when the shared variance between depression, anxiety and stress was accounted for, the majority of studies have found anxiety, but not depression or stress, predicted PLE (Allen, Freeman, McGuire, Garety, & et al., 2005; Fowler et al., 2006; Paulik et al., 2006).

In contrast, Cella et al. (2008) found depression, but not anxiety, was a predictor of PLE. However, they measured both state and trait anxiety, and accounted for the shared variance between both measures of anxiety (as well as depression) when predicting PLE. Given the high correlation between state and trait anxiety (70% in Cella et al., 2008), arguably the majority of variance explained by the anxiety was lost when the common variance was excluded. Therefore it is not surprising that anxiety was not a significant predictor of PLE. Nevertheless, Cella et al. (2008) did find an interaction effect of depression and anxiety predicting delusion, but not hallucination, PLE. Additionally, Martin and Penn (2001) found depression to be a better predictor of paranoia PLE than anxiety, however, they used different measures of anxiety (both examining social anxiety).

These findings are largely consistent with contemporary models of how negative affect relates to psychotic symptoms (see Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002). Specifically, that anxiety is thought to play a key role in hallucinations and paranoia, particularly in persecutory delusions, as anxiety disorders and delusions are thought to share
the same maintaining factors (e.g. threat beliefs; Clark, 1999; Freeman & Garety, 1999).

Depression and stress are also considered to play a role in hallucination and paranoia precipitation and maintenance, but to a lesser extent, whilst one’s emotional state (including negative affect) influences positive symptom content (Freeman et al., 2002; Trower & Chadwick, 1995).

A notable limitation of the above studies is the failure to separately account and control for the unique and shared variance of negative affect constructs such as depression, anxiety and stress. While phenomenologically distinct, these constructs are also highly correlated. Evidence exists that each of these constructs provides unique contribution to negative affect, but also that they share a common emotional construct which Henry and Crawford (2005) termed ‘psychological distress’. Therefore, failing to fully account for the unique variances of the depression, anxiety and stress, and the shared contribution of the general psychological distress factor, can lead to over-inflation of what appears to be the unique influence of one construct, masking of the role of the shared construct, and overall reduced specificity of findings to PLE. This is relevant because the optimal screening measures, preventative methods, and how it relates to PLE onset and maintenance may differ based on negative affect type (e.g. anxiety, depression). As an example, if anxiety is the prevailing factor, it may indirectly result from inadequate emotion perception and regulation (Rachman, 1980), and share common maintaining factors as anxiety disorders (Freeman & Garety, 1999).

In the current study we directly address this concern by analysing the unique and shared contributions of depression, anxiety and stress in the prediction of PLE. Based on the difference in findings in previous studies and the high covariance of depression, anxiety and stress, it is hypothesised that the generalised psychological distress factor will be the only significant predictor of PLE.
4.4 Emotion regulation and PLE

While the positive association between negative affect and PLE has been reported, only a handful of studies have explored the relationship between ER and PLE. In addition, findings are generally mixed. Some negative findings exist (Henry et al., 2008), while others show tentative evidence that ineffective ER is positively associated with PLE (Modinos, Ormel, & Aleman, 2010, n = 34; Westermann & Lincoln, 2011, n = 151 but only weakly; Westermann, Kesting, and Lincoln, 2012).

Regarding reappraisal, in an experimental fMRI study, Modinos et al. (2010) found reappraisal to be less effective in high-PLE individuals. Furthermore, another experimental study by Westermann et al. (2012) found reappraisal predicts paranoia expression (state paranoia), but only in stressful situations and individuals who score high in paranoia-proneness (trait paranoia). This is very surprising considering reappraisal is commonly found to be an adaptive strategy (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Spaapen et al., 2014). One explanation proposed by Westermann et al. (2012) is that in healthy individuals, reappraisal lowers stress, however, in individuals with PLE and significant distress, cognitive factors including jumping to conclusions, theory of mind deficits, pre-existing delusional beliefs, negative interpersonal schemata, and aberrant salience (a hyperdopaminergic state leading to the assignment of exaggerated importance and motivational significance to stimuli) may negatively bias their interpretation of an event, resulting in ineffective or maladaptive reappraisal, which may give rise to paranoid thoughts. However, this speculative hypothesis remains untested. Westermann et al. (2012) only measured adaptive reappraisal (and not whether it was successful). While tentative evidence of a link between reappraisal and PLE exists, no relationship has been found between expressive suppression and PLE (Henry et al., 2009; Westermann et al., 2012). In 2011,
Westermann and Lincoln, using the DERS, only found differences in impulse control to be related to paranoia, although this measure does not measure specific ER strategies. Considerable variations exists in the literature in methods for assessing ER (and PLE), which makes direct comparisons difficult.

In summary, the current study aimed to examine how specific types of emotion regulation and negative affect is associated with PLE. Whilst there are limited and inconclusive findings in regards to how ER directly relates to PLE, there are consistent findings that ER predicts negative affect, and negative affect predicts PLE. Therefore, it is hypothesised that ER will predict PLE indirectly through negative affect. Although no explicit hypothesis is set, the exploration of direct effects of ER on PLE will be examined.

4.5 Method

4.5.1 Participants

Participants were drawn from an Australian community sample (aged 17-95). Sample characteristics are presented in Table 1. Questionnaires were distributed via broad community advertising which asked for volunteers to take part in an “Emotions across the Lifespan” study. Volunteers were given the choice to complete the questionnaires online, or in hardcopy mailed out with a reply-paid envelope, as there is evidence that online and printed versions of questionnaires give similar results (Ritter et al., 2004). Participation was voluntary and completion of the questionnaires was taken to indicate consent. This project was granted approval from the UWA Human Research Ethics Committee (Project No RA/4/3/1247)

4.5.2 Materials

The Psychosis Screening Questionnaire (PSQ; Bebbington & Nayani, 1995) is a self-report measure used to screen for psychosis in the past year. Because of the need for
brevity in assessment battery, an abbreviated version was used comprising 6 items assessed: strange experiences (“Have there been times when you felt something strange was going on?”), delusions of control (“Have you ever felt that your thoughts were directly interfered with or controlled by some outside force or person?”) delusions (“Have there been times when you felt that people were against you”; “Have people deliberately acted to harm or plot against you?”), hallucinosis (“Have there been times when you heard or saw things that other people couldn’t?”; “Did you at any time hear voices saying quite a few words or sentences when there was no-one around that might account for it?”) Questions were answered with yes or no, and the final score was the number of yes responses.

The Emotion Regulation Questionnaire – Revised (ERQ-9; Spaapen et al., 2014) is a 9-item, self-report measure of habitual expressive suppression (4 items) and reappraisal (5 items), based on the original 10-item ERQ by Gross and John (2003), with the exclusion of Item 3 (“When I want to feel less negative emotion [such as sadness or anger], I change what I’m thinking about”). The ERQ-9 uses a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Example questions include “I control my emotions by changing the way I think about the situation I’m in” (reappraisal) and “I control my emotions by not expressing them” (suppression). Internal consistency was adequate in the community validation study (Spaapen et al., 2014).

