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An exploration into psychophysiological and affective responses to mental imagery.

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Table of Contents

Introductory Chapter: Thesis Overview……7

References……..10

Chapter I: Systematic Review……..12

Abstract……13

Introduction……14

Method……18

Literature Search……18

Study Eligibility……19

Types of Participants……19

Mental Imagery……19

HRV Measures……20

Data Extraction……20

Quality Assessment……20

Results……21

Search Results……21

Description of Included Studies……21

Quality Assessment……26

Study Findings……29

The Impact of Mental Imagery on HRV……29

Group Differences in HRV Response to Mental Imagery……35

Discussion……38

Limitations and Conclusions……44

References……46

Chapter II: Empirical Paper……56

Abstract……57

Introduction……59

Method……64

Participants……64

Materials……66

Failure Scenario……66

Mental Imagery Tasks……66

Verbal Thought Tasks……66

Measures……67

Demographics……67

PANAS……67

ToPAS……67

EMWSS……68

SUIS……68

Procedure……68

Results……69

Descriptives……69

Negative Affect (PANAS)……71

Positive Affect……72

ToPAS – Safe/Warmth……72

ToPAS – Relaxed……74

Discussion……75

Limitations……78

Clinical Implications……..79

References……82

Appendices……90

List of Tables

Chapter I

Table 1. Study Characteristics……23

Table 2. Quality Assessment……27

Table 3. Study Findings……30

Chapter II

Table 1. Participant Demographics……..65

Table 2. Means and standard deviations of the dependent variables……70

Table 3. Descriptives for the moderator variables……70

List of Figures

Chapter I

Figure 1. PRISMA flow diagram of search results and included and excluded articles……22

Chapter II

Figure 1. Mean negative affect scores……..71

Figure 2. Mean safeness/warmth scores……73

Figure 3. Mean relaxation scores……..75

List of Appendices

Appendix A – Author Guidelines for Psychophysiology……90

Appendix B – Quality Assessment Tool for Quantitative Studies……95

Appendix C – Author Guidelines for Psychology and Psychotherapy: Theory, Research and Practice……103

Appendix D – Research Review Committee Approval……109

Appendix E – University Ethics Approval……110

Appendix F – Scripts for the Failure Instructions and Conditions……112

Appendix G – Negative Affect Scale……114

Appendix H – Types of Positive Affect Scale……115

Appendix I – Early Memories of Warmth and Safeness Scale……116

Appendix J – Spontaneous Use of Imagery Scale……118

Appendix K – Participant Information Sheet……119

Appendix L – Participant Consent Form……124

Appendix M – Support Information……125

Appendix N – Participant Debrief Information……126

Appendix O – Descriptives Testing the Assumption of Normality……128

Appendix P – Cronbach's Alphas for the Dependent Variables and Moderators……135

Word Count

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Introductory Chapter: Thesis Overview	847	365
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Introductory Chapter: Thesis Overview

"Everything you can imagine is real" – Pablo Picasso

Throughout time, artists have utilised imagery to depict emotional experience within their work. During the early 20th century, the art movement of 'expressionism' emerged which centred around the depiction of human emotions within art (Behr, 1999). Many artists not only use their art to express emotion, but to additionally evoke an affective response in the viewer. Examples of this include Roy Lichtenstein's 'Frightened Girl', Edvard Munch's 'The Scream', and Pablo Picasso's 'The Weeping Woman', to name but a few (Matravers, 1998). Not only is imagery used in art to evoke an emotional response, but also within fiction. It is thought that humans are the only species to create fictional tales conveyed through using imagery (Wong, 2020). The oldest examples of humans using imagery within storytelling dates back to cave paintings that were found in Indonesia, thought to be from over 43,000 years ago (Aubert et al., 2019). Illustrating the use of imagery to evoke emotion as an ancient capacity utilised by humans for thousands of years.

Imagery is an important component in many cognitive skills, such as memory, creativity, emotion, language, problem solving and introspection. It has also been said that the use of imagery played an important role for both Albert Einstein and Marcel Proust, allowing them to amplify their creativity (Kosslyn et al., 2006). More recently, a growing body of psychological research has illustrated the strong link between imagery and emotion (Holmes & Mathews, 2010; Pearson et al., 2015), highlighting the power of creating an image in one's minds eye. Mental imagery has been found to evoke a larger affective response than verbal thought on self-report measures (Holmes & Mathews, 2005; Holmes et al., 2006), psychophysiological (Vrana et al., 1986) and neural (Kosslyn & Thompson, 2003) correlates of emotion. One theory that may explain why mental imagery appears

more closely related to emotion than language is that the former predates the latter in terms of evolution of cognitive capacities (Kosslyn et al., 2006). Mental imagery is considered a sensory experience, which can more rapidly activate the threat response and emotion areas within the brain, namely the amygdala, while bypassing areas involved in higher level processing (LeDoux, 2000; Holmes & Mathews, 2010). These emotional systems are considered to have developed prior to the capacity for language, thus suggesting that mental imagery may activate these brain systems underpinning emotion more directly than language alone (Holmes & Mathews, 2010).