Table 1.
Sample Characteristics

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td></td>
<td>623</td>
<td></td>
</tr>
<tr>
<td>Gender (N, %)</td>
<td>F:</td>
<td>402</td>
<td>66.3%</td>
</tr>
<tr>
<td></td>
<td>M:</td>
<td>204</td>
<td>33.7%</td>
</tr>
<tr>
<td>Age (years)</td>
<td>39.2</td>
<td>20.6</td>
<td>17 - 95</td>
</tr>
</tbody>
</table>
Education (years)  13.4  3.1  4 - 27.2
ERQ-9 - Suppression  25.2  5.3  5 – 35
ERQ-9 – Reappraisal  28.0  13.6  4 – 28
DASS - Depression    8.8  8.9  0 – 42
DASS – Anxiety       6.7  7.7  0 – 42
DASS - Stress        13.2  9.2  0 - 42
PSQ                   1.7  1.6  0 – 6

Ethnicity

Australian Aboriginal/Torres Strait  17 (2.7%)
Islander                              
Western European                     252 (40.5%)
Southern or Eastern European         37 (5.9%)
Asian                                 88 (14.1%)
African                               8 (1.3%)
Other                                 171 (27.5%)
Declined to say                      50 (8.0%)

Note. ERQ-9 (Spaapen, Waters, & Stopa, 2014) = Emotion Regulation Questionnaire,
DASS-21 (Lovibond & Lovibond, 1995) = Depression Anxiety and Stress Scale– DASS
scores are doubled to replicate DASS-42 scoring standard. PSQ (Bebbington & Nayani,
1995) = Psychosis Screening Questionnaire.

The Depression, Anxiety and Stress Scale 21 (DASS-21) is a shortened version of
Lovibond and Lovibond’s (1995) 42-item self-report measure of depression, anxiety, and
stress (DASS). Previous studies have found the DASS-21 yields satisfactory reliability
estimates (Antony, Bieling, Cox, Enns, & Swinson, 1998; Clara, Cox, & Enns, 2001; Henry
& Crawford, 2005). The DASS-21 uses a 4 point severity/frequency Likert scale, with scores
doubled to give comparable results to the original 42-item DASS. It can be scored as separate sub scales or as a single, generalised psychological distress factor (Henry & Crawford, 2005).

4.6 Results

Before analysis, patterns of missingness, distribution and outliers were examined to determine its suitability using SPSS version 21. Missing data by variable ranged from 0.5% to 4.1%. Little’s MCAR test revealed the data were missing completely at random. However, normality assumption testing based on Tabachnick and Fidell’s (2013) suggestion to examine the skewness and kurtosis z-scores over their standard errors, indicated both (Skewness = 4.97; Kurtosis = 2.70) were above the 1.96 critical score (which corresponds to a statistically significant score at $\alpha$ of .05). Therefore, the univariate normality assumption was not achieved. Multivariate normality was assessed using DeCarlo’s (1997) SPSS macro. The omnibus test of multivariate normality, based on Small’s (1980) statistics (see Looney, 1995, for add-on information) was significant, suggesting the data departed substantially from multivariate normality, $\chi^2(16, N = 356) = 478.92, p < .001$. These departures from normality are perhaps to be expected due to the clinical nature of the scales.

4.6.1 PSQ (PLE prevalence)

PSQ data by frequency are presented in Table 2. In descending order of prevalence, the most commonly reported PSQ items are ‘Have there been times when you felt that people were against you’ (53.7%), ‘Have there been times when you felt something strange was going on?’ (42.4%), ‘Have you ever felt that your thoughts were directly interfered with or controlled by some outside force or person?’ (33.4%), ‘Have people deliberately acted to harm or plot against you’? (20.7%), ‘Have there been times when you heard or saw things that other people couldn’t?’ (16.2%), and ‘Did you at any time hear voices saying quite a few
words or sentences when there was no-one around that might account for it?’ (6.1%).

Approximately 30% of participants reported no symptoms, 70% reported at least one symptom, and 50% reported two or more symptoms.

Table 2.

*Frequency of Psychosis Screening Questionnaire symptoms (6-item PSQ)*

<table>
<thead>
<tr>
<th>PSQ-symptoms</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>137</td>
<td>30.1</td>
</tr>
<tr>
<td>1</td>
<td>90</td>
<td>19.8</td>
</tr>
<tr>
<td>2</td>
<td>82</td>
<td>18.0</td>
</tr>
<tr>
<td>3</td>
<td>79</td>
<td>17.4</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>9.7</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>4.2</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>.9</td>
</tr>
<tr>
<td>Total</td>
<td>455</td>
<td>100</td>
</tr>
</tbody>
</table>

*Note:* Frequency refers to the number of PLE items endorsed, regardless of which items apply.

To determine if the PSQ items could be separated into factors (e.g. hallucinosis and paranoia), an exploratory factor analysis (EFA) was conducted using MLR extraction and geomin rotation using Mplus version 7.2. MLR extraction was chosen because it is appropriate for ordinal variables, and provides standard errors appropriate for a more comprehensive examination of factor structure and individual parameters (Schmitt, 2011). Obtained eigenvalues for the current sample are 2.32, 1.17, 0.78, 0.65, 0.60, 0.48. The decision around how many factors to extract was based on Horn’s (1965) Parallel Analysis, a method which repeatedly undertakes EFAs of randomly generated data of the same size as
the study data to set as a benchmark (using ViSta-PARAN software; Ledesma, 2007). If a factor eigenvalue from an EFA is greater than the 95% probability cut-off of factors obtained from randomly generated data (i.e. less than 5% of being obtained from randomly-generated data) then it is considered suitable for extraction. The PA eigenvalues (95% cut-off values) generated from 500 randomly generated datasets were 1.18, 1.11, 1.05, 1.00, 0.93, 0.91. Based on the Parallel Analysis, only one factor could be extracted. Therefore, no analysis by PLE clusters could be explored in this sample.

4.6.2 Demographics and ER, negative affect, and PLE

PSQ scores were negatively correlated with age, with younger participants reporting higher PSQ scores (see Table 3 for correlation matrix). There were no Gender ($F < 1$) or Education differences for PSQ (see Table 4 comparisons by gender). Older participants reported fewer depressive, anxious and stress symptoms ($p < .01$). No significant relationships were found between any of the DASS subtests and Education. Overall, there was a main effect of gender for DASS subscale scores (Depression, Anxiety and Stress), $F (3, 533) = 4.23$, $p = .006$, partial $\eta^2 = .023$. Inspection of the Univariate tests revealed that this omnibus effect was driven by significant gender differences in Depression and Stress, but not in Anxiety.

Table 3.
Correlations Between Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Educati</th>
<th>PSQ</th>
<th>DASS-D</th>
<th>DASS-A</th>
<th>DASS-S</th>
<th>ERQ-Rea</th>
<th>ERQ-Supp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-.18**</td>
<td>-.31**</td>
<td>-.27**</td>
<td>-.32**</td>
<td>-.27**</td>
<td>.08</td>
<td>-.02</td>
</tr>
<tr>
<td>Education</td>
<td>.03</td>
<td>.04</td>
<td>.02</td>
<td>.03</td>
<td>.01</td>
<td>-.09*</td>
<td>.04</td>
</tr>
<tr>
<td>PSQ</td>
<td></td>
<td>.36**</td>
<td>.43**</td>
<td>.41**</td>
<td>.04</td>
<td>.04</td>
<td></td>
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<tr>
<td>DASS-D</td>
<td></td>
<td></td>
<td>.55**</td>
<td>.59**</td>
<td>-.15**</td>
<td>.26**</td>
<td></td>
</tr>
<tr>
<td>DASS-A</td>
<td></td>
<td></td>
<td></td>
<td>.64**</td>
<td>-.10**</td>
<td>.15**</td>
<td></td>
</tr>
</tbody>
</table>
No significant correlations were found between ERQ Reappraisal and Age or Education. ERQ Suppression was significantly correlated (negative and very weak) with education (see Table 5 for correlations). As level of education increased, participants’ scores on ERQ Suppression slightly decreased. No relationship was observed between ERQ Suppression and age. There was a significant gender difference for the combined ERQ
subscales, $F(2, 531) = 4.429, p = .012$, partial $\eta^2 = .016$. Analysis of the ERQ subscales individually revealed a significant gender difference for ERQ Suppression, $F(1, 532) = 8.244, p = .004$, partial $\eta^2 = .015$. No gender difference was observed for ERQ Reappraisal.

Significant correlations were found between all DASS subscales and ERQ Suppression scores, which were positive and weak. Significant correlations were obtained between ERQ Reappraisal and DASS Depression scores. The relationship was negative and weak, indicating that participants who reported higher ERQ Reappraisal scores had slightly lower DASS Depression scores. No significant relationship was found between ERQ Reappraisal and DASS Anxiety or Stress subscales.

### 4.6.3 Factor analysis

To examine the relationship between ER, negative affect, and PLE, accounting for the proportion of unique and shared variance within the depression, anxiety and stress factors, a Confirmatory Factor Analyses (CFA) was undertaken, so as to establish an appropriate measurement model for the DASS, given the strong intercorrelations that are typically observed amongst the three components. As such, we followed the method described by Henry and Crawford (2005; see below). Following the CFA, full Structural Equation Models (SEM) were specified to test the hypotheses. The CFA and SEM analyses were all undertaken using Mplus version 7.2 with Maximum Likelihood Robust (MLR) estimation, which calculates parameter standard errors and a $\chi^2$ statistic that is robust to the non-normality of the data (Muthén & Muthén, 2010). All models were evaluated using the a combination of fit indices including $\chi^2$, the Standardised Root Mean-square Residual (SRMR; Jöreskog & Sörbom, 1993) the comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), and Root Mean Square Error of Approximation (RMSEA; Steiger & Lind, 1980). A non-significant $\chi^2$, TLI and CFI values above 0.95, 100
SRMR below .08, and RMSEA values below .06 are commonly recommended criteria for good fit (Hu & Bentler, 1999). To identify the models, the first item of each factor were selected to be the marker indicators with factor loadings fixed at 1.00.

4.6.4 Establishing the measurement models using confirmatory factor analysis

As discussed in the introduction, Henry and Crawford (2005) raised the importance of the distinction between the three specific factors within the DASS, namely Depression, Anxiety, and Stress, and the general psychological distress factor. As such, here we replicated the quadripartite CFA that they undertook. To do so, we specified a model with three ‘unique’ Depression, Anxiety and Stress factors, on which their respective DASS items loaded. We also specified a fourth general ‘psychological distress’ factor on which all DASS items were loaded (see Figure 1 for the quadripartite structure with standardised factor loadings). Within this model, the generalised distress factor is therefore a measure of the shared variance between the DASS items, and the depression, anxiety and stress factors only represent their unique variance. With the exception of the $\chi^2$ statistic, which is known to be inflated in large samples, the fit indices for the quadripartite factor structure were close to the recommended cut-offs (see Table 5 for fit indices), and this model was used for the remainder of the analyses involving the DASS.

4.6.4.1 Full measurement model. All factors were then entered into a measurement model to assess construct validity. All factors were set to covary, with the exception of the DASS quadripartite factors, which were not set to internally covary because the generalised psychological distress factor already measures the covariance between the depression,

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4 “Due to the highly interrelated nature of the DASS subscales, caution is advised when interpreting the association of variables with a single quadripartite sub-factor in isolation.”
anxiety and stress factors. Once again, the fit indices were close to recommended cut-offs, suggesting the scales are measuring distinct constructs.

Figure 1. DASS Quadripartite Model Confirmatory Factor Analysis model. Dep = DASS Depression, Anx = DASS Anxiety, Stress = DASS Stress, gd = generalised psychological distress factor.
Table 5.

Confirmatory Factor Analyses and Structural Equation Models

<table>
<thead>
<tr>
<th>Model</th>
<th>χ²</th>
<th>df</th>
<th>p</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>LO 90</th>
<th>HI 90</th>
<th>P-CLOSE</th>
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<tr>
<td><strong>Measurement models</strong></td>
<td></td>
<td></td>
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<tr>
<td>Quadripartite</td>
<td>473.25</td>
<td>168</td>
<td>&lt;.001*</td>
<td>.035</td>
<td>.930</td>
<td>.944</td>
<td>.057</td>
<td>.051</td>
<td>.063</td>
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</tr>
<tr>
<td>7 factor</td>
<td>946.114</td>
<td>558</td>
<td>&lt;.001*</td>
<td>.047</td>
<td>.930</td>
<td>.938</td>
<td>.033</td>
<td>.030</td>
<td>.037</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Structural models</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Quad + PLE + age</td>
<td>640.067</td>
<td>321</td>
<td>&lt;.001*</td>
<td>.041</td>
<td>.921</td>
<td>.933</td>
<td>.040</td>
<td>.036</td>
<td>.045</td>
<td>1.00</td>
</tr>
<tr>
<td>Full structural model</td>
<td>1054.489</td>
<td>587</td>
<td>&lt;.001*</td>
<td>.048</td>
<td>.919</td>
<td>.928</td>
<td>.036</td>
<td>.032</td>
<td>.039</td>
<td>1.00</td>
</tr>
</tbody>
</table>
+ age

Note. For the fit statistics, the following is regarded as indicating good fit; CFI, TLI > .95; SRMR < .08; RMSEA < .06. SRMR = standardised root mean-square residual, TLI = Tucker-Lewis Index, RCFI = Robust comparative fit index, CFI = comparative fit index, RMSEA = root mean square error of approximation, LO 90 and HI 90 = lower and upper boundary of 90% confidence interval for RMSEA. Maximum Likelihood Robust (MLR) estimation was used. Quad = quadripartite model (see Figure 1).

4.6.5 Structural Equation Modelling Predicting PSQ with the quadripartite model of the DASS

It was hypothesised that generalised psychological distress, and not the individual contributions of depression, anxiety and stress, would predict PLE. To test this, a SEM was specified with the PSQ being indicated with its six items, and then regressed on the four DASS factors (i.e. Depression, Anxiety, Stress, and general). All factors were also regressed on age, because both negative affect and PLE are considered to be influenced by age (see Table 3 for correlations; Charles, Reynolds, & Gatz, 2001; Scott et al., 2008).

In support of the current hypothesis, the generalised psychological distress factor (shared variance) was the only significant DASS predictor of PSQ scores ($\beta = .55, p < .001$),
accounting for 30% of the variance in PSQ (depression, anxiety, stress $p > .05$). Not surprisingly, age also predicted PSQ scores ($\beta = .26, p < .001$), accounting for 6.8% of the variance in PSQ scores. Model fit was close to recommended cut-off values and considered adequate (see Table 5 for fit indices).

4.6.6 ERQ PLE model (direct effects)

Attention then turned to an exploratory analysis of possible direct effects of emotion regulation on PLE. To explore this, a SEM was specified with PSQ regressed on suppression, reappraisal and age (ER was not regressed on age because no bivariate relationship was observed, and there is no consistent evidence suggests reappraisal or suppression is influenced by age). After accounting for age, no direct effects of reappraisal ($\beta = -.05, p = .443$) or suppression ($\beta = .03, p = .625$) were observed. We concluded from this that there are no mediating effects of DASS between the ERQ and PSQ scores.