Given the strong link between imagery and emotion, it is unsurprising that it additionally plays a pivotal role in mental health difficulties and distress (Holmes & Mathews, 2010; Pearson et al., 2015). Many mental health difficulties are characterised by intrusive and distressing mental imagery, for example within Post-Traumatic Stress Disorder (PTSD), social anxiety, phobias, Obsessive Compulsive Disorder (OCD), and psychosis (Pearson et al., 2015). Thus, in order to effectively reduce distress related to these difficulties, therapeutic techniques may involve an imagery-based element to the intervention. Many psychotherapeutic models utilise mental imagery as a core component of therapy such as; imagery rescripting and imaginal exposure within Cognitive Behavioural Therapy (CBT; Holmes et al., 2007), emotive memory desensitisation in Eye Movement Desensitisation and Reprocessing (EMDR) therapy (Shapiro, 2017), imagery within schema therapy (Young et al., 2003), and compassionate imagery within Compassion Focused Therapy (CFT; Gilbert, 2009).

CFT is an emerging therapy that particularly emphasises mental imagery as a core component of interventions (Gilbert, 2009). Interventions within this therapy model centre around stimulating the parasympathetic nervous system in order to evoke a

psychophysiological soothe response. The imagery exercises consist of creating a safe place and imagining receiving and giving compassion. Compassionate imagery has been demonstrated to be soothing (Beaumont & Hollins-Martin, 2015), however, for some people, imagining receiving compassion can evoke a fear response, possibly as a result of early problematic attachment relationships (Gilbert, 2010). Thus, although imagery interventions can be useful in reducing distress, they may also induce a physiological stress response for some.

This thesis explores the relationship between psychophysiological and affective responses to mental imagery further. Chapter I is a systematic review of the literature around the psychophysiological impact of mental imagery, in particular using the physiological measure of Heart Rate Variability (HRV). This chapter explores the impact of both aversive and positive mental imagery on HRV, and the direction of this relationship. A secondary aim of the review is to explore whether any HRV changes found differ based on group characteristics. It is hoped that the findings of this systematic review will summarise whether generally people find mental imagery stressful or soothing based upon their psychophysiological responding. Chapter II adds to the CFT and mental imagery literature by exploring whether compassionate and critical imagery evoke larger self-reported affective responses, when compared to verbal thought alone. This empirical study further considers whether early memories of feelings of warmth and safeness, and use of imagery in daily life, are factors that influence how people react to compassionate and critical tasks. This empirical study thus explores some of the premises and predictions of CFT in an experimental non-clinical context.

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Chapter I: Systematic Review

Exploring the Impact of Mental Imagery upon Heart Rate Variability: A Systematic Review

Manuscript prepared for submission to Psychophysiology (see Appendix A for author guidelines)

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Abstract

Mental imagery has been described as an emotional amplifier of cognition and is closely linked to emotion. Research has found links between mental imagery and increased affect, neural activation of the amygdala, and physiological changes. In the last two decades, there has been an increase in research utilising heart rate variability (HRV) as a psychophysiological measure of cardiac vagal tone. To date, there have been no reviews exploring the possible link between imagery and HRV. The present review evaluated the evidence of the impact of mental imagery on HRV. A secondary aim was to explore whether any changes found in HRV response to imagery differed by group. Electronic searches of PsycINFO, PubMed, Medline and Web of Science were carried out to identify papers that met the eligibility criteria. Studies were required to have participants aged 18 or over, measured HRV at at least two time points, and utilised a mental imagery task within their design. A total of 12 studies met the inclusion criteria and were reviewed. Results demonstrated some limited evidence that mental imagery reduces HRV, indicative of a stress response. However, this finding was not consistent across all studies and other factors may influence HRV responses to mental imagery, specifically worry, self-criticism, emotional intelligence and depression. Further research is needed to explore the impact of positive imagery on psychophysiology and the factors and characteristics that may influence the effect of mental imagery upon HRV reactivity.

1. Introduction

Mental imagery is a psychological phenomenon that has played a central role in discussions regarding mental function for many years Pearson et al. (2015). Mental imagery, defined as creating a visual picture or representation of information in the mind's eye, is usually accompanied with sensory information (Pearson et al., 2015). It is considered a common human experience that often occurs when recalling a past memory, imagining future events, and when day-dreaming (Holmes & Mathews, 2010). Imagery is believed to support in planning, remembering, navigating and making decisions (Pearson et al., 2015). With the growth in imagery studies in recent years (Holmes & Mathews, 2010; Pearson et al., 2015), there is increasing research into the vast ways in which mental imagery plays a part in human experience and cognition (Pearson & Kosslyn, 2015).