4.6.7 Full ERQ, DASS quadripartite, PLE model

It was hypothesised, however, that ER indirectly influences PLE through negative affect. To determine whether there are indirect effects of ER on PSQ through DASS a full model was then specified with all seven factors (see Figure 2 for simplified path model, and Chapter 4 appendix for full model). This model was identical to the previous model, except the DASS quadripartite factors were added as second-order predictors. That is, PLE was regressed on the four DASS factors, which were regressed on ERQ-S and ERQ-R.

The total indirect effect of suppression ($\beta = .09, p = .018$) on PSQ, through the DASS quadripartite factors was significant. The specific indirect effects for suppression on PLE were through the generalised distress factor only (Suppression – Generalised Distress – PSQ:

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5 A moderator analysis was also conducted to see if DASS subscales moderated the possible relationship between the emotion regulation and PLE. DASS did not moderate this relationship.
$\beta = .08, p = .022, R^2 = .01$). However, once again, this indirect effect only accounted for less than 1% of the variance in PLE, representing a practically insignificant effect.

Figure 2. Full Structural Equation Model. Statistics are: Beta weights (standard error). * = $p < .05$. Paths that are grey represent associations with negligible to no practical significance. A full SEM model with indicators is presented in the Appendix A.

Attention then turned towards the relationships between ER and negative affect. It was hypothesised that ER would predict negative affect. Reappraisal significantly and inversely predicted depression ($\beta = -.12, p < .05$) only, however this relationship was negligible in magnitude (only accounted for 1% of the variance depression). By contrast, suppression positively predicted depression ($\beta = .33, p < .01$) and generalised psychological distress ($\beta = .14, p < .05$). In the case of generalised psychological distress, however,
suppression only explained 2% of the variance, so this relationship is arguably practically insignificant. The degree of variance explained was determined by running the analysis three times, once with both factors (reappraisal and suppression), and two with only suppression or reappraisal being predictors of the generalised psychological distress factor. In summary, the only practically significant relationship observed between ER and negative affect was suppression predicting depression.

Once again, of the DASS factors, the generalised psychological distress factor was the only significant predictor of PSQ ($\beta = .54$, $p < .01$; depression, anxiety, stress $p > .05$). Thus in sum, suppression was positively associated with depression, and the generalised distress factor was positively associated with PLE, but the remaining direct paths were either weak but significant, or simply non-significant.

4.7 Discussion

The aim of the current study was to explore the extent to which ER strategies and negative emotion are associated with PLE. In the current sample, between 40-54% of the population reported paranoid thoughts, 33% passivity thoughts, and 6-16% hallucinosis. These figures are a little higher than most other studies of PLE, although much variation exist depending on scale used, the symptom criteria (strict, general) and population group in the population (PSQ; 66%; Johns et al., 2004; CIDI; 28.4%; Kendler & Kessler, 1996; PQ; 43%; Loewy et al., 2007; 8%; van Os et al., 2009).

4.7.1 Negative affect and PLE

Consistent with previous studies, increased depression, anxiety and stress scores were associated with the presence of PLE (Armando et al., 2010; Cella et al., 2008; Mackie et al., 2011; Paulik et al., 2006). To ascertain the unique and shared contribution of depression,
anxiety and stress in predicting PLE, an analysis using SEM was performed (quadripartite model). The findings supported our hypothesis, with the generalised psychological distress factor being the only significant predictor of PLE. This finding may explain the inconsistent results of previous studies which have found that a single negative affect factor (e.g. depression, or anxiety) predicted PLE (Allen et al., 2005; Cella et al., 2008; Paulik et al., 2006). It is possible that these single (unique) factor results are an artefact of using common statistical analyses, with standard regression usually emphasising the unique contributions of predictors over the predictive utility of shared variance. Ultimately, it is difficult to compare the current results to previous studies which did not account for shared variance when examining how negative affect predicts PLE (Mackie et al., 2011; Martin & Penn, 2001).

One possibility exists that these specific negative affects domains may be differentially linked to PLE symptom clusters (e.g. hallucinations or paranoia), or even symptom subtype. For example, anxiety is considered central in the formation in persecutory delusions (Freeman et al., 2002), whilst depression may contribute to other subtypes of delusions (i.e. paranoia content relating to self-punishment for intrinsic badness; Trower & Chadwick, 1995), whilst stress is not as relevant for grandiose delusions (Freeman et al., 2002). Also, other research suggests the content of hallucinations can reflect negative affect (depression and anxiety; Garety et al., 2001) and maintain symptoms (Chadwick & Birchwood, 1994), but not are not a critical hallucination onset. Unfortunately, PLE could not be fully functionally separated into symptom clusters as symptom subtype information was not available. In addition, all individuals with hallucinations also had high levels of paranoid thoughts, so no differentiation between depression and paranoia could be undertaken. Nevertheless, it is possible that negative affects domains are specifically linked to PLE symptom clusters, although this hypothesis could not be explored in this population group.
4.7.2 ER and negative affect

An examination of bivariate correlations between ER strategy use and negative affect shows that greater suppression and lower reappraisal were related to increased depression, anxiety and stress. This is finding is consistent across studies of ER and negative emotion (Aldao et al., 2010; Matheson & Anisman, 2003; Spaapen et al., 2014). Subsequent examination of the influence of ER on the unique and shared variance of negative affect, showed that suppression predicted depression only. No other practically significant results were observed between ER and negative affect.

These findings are somewhat consistent with Wiltink et al. (2011) who found suppression predicted depression, male gender, lower education level, and lower household income, but not anxiety. In contrast, Wiltink et al. (2011) did find reappraisal predicted depression, but not anxiety. Other studies have found contrary results. For example, Dennis (2007) found that suppression was related to state anxiety only, and reappraisal was associated with depressed mood only, depending on affect style. Another study using a different, wider set of emotion regulation strategies (SCOPE abbreviated; Matheson & Anisman, 2003) found that ER strategies were related to differences in individuals’ negative affect profile (i.e. control, anxious only, dysphoric only, both). Most maladaptive ER strategies (e.g. rumination and emotional containment.) were related to anxiety and dysphoria. However, there was a trend for these ER strategies to result in higher dysphoria scores, compared to anxiety (with the exception of emotional expression, with higher anxiety scores). The adaptive ER strategies were endorsed less by the dysphoric only group, compared to the anxious only group. Additionally, the most maladaptive, and least adaptive ER endorsement was found in the comorbid (both anxious and dysphoric) group. It is worth noting that Matheson and Anisman (2003) also found substantial overlap in almost every association between ER strategies, dysphoria and anxiety. It is well established that
depression and anxiety are highly correlated, so is this finding is not overly surprising. Based on these findings, it appears that the degree to which ER is associated with depression and anxiety, is dependent on the specific emotion regulation strategies used (with some degree of overlap), with depression appearing to be associated with adopting more maladaptive, and less adaptive ER strategies. This area of ER and negative affect is still not well explored. It is suggested that additional studies explored the relationship of ER with a comprehensive list of ER strategies.

The discrepancy in findings between the current study and Wiltink et al. (2011), and that of Dennis (2007), may be explained by differing methodology. Indeed, Dennis (2007) used a smaller ($N = 67$), less representative sample (all females and lower age range), as well as different measures of depression and anxiety. Whilst ER strategies are consistently related to age and gender, this is not expected to account for these findings. More likely, it is related to the different measures of negative affect or sampling error (more likely in smaller samples) influencing results.