Mental imagery can both be spontaneous, triggered by naturalistic internal and external events, or experimentally induced, and can take many different forms (Mathews et al., 2013). The majority of experimentally induced imagery tasks involve the generation of either autobiographical and episodic memories, or general images that are not necessarily personally relevant (Gardini et al., 2009). Imagery tasks commonly involve participants being provided with visual or auditory cues prompting them to maintain the image in their mind (Tiggemann & Kemps, 2005), however there is some evidence indicating this may be unnecessary, with imagery generation and engagement unaffected by whether participants have their eyes open or closed (Isaac & Marks, 1994; McKelvie, 1995). Motor imagery is another general form of mental imagery whereby motor movements are internally rehearsed without any physical motor output (Decety, 1996). However, motor imagery is considered a differential phenomenon due to appearing to be underpinned by different neural processes to that of mental imagery (Decety, 1996; McAvinue & Robertson, 2008).

Mental imagery has been described as an emotional amplifier of cognition and is considered to be closely related to emotion (Holmes et al., 2008; Holmes & Mathews, 2005), supported by evidence of amygdala activation during emotionally valiant imagery (Cabeza & St Jacques, 2007; Sharot et al., 2007). Mental imagery is considered to be different from verbal thought, with the

former being found to elicit stronger emotions (Mathews et al., 2013). Using different emotional valencies, Holmes and Mathews (2005) demonstrated that both positive and negative imagery led to larger self-reported emotional responses than did instructions to verbally think about an image. Further studies supported the generality of this effect of imagery to enhance emotional responses. (Holmes et al., 2009; Holmes et al., 2006), substantiating a privileged link between imagery and emotion.

Given this evidence of the impact of imagery upon the affect systems, it is unsurprising that the use of mental imagery appears relevant to the treatment of (emotionally laden) mental health difficulties (van den Hout & Engelhard, 2012). There is a long history of imagery techniques deployed in psychotherapy (Holmes et al., 2007), and within cognitive behavioural therapies, imaginal exposure to feared memories or objects has been a core intervention technique for decades, seen as superior to verbal-only strategies (Stopa, 2009). Whilst many therapies utilise imagery techniques, for Compassion Focused Therapy (CFT), imagery takes a pivotal role in the intervention approaches to significant psychological distress (Gilbert, 2010). CFT, shown to be effective for various clinical populations (Craig et al., 2020; Cuppage et al., 2018), specifically addresses the emotional aspects of mental health, and imagery techniques are intended to target specific emotional systems and promote greater emotional regulation.

The link between mental imagery and affect receives considerable support from neuroimaging studies. Not only does imagery appear to have the same neural correlates as visual perception (Kosslyn, 2005; Kosslyn & Thompson, 2003), but these appear to additionally link imagery with neural areas associated with emotional processing, namely the amygdala. Kim et al. (2007) found that when imagining negative emotion facial expressions, this activated the amygdala, when compared to imagining neutral faces. Similarly, imagery aimed to induce feelings of fear evokes neural activity within fear-processing areas of the brain including the amygdala, midcingulate cortex, and insula (Hoppe et al., 2021). Thus, indicating that emotionally valiant imagery may activate neural mechanisms in much the same way as perceived emotional events. Therefore, simply imagining an

event or creating a visual picture in the mind's eye appears to evoke similar neural patterns as would be activated when perceiving the same information.

It is widely documented that emotional experience is correlated with the activation of the central and peripheral nervous systems (Gross & Feldman Barrett, 2011; Ji et al., 2016). Therefore, due to mental imagery appearing to elicit both self-reported and neural emotional responses, it is expected that it would additionally evoke a physiological response. Research has confirmed this link between imagery and psychophysiology with emotionally salient imagery appearing to evoke a larger skin conductance response (Lang et al., 1983; Reyher & Smeltzer, 1968), increased heart rate (Cook et al., 1991; Vrana et al., 1986), increased respiration (Van Diest et al., 2001), and a greater startle blink reflex (Cuthbert et al., 2003; Vrana & Lang, 1990), when compared to words or neutral imagery.

Heart Rate Variability (HRV) is a measure used increasingly within psychophysiological research due to its non-invasive nature and ease of measurement (Laborde et al., 2017). HRV is the change in time intervals between heartbeats and is thought to reflect cardiac vagal tone (Laborde et al., 2017). However, the measurement of HRV is complex due to the complicated nature of understanding and interpreting the different HRV parameters. HRV analysis can use the time-domain or frequency-domain analysis with different parameters within each, reflecting differential physiological systems (Laborde et al., 2017). Within the frequency-domain, the ultra-low frequency (ULF) band that is thought to reflect circadian oscillations, metabolism and body temperature and is located below 0.0033 Hz (Berntson et al., 1997). The very-low frequency (VLF) range is between 0.0033 and 0.04 Hz and represents thermoregulation and hormonal mechanisms (Berntson et al., 1997). The low-frequency (LF) band range is between 0.04 and 0.15 hz and is thought to represent sympathetic and vagal influences (Malik et al., 1996). High-frequency (HF) HRV ranges between 0.15 and 0.40 Hz and reflects vagal tone (Malik et al., 1996). The LF/HF ratio is also sometimes used within psychophysiological research which is thought to represent a mix of parasympathetic and sympathetic activation (Laborde et al., 2017). However, this measure has been criticised due to the

unclear relationship between LF power and sympathetic activation (Billman, 2013). Thus, within the frequency-domain measurements, only the HF band is thought to reflect vagal tone.

Within the time-domain, the measures of root mean square of successive differences (RMSSD) and standard deviation of all R-R intervals (SDNN) are additionally considered to be reflective of cardiac vagal tone (Thayer et al., 2000) and are highly correlated with HF HRV (Kleiger et al., 2005). Finally, respiratory sinus arrythmia (RSA) is another measure of HRV and reflects the acceleration of heart rate during inspiration and the deceleration during expiration (Laborde et al., 2017). RSA is additionally thought to reflects cardiac vagal tone (Eckberg & Eckberg, 1982). Reduced vagally-mediated HRV (including HF HRV, SDNN, RMSSD, and RSA) is generally considered as indicative of physiological stress, with increased HRV reflecting a physiological calming response (Laborde et al., 2017). However, it is necessary to consider respiration and confounding variables when interpreting and understanding HRV results as it is highly sensitive to these components (Laborde et al., 2017).

There are several theories implying HRV in psychophysiological research. Polyvagal theory (PVT) suggests that HRV provides an index of parasympathetic nervous system influence on the heart via the vagus nerve (Porges, 2007). The vagus nerve acts as a 'vagal break' inhibiting sympathetic nervous system arousal, inducing a calm physiological state which is reflected in an increase in HRV. However, at times of stress, this vagal break is withdrawn which results in an increase in sympathetic nervous system activation enabling the fight or flight response (Porges, 2007). This vagal withdrawal is reflected within a reduction in HRV (Porges, 2007; Thayer & Lane, 2000). Competing with the PVT, Thayer and Lane (2000) propose an alternative model of the connections and functioning of the vagus nerve. The neurovisceral integration model posits a connection between the prefrontal cortex and the heart which is regulated by the central autonomic network and the vagus nerve. This network thus adjusts physiological arousal via the vagus nerve based upon external and internal information received in the cortex (Thayer & Lane, 2000). This model and PVT concur with the theory that vagally-mediated HRV is reflective of parasympathetic nervous system activation, with

higher resting HRV indicative of better emotion regulation abilities (Reynard et al., 2011; Thayer et al., 2009). Whilst there is a wealth of evidence that higher resting vagal tone is associated with positive physical and mental health indices (Kemp & Quintana, 2013), less research has explored HRV reactivity (Laborde et al., 2017), namely how responsive the vagal system is to external or internal stressors.

Reduced HRV reactivity is thought to be indicative of physiological stress, whilst increased HRV reactivity reflects a calming response (Porges, 2007; Thayer & Lane, 2000). There have been multiple empirical studies exploring the impact that mental imagery has upon HRV reactivity, i.e., how does HRV change in response to imagery, however, to date no synthesis of this is available within the literature. Thus, the current review examines whether mental imagery has a significant impact upon HRV, and if so, in what direction? The above literature suggests that emotionally evocative imagery is associated with self-reported affective response; specifically, aversive imagery appears to elicit stronger negative emotions (Hirsch & Holmes, 2007; Holmes & Mathews, 2005, 2010) and positive imagery appears to induce positive affect (Holmes et al., 2009; Holmes et al., 2006). Thus, the literature is expected to reveal an impact of mental imagery on HRV, with aversive imagery expected to reduce and positive imagery expected to increase HRV reactivity. Whether any such associations vary with participant characteristics is explored as a secondary research question.

2. Method

2.1. Literature Search

Comprehensive literature searches were conducted by the author utilising online databases in July 2021. The databases searched were PsycINFO, PubMed, Medline and Web of Science. The search terms that were used were considered in relation to the specific database being searched and included descriptors for both mental imagery and HRV. Search terms used for PsycINFO were (‘mental AND imag*’ OR ‘guided imag*’ OR ‘imag*’) AND (‘psychophysiolog*’ OR ‘heart rate variability’ OR ‘HRV’ OR ‘cardiac vagal tone’ OR ‘cardiac vagal control’ OR ‘respiratory sinus arrhythmia’ OR ‘RSA’). Searches were additionally restricted to peer-reviewed articles and written in

English. Search terms used for PubMed, Medline and Web of Science were the same as above; however, they excluded the search term 'imag*' due to this retrieving large numbers of irrelevant papers. Articles written prior to 1996 were excluded since this was before the Task Force paper was published (Malik et al., 1996), which detailed the required standards of measurement and interpretation of HRV.[1]

2.2. Study Eligibility

The titles and abstracts of papers retrieved from the above searches were screened by the first author in line with the predetermined inclusion/exclusion criteria. The full texts of relevant papers were then additionally screened and retained if they met the eligibility criteria.