4.7.3 Emotion regulation and PSQ

An exploratory SEM analysis examining the possible direct effect of ER on PLE was undertaken, however, no significant relationships were found. These results are divergent from the existing literature, with some studies finding reappraisal (generally considered adaptive), but not suppression, was associated with paranoia expression (Taylor, Graves, & Stopa, 2009; Westermann et al., 2012). In contrast, Westermann, Boden, Gross, and Lincoln (2013) found only maladaptive strategies (not reappraisal) were related to paranoia expression. It is worth noting that these studies did not account for the potential mediating relationship of negative emotion. However, as the few previous studies have used different measures or procedures, and have returned largely different results, it is difficult to compare
the findings. Nevertheless, the current study does differ from other studies in that it found no direct relationship between adaptive or maladaptive ER and PLE.

The relationship between ER strategies and negative emotion, and negative emotion and PLE is well established (Brans et al., 2013; Cella et al., 2008; Gross & John, 2003; Paulik et al., 2006). Therefore, it was hypothesised that maladaptive and adaptive ER strategies use would lead to increased or decreased negative emotion, respectively, and in result, would help influence PLE (indirect relationship). The current study found a relationship between suppression and PLE through the general psychological distress factor, however this finding only accounted for less than 1% of the variance in PLE scores. No other indirect relationships were observed in the current sample. This suggests that the habitual use of ER strategies assessed by the ERQ is not related to PLE.

There are several explanations for the findings. There may be a relationship between ER and PLE, but limitations related to measurement or sampling have influenced the findings. Whilst there are many ER strategies, the current study only examined reappraisal and expressive suppression. It is possible that including a more comprehensive set of ER strategies, particularly those associated with psychopathology (e.g. rumination, avoidance, thought suppression; Aldao et al., 2010) may return different results. Also, it may be self-report measures of ER strategy use are less accurate due to inherent drawback of not knowing if reported self-reflection truly reflects habitual cognition/behaviour. Nevertheless, self-report measures are still considered the most viable method of examining the unique and shared variance between negative emotion, ER strategy use, and PLE. The abbreviated PSQ measure adopted for this study may also have skewed the results. For example, it is possible the current PSQ version measures more common, less distressing PLE. Alternatively, the sample composition may have also influenced the results. In the case of a sample being
relatively homogenous for PLE, finding no association between ER strategies and PLE could be foreseeable. However, the current sample distribution (positively skew) is expected in sub-clinical presentations of mental illnesses with multi-factorial causes (e.g. psychosis; van Os et al., 2009). This coupled with the large sample size (leading to sufficient numbers of extreme cases), leads us to believe sample composition was not a significant influence on the results. In addition, some of our results above replicated existing findings, suggesting that our sample was not unusual and that the analyses were adequate.

As mentioned previously, it is recommended that future studies examine the relationship between a wide range of ER strategies, the shared and unique variance within negative emotion, and their influence on hallucination and paranoia PLE independently. It is suggested that structural equation modelling (SEM) is used to assess these relationships, due to several advantages compared to conventional regression analyses. Firstly, it will allow for indirect effects, to assess the influence of negative emotion on the relationship between ER strategies and PLE, which is not appropriate in standard regression models due to the covariance of negative emotion with both the predictor and criterion. Secondly, SEM simultaneously gives access to examine the unique and shared variance between measures of negative affect (quadripartite model). This way, the extent to which generalised distress (i.e. underlying shared variance between depression, anxiety and stress) and variance unique to specific negative affect factors are related to hallucination and paranoia PLE can be examined. Thirdly, SEM is a more comprehensive assessment technique of the relationships between aspects of negative emotion, ER and PLE because it can account for the random error present in all measurement that is not directly related to relevant variables.

In summary, our results support existing research suggesting ER influences negative affect, and negative affect predicts PLE. However, the relationship between ER and PLE is less clear, with limited and inconsistent results in the literature. Due to the limited research in
the area of emotion and PLE, and the complex nature of PLE expression, the exact nature of these relationships needs to be explored further.
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Chapter 5: General discussion

The aim of the thesis was to explore emotion processing, and its association with PLE. This is important because individuals with PLE frequently have negative affect, and studies have demonstrated a relationship between poor emotion processing and negative affect. The broad objective of my thesis was therefore to examine whether PLE in the general community were linked to negative affect and difficulties with emotional processing. This is significant because individuals with PLE may be at ‘high risk’ to make a transition to psychosis. The identification of the specific type of emotion processing dysfunctions in PLE is therefore likely to be informative when putting in place intervention strategies aimed at reducing the vulnerability of these individuals in developing psychosis.

The tasks chosen to assess emotion processing included the Emotion Regulation Questionnaire (ERQ) and the Emotion Processing Scale (EPS), which are frequently used and generally well accepted in the emotion processing literature. However, given that the ERQ and EPS have not yet been well validated, my first task was to assess their psychometric properties in community samples. Without this assessment, inferences made based on scale scores may be inaccurate and misguided. By achieving validation of the tasks, I hoped to use the best tasks possible to examine the relationship between PLE and emotion processing. Therefore, the psychometric assessment of the ERQ is covered in Chapter 2, and the EPS is assessed in Chapter 3. In chapter 4, I specifically assessed the relationships between emotion regulation, negative affect, and PLE.

5.1 Chapter 2

The 10-item Emotion Regulation Questionnaire (ERQ) was developed by Gross and John (2003) to measure the habitual use of two emotion regulation strategies – reappraisal and
suppression. As a preliminary study to our investigations of emotion processing in PLE, a confirmatory factor analysis (CFA) on the ERQ was carried out on two large community samples (Australia, \( N = 550 \); United Kingdom, \( N = 483 \); 17–95 years of age). The original factor ERQ structure was not supported by either sample. However, with the removal of one item, a strong model fit was obtained for both samples (revised ERQ-9). Using measurement invariance tests, the revised ERQ-9 was found to be equivalent across the samples and demographics (age, gender and education). In other words, people who varied by country and demographics did not differ in how they interpreted and scored themselves on the ERQ-9. This lends support to the external validity of the ERQ-9. Furthermore, there was an association between gender, depression, anxiety and stress (DASS), whereby males and higher DASS scores were associated with increased suppression use, and females and lower DASS scores were associated with greater reappraisal scores. Whilst it was recommended that these findings are replicated in other community samples, the results suggest that the revised ERQ-9 is a robust measure of reappraisal and suppression in community samples.

5.2 Chapter 3

The Emotion Processing Scale (EPS-25) was developed by Baker et al. (2010) to identify difficulties in the processing of emotions Similar to Chapter 2, a CFA was conducted on the EPS, using the same two community samples (Australia, \( N = 575 \); United Kingdom, \( N = 597 \), age 17-95). In contrast to the previous chapter, the original factor structure of the EPS could not be replicated in either the Australian or United Kingdom samples, and attempts to revise the scale by re-specifying an optimal measurement model for the samples were not successful. Despite all attempts to find a working model of the scale, problems with significant widespread standardised residual covariances in the original and optimised model could not be overcome.
This was a significant blow to this study, as the overarching conclusion of these analyses was that the EPS could not be validated as a measure of emotion processing in healthy populations, and that it was unstable and not suitable for use in community samples until substantial scale refinement or redevelopment with subsequent validation is achieved. Therefore, the EPS could not be used for subsequent analyses.

5.3 Chapter 4

After examining the psychometric properties of the ERQ and EPS, attention turned towards the examination of whether emotion regulation and negative affect predicted PLE. Given that the EPS could not be used, the focus was on the ERQ, and the measure of depression anxiety and stress (DASS), in relation to PSQ.

The specific questions were: does negative affect predict PLE, does emotion regulation predict negative affect, and does emotion regulation predict PLE (directly, and indirectly. This was achieved by through several structural equation models, with the final model specifying all scales, with emotion regulation factors assigned as first-order predictors, and the negative affect factors set as second-order predictors of PLE. Surprisingly, the only significant predictor of PLE was the negative affect factor, generalised psychological distress, which measured the common variance from depression, anxiety, and stress. Despite previous research suggesting a relationship between emotion regulation (including reappraisal) and PLE (Taylor, Graves, & Stopa, 2009; Westermann, Boden, Gross, & Lincoln, 2013; Westermann, Kesting, & Lincoln, 2012), no direct or indirect association was observed. The only relationship found between ER and negative affect was suppression predicting depression. Other statistically significant results were observed, however the effect of these results were practically negligible. It was suggested that future research examine a wider
range of ER strategies, especially those which are rarely adaptive, and related to psychopathology (e.g. thought suppression).

5.4 Negative affect, emotion processing problems: relevance to PLE?

In summary, the findings of my thesis in regards to PLE and emotion processing were as follows: First, my thesis showed a link between PLE and negative affect. This finding is largely consistent with studies finding higher levels of depression, anxiety and stress predict PLE (Cella, Cooper, Dymond, & Reed, 2008; Jones, Murray, Jones, Rodgers, & Marmot, 1994; Kugelmass et al., 1995; Paulik, Badcock, & Maybery, 2006). Specifically novel to the current study, we also explored the contribution of unique and shared variance within depression, anxiety and stress, as predictors of PLE. The results showed the generalised distress factor (shared variance) to be the only predictor of PLE. This suggests that negative affect predicting PLE may be best explained by a general predisposition to distress, rather than specifically to negative symptoms such as depression, anxiety and stress.

Second, the only significant relationship between emotion regulation and negative affect in the current study was a positive association between emotion suppression and depression. This underscores a general trend in the literature that suppression is a better predictor of depression, than anxiety or stress (Matheson & Anisman, 2003; Wiltink et al., 2011). In contrast, previous studies have found reappraisal to be associated with decreased negative affect (Gross & John, 2003; Wiltink et al., 2011). The difference in findings may be due to studies using different negative affect measures (PANAS - mood, $r = -.51$, Gross & John, 2003; HADS - depression, $r = -.16$, Wiltink et al., 2011; DASS – depression, $r = -.12$, Chapter 4).

Third, the results showed that there was no direct, or indirect (via DASS), relationship between emotion regulation and PLE. This is somewhat at odds with a previous report, which
reported that (contrary to expectations) adaptive ER strategies (e.g. reappraisal), but not maladaptive strategies (e.g. reappraisal) were associated with PLE (Westermann et al., 2012), and a later (contradictory) finding by the same author- that maladaptive, but not adaptive ER, predicted PLE (Westermann et al., 2013). Generally, it is difficult to extrapolate any trends from the literature, because existing studies varying considerably in how they capture PLE and ER, and the nature of the samples investigated.

Overall, on the basis of the current results, and the tasks used in this study, I can conclude that emotion processing difficulties are not directly related to PLE as assessed using our measures. However, there may be alternative explanations for this finding, including limitations regarding measurement and sampling methods. As we discussed in chapter 4, the current measure of emotion regulation (ERQ) is very limited in content. Including a more comprehensive set of ER strategies, particularly those associated with psychopathology (e.g. rumination, avoidance, and thought suppression) may return different results. In addition, the use of other emotion processing scales would be worthwhile. The study sample also was relatively homogenous for PLE, however, the sample distribution was expected for measuring sub-clinical presentations of mental illness. Given the large sample size, we considered sample composition is unlikely to significantly influence the results.

5.5 Limitations

In addition to the limitations discussed above, other limitations of this research included: cross-sectional data, scale timeframes, and no measure of emotion perception/awareness. The cross-sectional nature of the data also makes it difficult to argue the causality of associations. The current study has drawn on previous experimental and prospective research which found maladaptive ER increases and negative affect, and persistent negative affect increases PLE, to argue the direction of relationships. However,
there are also findings that suggest psychotic symptoms increase negative affect (Kuipers et al., 2006; Smith et al., 2006), and negative affect influences the effectiveness and choice of emotion processing (Joormann & Gotlib, 2010; Phillips, Drevets, Rauch, & Lane, 2003). To our knowledge, no experimental or prospective studies have incorporated emotion processing, negative affect, and PLE simultaneously. Given the apparent reciprocal relationship between aspects of emotion processing, negative affect and PLE, experimental and prospective studies encompassing all three factors is recommended.

The measurement time frame of the scales may also have influenced results. The PSQ measures PLE in the last previous year, the DASS measures negative affect in the past week, whilst the ERQ has no set time frame. Indeed, the larger the discrepancy in the time frame between the traits captured, the more likely any relationship between them is spurious. For example, it is possible that high negative affect scores reflect a transitional stressful event, with the individual otherwise being low on negative affect. It is expected that longer term or trait negative affect is more likely to influence PLE (Docherty, St-Hilaire, Aakre, & Seghers, 2008; Rössler, Hengartner, Ajdacic-Gross, Haker, & Angst, 2013), so in this example, transitional scores may suppress what would otherwise be a stronger relationship between negative affect and PLE.

The study was also limited by the lack of validation of the EPS-25. As a measure which tapped emotion perception, regulation and experience, it would have allowed for a more comprehensive assessment of how emotion processing relates to PLE (specifically emotion perception). However, it was fortuitous that we conducted a validation study before exploring any associations, otherwise any inferences may have been unsound.

5.6 Areas for future research
It is recommended that future studies of emotion processing and PLE include measures of dysfunctional ER (e.g. intrusion of thoughts) and a more comprehensive set of emotion regulation strategies, particularly those associated with psychopathology (e.g. rumination and thought suppression). Accounting for the unique and shared variance between negative affect scales may also elucidate to what extent negative affect types influence PLE onset and maintenance. This may help with the development of optimal screening and preventative measures. Furthermore, future studies may benefit from obtaining larger samples sizes, or sampling groups with more distinct PLE clusters (e.g. paranoia and hallucinations), and the use of a PLE scale with stricter symptom inclusion. This would allow for the exploration of whether aspects of emotion processing differentially influence PLE clusters.
5.7 References


negative schematic beliefs and delusions and hallucinations. *Schizophrenia Research*, 86(1-3), 181-188. doi: 10.1016/j.schres.2006.06.018


5.8 Appendices and supplementary materials

5.8.1 Chapter 2

Appendix A

The following tables and figures were provided to the reviewers, and are available as an online resource at

http://supp.apa.org/psycarticles/supplemental/a0034474/a0034474_supp.html

Figure 1. AUS sample: Standardized factor loadings for CFA.

Appendix B
Figure 2. UK sample: Standardized factor loadings for CFA.
Figure 3. AUS sample: Modified Standardized factor loadings for CFA with item-3 deletion.
Figure 4. UK sample: Modified standardized factor loadings for CFA with Item-3 deletion.
Appendix E

Revised 9-item Emotion Regulation Questionnaire (9-item ERQ)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reappraisal</td>
<td>1 - When I want to feel more positive (such as joy or amusement), I change what I’m thinking about.</td>
</tr>
<tr>
<td></td>
<td>5 – When I’m faced with a stressful situation, I make myself think about it in a way that helps me calm down.</td>
</tr>
<tr>
<td></td>
<td>7 – When I want to feel more positive emotion, I change the way I’m thinking about the situation.</td>
</tr>
<tr>
<td></td>
<td>8 – I control my emotions by changing the way I think about the situation I’m in.</td>
</tr>
<tr>
<td></td>
<td>10 – When I want to feel less negative emotion, I change the way I’m thinking about the situation.</td>
</tr>
<tr>
<td>Suppression</td>
<td>2 - I keep my emotions to myself</td>
</tr>
<tr>
<td></td>
<td>4 – When I am feeling positive emotions, I am careful not to express them.</td>
</tr>
<tr>
<td></td>
<td>6 – I control my emotions by not expressing them</td>
</tr>
<tr>
<td></td>
<td>9 – When I am feeling negative emotions, I make sure not to express them.</td>
</tr>
</tbody>
</table>
Appendix F

 Nested Model Comparisons for invariance test between Australian and United Kingdom community samples.