2.2.1. Types of Participants

Studies with adults aged 18 years or over were included. A number of physical health conditions and behaviours which have been shown to affect HRV were adopted as exclusion criteria. This resulted in excluding research where participants were pregnant (Chamchad et al., 2007; Stein et al., 1999), had acute and chronic alcohol ingestion or smoked cigarettes (Gonzalez Gonzalez et al., 1992; Karakaya et al., 2007).

2.2.2. Mental Imagery

All imagery interventions that instructed participants to create a mental image were included within the review. Interventions that used motor imagery (including movement) or visuospatial manipulation tasks were excluded due to these being underpinned by different neural processes to mental imagery (Decety, 1996; Pearson et al., 2015). For inclusion, studies had to report a baseline of HRV measured in the absence of any imagery task, to indicate HRV changes (reactivity); this resulted in the exclusion of 12 studies.

[1] Papers written prior to the Task Force paper, published in 1996, were excluded due to this being the first guidelines published highlighting the standards of measurement and interpretation of HRV data. Papers prior to this may not have correctly utilised and interpreted HRV measurements, making them less reliable and valid.

2.2.3. HRV Measures

Eligible studies were required to evaluate the change in HRV in response to mental imagery. Therefore, included studies measured HRV at at least two time points (baseline and either during- or post-imagery). The method of recording HRV is important with respect to the validity and reliability of the data collected. In Laborde et al. (2017) measurement standards, it is recommended that electrocardiogram (ECG) is the gold standard method for recording HRV. The use of chest belts to record HRV via the inter-beat interval (IBI) are widely used within research due to practicalities and are considered reliable since IBIs are generally extracted from ECG anyway to determine variability in heart rate – sometimes while extracting frequency components (Laborde et al., 2017). Studies using chest belts were therefore included; however, alternative methods such as photoplethysmography were excluded due to poor reliability (Laborde et al., 2017).[2]

2.3. Data Extraction

Data pertinent to the research question were extracted, specifically group characteristics, age and gender, type of HRV measure, type of mental imagery, and the timepoints that HRV was measured. Data that indicated HRV response to mental imagery was additionally extracted.

2.4. Quality Assessment

Each article was assessed using the Effective Public Health Practice Project (EPHPP) quality assessment tool for quantitative studies (Jackson & Waters, 2005) (Appendix B). The EPHPP is a generic quality assessment tool which can be utilised to assess a range of research designs such as randomised control trials, case-control, cohort and observational studies and has been found to have good content and construct validity (Jackson & Waters, 2005). The tool assesses the quality of six domains including selection bias, study design, confounders, blinding, data collection methods and withdrawals and dropouts. The domains for each paper can be rated as 'strong', 'moderate', or

[2] Photoplethysmography is a technique where heart rate is monitored using a light source and a photodetector on the surface of the skin to measure volumetric variations of blood circulation. Castaneda, D., Esparza, A., Ghamari, M., Soltanpur, C., & Nazeran, H. (2018). A review on wearable photoplethysmography sensors and their potential future applications in health care. *International Journal of Biosensors & Bioelectronics, 4*(4), 195-202. https://doi.org/10.15406/ijbsbe.2018.04.00125

'weak' and an overall rating is calculated by averaging these domains. Pre-determined confounds that are known to impact upon HRV measurement were age, sex, menstrual cycle, oral contraception, sleep, exercise, body mass index (BMI), dietary factors (e.g. caffeine intake), smoking status, alcohol intake, and medication (Laborde et al., 2017). To check validity the included papers were scored by another researcher and any differences in ratings were discussed to reach a decision. Papers received a global rating of 'strong' if they did not receive a 'weak' rating in any domain. Studies were awarded an overall 'moderate' rating if they received one 'weak' rating and were classified as 'weak' if they received two or more 'weak' domain ratings.

3. Results

3.1. Search Results

Figure 1 illustrates the PRISMA flow diagram (Moher et al., 2009) summarising the search results and selection process of the articles that were included and excluded from the analysis. Overall, 457 articles resulted from the aforementioned search strategy. After duplicates were removed (n = 115), the titles and abstracts of 342 articles were screened, and 47 papers were retained. The full texts of these articles were then screened using the detailed inclusion and exclusion criteria. Following this, 35 articles were excluded due to not meeting the eligibility criteria, and a total of 12 studies were retained for the synthesis.

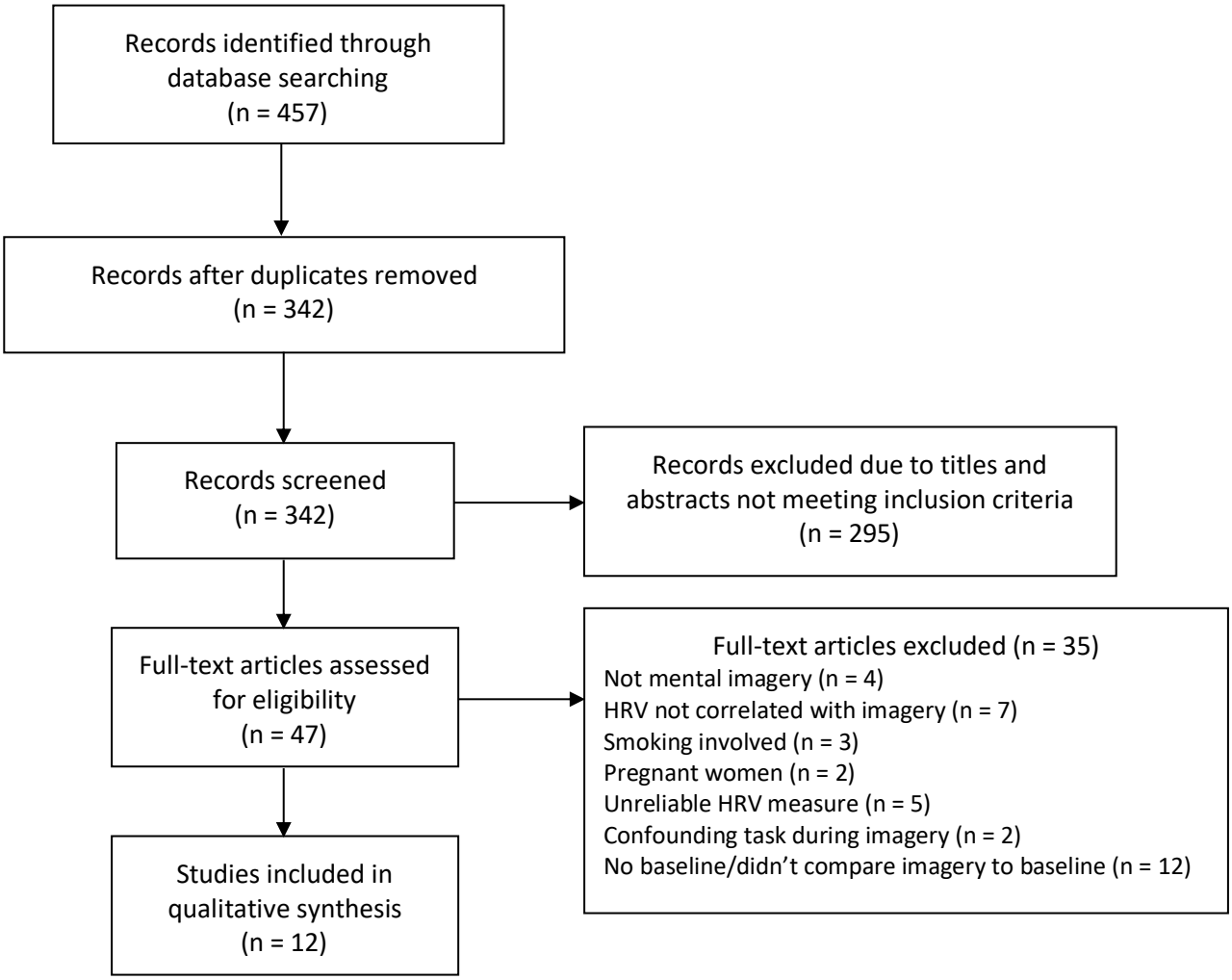
3.2. Description of Included Studies

A summary of the characteristics for the included studies are reported in Table 1. The included 12 studies were conducted between 2002 and 2019, and varied by sample size, ranging from 10 (Marci et al., 2007) to 273 participants (Humbel et al., 2018). The majority of studies had mixed sex samples, however four had all-female samples (Cyranowski et al., 2011; Davis et al., 2002; Gemignani et al., 2006; Humbel et al., 2018) and one had an all-male sample (Laborde et al., 2011). The majority of studies utilised group comparisons (N=10), with the remaining two studies employing a repeated measure design (Kleim et al., 2010; Marci et al., 2007). Group comparisons focused either on clinical versus non-clinical groups (Cyranowski et al., 2011; Fitzpatrick et al., 2019;

Humbel et al., 2018; Levine et al., 2016), by groups defined by a categorical trait characteristics, or by intervention received (Campbell et al., 2019; Davis et al., 2002; Gemignani et al., 2006; Halamova et al., 2019; Laborde et al., 2011; Levine et al., 2016; Rockliff et al., 2008).