<table>
<thead>
<tr>
<th>Model</th>
<th>Δdf</th>
<th>Δχ²</th>
<th>Sig.</th>
<th>ΔTLI</th>
<th>ΔCFI</th>
<th>ΔRMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal factor loadings</td>
<td>7</td>
<td>6.589</td>
<td>.473</td>
<td>.004</td>
<td>0</td>
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<td>9</td>
<td>14.144</td>
<td>.117</td>
<td>0</td>
<td>.001</td>
<td>.001</td>
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<tr>
<td>Equal covariance</td>
<td>3</td>
<td>6.920</td>
<td>.074</td>
<td>0</td>
<td>.002**</td>
<td>.001</td>
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<tr>
<td>Equal Error</td>
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<td>39.832</td>
<td>.001*</td>
<td>.007</td>
<td>.011**</td>
<td>.004</td>
</tr>
</tbody>
</table>

Note.  * = p < .05; ** = ΔCFI > .002; Each row of this table is assuming that the previous row is invariant. E.g. the Equal FL statistics are assuming the unconstrained model is invariant. TLI = Tucker-Lewis Index, CFI = comparative fit index, RMSEA = root mean square error of approximation. Maximum Likelihood (ML) estimation was used. Maximum Likelihood (ML) estimation was used because it is a more thorough method to examine the extent of invariance (compared to asymptotic distribution free - ADF).
Appendix G

**Nested Model Comparisons for invariance tests for Age, Education and Gender in the combined Australian and United Kingdom community sample.**

<table>
<thead>
<tr>
<th>Model</th>
<th>Δdf</th>
<th>Δ $\chi^2$</th>
<th>Sig.</th>
<th>Δ TLI</th>
<th>Δ CFI</th>
<th>Δ RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>7</td>
<td>11.232</td>
<td>.129</td>
<td>.003</td>
<td>.002**</td>
<td>.002</td>
</tr>
<tr>
<td>Equal means/intercepts</td>
<td>9</td>
<td>24.591</td>
<td>.003*</td>
<td>.002</td>
<td>.005**</td>
<td>.001</td>
</tr>
<tr>
<td>Equal covariance</td>
<td>3</td>
<td>2.497</td>
<td>.476</td>
<td>.002</td>
<td>&lt;.001**</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Equal Error</td>
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<td>14.385</td>
<td>.109</td>
<td>.002</td>
<td>.002**</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Education</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>7</td>
<td>16.335</td>
<td>.022*</td>
<td>&lt;.001</td>
<td>.003**</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Equal means/intercepts</td>
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<td>29.414</td>
<td>.001*</td>
<td>.003</td>
<td>.007**</td>
<td>.001</td>
</tr>
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<td>Equal covariance</td>
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<td>14.173</td>
<td>.003*</td>
<td>.003</td>
<td>.004**</td>
<td>.002</td>
</tr>
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<td>Equal Error</td>
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<td>27.596</td>
<td>.001*</td>
<td>.001</td>
<td>.007**</td>
<td>&lt;.001</td>
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<td><strong>Gender</strong></td>
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<td>Equal factor loadings</td>
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<td>9.775</td>
<td>.202</td>
<td>.003</td>
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<td>.001</td>
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<td>Equal means/intercepts</td>
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<td>34.794</td>
<td>&lt;.001*</td>
<td>.006</td>
<td>.009**</td>
<td>.003</td>
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<tr>
<td>Equal covariance</td>
<td>3</td>
<td>4.229</td>
<td>.238</td>
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<td>.001</td>
<td>.001</td>
</tr>
<tr>
<td>Equal Error</td>
<td>9</td>
<td>32.027</td>
<td>&lt;.001*</td>
<td>.004</td>
<td>.008**</td>
<td>.002</td>
</tr>
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</table>

*Note.* * = p < .05; ** = Δ CFI > .002; Each row of this table is assuming that the previous row is invariant. E.g. the Equal FL statistics are assuming the unconstrained model is invariant. TLI = Tucker-Lewis Index, CFI = comparative fit index, RMSEA = root mean square error of approximation. Maximum Likelihood (ML) estimation was used. Maximum
Likelihood (ML) estimation was used because it is a more thorough method to examine the extent of invariance (compared to asymptotic distribution free - ADF).
### Appendix H

**Effects of Non-Equivalence on Scale-Level Properties**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Δ mean</th>
<th>Observed mean difference</th>
<th>Δ Var</th>
<th>Observed variance difference</th>
<th>dMACS min - max</th>
<th>dMACS Factor-level</th>
</tr>
</thead>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Reappraisal</td>
<td>-0.81</td>
<td>-0.67</td>
<td>9.95</td>
<td>-1.26</td>
<td>.11 - .49</td>
<td>.17</td>
</tr>
<tr>
<td>Suppression</td>
<td>0.70</td>
<td>0.03</td>
<td>-18.93</td>
<td>-3.25</td>
<td>.09 - .44</td>
<td>.15</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reappraisal</td>
<td>-0.49</td>
<td>-0.37</td>
<td>6.11</td>
<td>8.04</td>
<td>.02 - .39</td>
<td>.10</td>
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<tr>
<td>Suppression</td>
<td>-0.17</td>
<td>0.93</td>
<td>10.79</td>
<td>5.68</td>
<td>.14 - .30</td>
<td>.04</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reappraisal</td>
<td>0.18</td>
<td>-0.88</td>
<td>-16.82</td>
<td>3.73</td>
<td>.05 - .38</td>
<td>.04</td>
</tr>
<tr>
<td>Suppression</td>
<td>0.49</td>
<td>1.43</td>
<td>4.49</td>
<td>1.60</td>
<td>.09 - .22</td>
<td>.11</td>
</tr>
</tbody>
</table>

*Note. Δ mean = the difference in means that can be attributed to items functioning differently between the analysed groups due to non-equivalence. Δ Var = the difference in variance that can be attributed to items functioning differently between the analysed groups due to non-equivalence. The observed mean and variance differences are the true differences between the groups. Positive values refer to the reference group having higher mean/variance than the focal group. Negative values imply that the focal has higher mean/variance than the reference group. Reference groups: Age, Younger; Education, Lower; Gender, Male. Focal groups: Age, Older; Education, Higher; Gender, Female. dMACS = effect size of mean and*
covariance structure. Factor-level dMACS is calculated by dividing the Δ mean by the pooled standard deviation.
Appendix I

Revised multi-group analysis (9-item ERQ) - invariance test for age and education with the combined Australian and United Kingdom community sample.