Figure 1

PRISMA flow diagram of search results and included and excluded articles.



The types of imagery varied in the affective valence of the imagery task, with seven of the 12 studies employing aversive imagery (Davis et al., 2002; Fitzpatrick et al., 2019; Gemignani et al., 2006; Humbel et al., 2018; Kleim et al., 2010; Laborde et al., 2011; Levine et al., 2016) and three employing positive imagery (Campbell et al., 2019; Cyranowski et al., 2011; Rockliff et al., 2008). The remaining two studies used both aversive and positive imagery tasks (Halamova et al., 2019; Marci et al., 2007). With regard to the imagery methodology, the studies again deployed a range of

Table 1

Study Characteristics

Study	*N*	Age *M* (SD)	Sex (F, M)	Groups	HRV Measure(s)	HRV Measurement	Imagery Task	Baseline	HRV Time Points (T)
Fitzpatrick et al. (2019)	60	23.8 (4.8)	52, 8	2 Groups *Borderline Personality Disorder (N=30),* *Healthy Controls (N=30)*	RSA	ECG (2 electrodes and chest band)	Aversive	Resting	T1=Baseline T2=Imagery
Halamova et al. (2019)	89	21.6 (1.6)	82, 7	2 Groups *High Self-Critics (N=35),* *Low Self-Critics (N=54)*	RMSSD	ECG (3 electrodes)	Aversive and Positive	Relaxation	T1=Baseline T2=Criticism Imagery T3=Protection Imagery T4=Compassion Imagery
Campbell et al. (2019)	24	47 (8.9)	20, 4	2 Groups *Compassion Imagery (N=12),* *Relaxation Imagery (N=12)*	SDNN	Chest Strap	Positive	Resting	T1=Baseline T2=Imagery 1 T3=Imagery 2
Humbel et al. (2018)	273	22.9 (3.9)	275, 0	2 Groups *High Emotion Dysregulation (N=133),* *Low Emotion Dysregulation (N=140)*	HF HRV LF HRV LF/HF	ECG (chest belt with dry electrodes)	Aversive	Resting	T1=Baseline T2=Imagery T3=Recovery
Levine et al. (2016)	40	21.3 (1.5)	35, 5	3 Groups *Low Worry (N=15),* *High Worry (N=15),* *High Worry GAD (N=10)*	HF HRV	ECG (2 electrodes)	Aversive	Resting	T1=Baseline T2=Anticipation T3=Worry Induction T4=Imagery

									T5=Recovery
Laborde et al. (2011)	30	22.5 (1.7)	0, 30	2 Groups *High Emotion Intelligence (N=NR),* *Low Emotion Intelligence (N=NR)*	LF/HF	ECG (3 electrodes)	Aversive	Resting	T1=Baseline T2=Post-Imagery
Cyranowski et al. (2011)	30	29.8 (5.9)	30, 0	2 Groups *Depressed (N=15),* *Non-Depressed (N=15)*	RSA	ECG (3 electrodes and respiratory band)	Positive	Resting	T1=Baseline T2=Imagery T3=Recovery 1 T4=Recovery 2
Kleim et al. (2010)	155	33.9 (11.2)	56, 99	1 Group	RSA	Chest Strap	Aversive	Resting	T1=Baseline T2=Imagery
Rockliff et al. (2008)	22	NR 18 – 35	NR	2 Groups *Reduced HRV (N=11),* *Increased HRV (N=11)*	SDNN	ECG (3 electrodes)	Positive	Relaxation	T1=Baseline T2=Compassion Imagery* T3=Control Imagery*
Marci et al. (2007)	10	33.9 (11.9)	5, 5	1 Group	HF HRV LF HRV LF/HF	ECG (1 electrode)	Aversive and Positive	Resting	T1=Baseline T2=Imagery
Gemignani et al. (2006)	14	23.9 (4.6)	14, 0	2 Groups *Low Hypnosis (N=7),* *High Hypnosis (N=7)*	HF HRV LF HRV LF/HF	ECG (3 electrodes and respiratory band)	Aversive	Relaxation	T1=Baseline T2=Neutral Imagery T3=Baseline 2 T4=Aversive Imagery
Davis et al. (2002)	62	22.7 (6.6)	62, 0	2 Groups *Worriers (N=31),* *Non-Worriers (N=31)*	SDNN	ECG (3 electrodes)	Aversive	Relaxation	T1=Baseline T2=Worry Task T3=Imagery

N = Number of Participants
M = Mean
SD = Standard Deviation
F = Female
M = Male
HRV = Heart Rate Variability
RSA = Respiratory Sinus Arrythmia
RMSDD = Root Mean Square of the Successive Differences
SDNN = Standard Deviation of the NN Intervals
HF HRV = High Frequency HRV
LF HRV = Low Frequency HRV
LF/HF = Ratio of Low and High Frequency HRV
ECG = Electrocardiogram
NR = Not Recorded
* = Conditions counterbalanced

methods. The majority of studies used a similar method to induce imagery, requiring participants to imagine generic hypothetical situations or generate an image to evoke a specific feeling. However, three studies asked participants to bring to mind specific memories (Cyranowski et al., 2011; Kleim et al., 2010; Marci et al., 2007).