<table>
<thead>
<tr>
<th>Model</th>
<th>df</th>
<th>$\chi^2$</th>
<th>Sig.</th>
<th>$\chi^2$/df</th>
<th>SRMR</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>LO 90</th>
<th>HI 90</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unconstrained</td>
<td>130</td>
<td>219.805</td>
<td>&lt;.001*</td>
<td>1.579</td>
<td>.036</td>
<td>.962</td>
<td>.973</td>
<td>.024</td>
<td>.017</td>
<td>.030</td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>151</td>
<td>255.428</td>
<td>&lt;.001*</td>
<td>.045</td>
<td>.968</td>
<td>.973</td>
<td></td>
<td>.022</td>
<td>.016</td>
<td>.028</td>
</tr>
<tr>
<td>Equal means/intercepts</td>
<td>178</td>
<td>324.264</td>
<td>&lt;.001*</td>
<td>1.554</td>
<td>.046</td>
<td>.964</td>
<td>.964</td>
<td>.023</td>
<td>.018</td>
<td>.029</td>
</tr>
<tr>
<td>Equal covariance</td>
<td>187</td>
<td>330.417</td>
<td>&lt;.001*</td>
<td>1.534</td>
<td>.046</td>
<td>.965</td>
<td>.964</td>
<td>.023</td>
<td>.017</td>
<td>.028</td>
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<tr>
<td>Equal Error</td>
<td>214</td>
<td>372.002</td>
<td>&lt;.001*</td>
<td>1.528</td>
<td>.047</td>
<td>.966</td>
<td>.959</td>
<td>.023</td>
<td>.018</td>
<td>.028</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unconstrained</td>
<td>78</td>
<td>155.364</td>
<td>&lt;.001*</td>
<td>1.992</td>
<td>.038</td>
<td>.961</td>
<td>.972</td>
<td>.031</td>
<td>.024</td>
<td>.039</td>
</tr>
<tr>
<td>Equal factor loadings</td>
<td>92</td>
<td>176.154</td>
<td>&lt;.001*</td>
<td>.044</td>
<td>.964</td>
<td>.970</td>
<td></td>
<td>.030</td>
<td>.023</td>
<td>.037</td>
</tr>
<tr>
<td>Equal means/intercepts</td>
<td>110</td>
<td>223.269</td>
<td>&lt;.001*</td>
<td>2.030</td>
<td>.043</td>
<td>.960</td>
<td>.959</td>
<td>.032</td>
<td>.026</td>
<td>.038</td>
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<td>Equal covariance</td>
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<td>.959</td>
<td>.955</td>
<td>.033</td>
<td>.027</td>
<td>.038</td>
</tr>
<tr>
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<td>.049</td>
<td>.956</td>
<td>.945</td>
<td>.034</td>
<td>.028</td>
<td>.039</td>
</tr>
</tbody>
</table>

Note. Age = quintile split – age groups in years (17 – 20, 21 – 25, 26 – 41, 42 – 61, 62 - 95);
Education = 3 groups – designed to represent up to highschool (4 – 12), undergraduate/tertiary (12.5 – 16), and postgraduate (16.5 – 27.25) years of education.
SRMR = standardised root mean-square residual, RMSEA = root mean square error of approximation, CFI = comparative fit index, TLI = Tucker-Lewis Index, LO 90 and HI 90 = lower and upper boundary of 90% confidence interval for RMSEA. Maximum Likelihood (ML) estimation was used. Maximum Likelihood (ML) estimation was used because it is a more thorough method to examine the extent of invariance (compared to asymptotic distribution free - ADF).
Appendix J

Revised multiple (two-group) invariance testing by effect size

<table>
<thead>
<tr>
<th>Effect size (min – max)</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<td><strong>Age groups</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>0.07 – 0.17</td>
<td>0.13 – 0.24</td>
<td>0.16 – 0.46</td>
<td>0.04 – 0.21</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>0.03 - 0.21</td>
<td>0.06 - 0.33</td>
<td>0.03 – 0.13</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.05 - 0.30</td>
<td>0.08 – 0.22</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.04 – 0.28</td>
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<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Suppression</td>
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</tr>
<tr>
<td>1</td>
<td>-</td>
<td>0.22 – 0.36</td>
<td>0.21 – 0.29</td>
<td>0.28 – 0.46</td>
<td>0.10 – 0.27</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>0.03 - 0.11</td>
<td>0.02 - 0.17</td>
<td>0.16 – 0.48</td>
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<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.02 - 0.23</td>
<td>0.14 – 0.52</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.28 – 0.33</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td><strong>Education groups</strong></td>
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<tr>
<td>Reappraisal</td>
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</tr>
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<td>-</td>
<td>0.04 - 0.21</td>
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<tr>
<td>3</td>
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150
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<tr>
<td></td>
<td></td>
<td>0.19 - 0.26</td>
<td>0.20 - 0.39</td>
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</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>0.06 – 0.19</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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</tbody>
</table>

*Note.* Age groups (in years): 1) 17 – 20, 2) 21 – 25, 3) 26 – 41, 4) 42 – 61, 5) 62 – 95. Age groups were determined by a quintile split. Education groups (in years): 1) 4 – 12, 2) 12.5 – 16, 3) 16.5 – 27.25. The three groups for the revised education-based invariance testing represented up to high school (group 1), undergraduate/tertiary (group 2), and postgraduate (group 3) education levels.
### 5.8.2 Chapter 3

**Appendix A**

*EFA item loadings for UK, 5 factors specified.*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1</th>
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<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
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Note: Geomin rotation. Item loadings less than .30 were omitted.
Appendix B

*EFA item loadings for UK. 2 factors specified.*

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Note: Geomin rotation. Item loadings less than .30 were omitted.
### Appendix C.

**Emotion Processing Scale (25-item EPS)**

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<tr>
<th>Scale</th>
<th>Items</th>
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<tbody>
<tr>
<td><strong>Suppression</strong></td>
<td>1 – I smothered my feelings</td>
</tr>
<tr>
<td></td>
<td>6 – I could not express feelings</td>
</tr>
<tr>
<td></td>
<td>11 – I kept quiet about my feelings</td>
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<td></td>
<td>16 – I bottled up my emotions</td>
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<tr>
<td></td>
<td>21 – I tried not to show my feelings to others</td>
</tr>
<tr>
<td><strong>Unprocessed</strong></td>
<td>2 – Unwanted feelings kept intruding</td>
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<tr>
<td></td>
<td>7 – My emotional reactions lasted for more than a day</td>
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<td></td>
<td>12 – I tended to repeatedly experience the same emotion</td>
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<td></td>
<td>17 – I felt overwhelmed by my emotions.</td>
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<tr>
<td></td>
<td>22 – I kept thinking about the same emotional situation again and again</td>
</tr>
<tr>
<td><strong>Unregulated</strong></td>
<td>3 – When upset or angry it was difficult to control what I said.</td>
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<td></td>
<td>8 – I reacted too much to what people said or did</td>
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<td></td>
<td>13 – I wanted to get my own back on someone</td>
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<td></td>
<td>18 – I felt the urge to smash something</td>
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<td></td>
<td>23 – It was hard for me to wind down</td>
</tr>
<tr>
<td><strong>Avoidance</strong></td>
<td>4 – I avoided looking at unpleasant things (e.g. on TV/in magazine)</td>
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<tr>
<td></td>
<td>9 – Talking about negative feelings seemed to make them worse</td>
</tr>
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<td></td>
<td>14 – I tried to talked only about pleasant feelings</td>
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<td></td>
<td>19 – I could not tolerate unpleasant feelings</td>
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<td></td>
<td>24 – I tried very hard to avoid things that might make me upset</td>
</tr>
<tr>
<td><strong>Impoverished</strong></td>
<td>5 – My emotions felt blunt/dull</td>
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</tbody>
</table>

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10 – My feelings did not seem to belong to me

15 – It was hard to work out if I felt ill or emotional

20 – There seemed to be a big blank in my feelings

25 – Sometimes I got strong feelings but I’m not sure if their emotions
Figure 2. Full Structural Equation Model. Dep = DASS Depression, Anx = DASS Anxiety, Stress = DASS Stress, gd = generalised distress factor, PLE = PSQ.