HRV is vulnerable to the impact of the precise methodology, equipment, data analysis and data reporting employed (Laborde et al., 2017; Malik et al., 1996). Therefore, it was important to consider the potential impact of the specific HRV metrics reported within the studies. The majority of the included studies (N=9) used only one metric of HRV. However, three studies used three measurements of HRV being the high frequency band (HF HRV), low frequency band (LF HRV), and the LF/HF ratio (Gemignani et al., 2006; Humbel et al., 2018; Marci et al., 2007). The most common metrics were the frequency-domain measures of HF HRV (N=4) and the LF/HF ratio (N=4) (Gemignani et al., 2006; Humbel et al., 2018; Laborde et al., 2017; Levine et al., 2016; Marci et al., 2007). The least commonly used HRV metric was the time domain measure of the root mean square of the successive differences (RMSSD) with only one study using this (Davis et al., 2002; Halamova et al., 2019). All HRV metrics used within the included studies are considered reliable and acceptable measures of HRV within psychophysiological research (Laborde et al., 2017; Shaffer & Ginsberg, 2017).

3.3. Quality Assessment

A summary of the individual domains and overall ratings for the quality assessment of the included papers is displayed in Table 2. Only one study received an overall quality rating of weak (Marci et al., 2007), with five studies being rating as moderate (Campbell et al., 2019; Gemignani et al., 2006; Halamova et al., 2019; Laborde et al., 2011; Rockliff et al., 2008) and six as strong (Cyranowski et al., 2011; Davis et al., 2002; Fitzpatrick et al., 2019; Humbel et al., 2018; Kleim et al., 2010; Levine et al., 2016). Four studies received a weak rating within the selection bias domain due to not stating the demographics or number of participants in each group (Laborde et al., 2011) or having a small sample size (Gemignani et al., 2006; Marci et al., 2007; Rockliff et al., 2008) limiting

Table 2

Quality Assessment

Study	Selection Bias	Study Design	Confounders	Blinding	Data Collection Method	Withdrawals/ Dropouts	Overall Rating
Fitzpatrick et al. (2019)	Strong	Moderate	Strong	Moderate	Strong*	Moderate	Strong
Halamova et al. (2019)	Moderate	Moderate	Weak	Moderate	Strong	Moderate	Moderate
Campbell et al. (2019)	Moderate	Strong	Weak	Strong	Strong	Moderate	Moderate
Humbel et al. (2018)	Strong	Strong	Strong	Strong	Strong*	Strong	Strong
Levine et al. (2016)	Moderate	Moderate	Strong	Moderate	Strong*	Moderate	Strong
Laborde et al. (2011)	Weak	Moderate	Moderate	Moderate	Strong	Moderate	Moderate
Cyranowski et al. (2011)	Moderate	Moderate	Strong	Moderate	Strong*	Moderate	Strong
Kleim et al. (2010)	Strong	Moderate	Moderate	Moderate	Strong	Strong	Strong
Rockliff et al. (2008)	Weak	Moderate	Moderate	Moderate	Strong*	Moderate	Moderate
Marci et al. (2007)	Weak	Moderate	Weak	Moderate	Strong	Moderate	Weak
Gemignani et al. (2006)	Weak	Moderate	Moderate	Moderate	Strong	Moderate	Moderate
Davis et al. (2002)	Moderate	Moderate	Moderate	Moderate	Strong	Moderate	Strong

* depicts studies that used visual inspection methods to remove artefacts from the HRV data, as appose to using software to remove artefacts.

the generalisability and representativeness of the sample. Only three studies received a strong rating within this domain due to completing an a priori power analysis (Fitzpatrick et al., 2019) or having large samples and ensuring representation of the wider population within the included sample (Humbel et al., 2018; Kleim et al., 2010). With regards to study design, only two studies were awarded with a strong rating due to utilising a randomised control design (Campbell et al., 2019; Humbel et al., 2018), with the remaining studies being awarded a moderate rating and using either a cohort study (Kleim et al., 2010; Marci et al., 2007) or cohort analytic design (Cyranowski et al., 2011; Davis et al., 2002; Fitzpatrick et al., 2019; Gemignani et al., 2006; Halamova et al., 2019; Laborde et al., 2011; Levine et al., 2016; Rockliff et al., 2008).

It is considered critical to control for confounds within HRV research due to the number of variables that can impact upon HRV (Laborde et al., 2017). Four studies were awarded with a strong rating as they reported and controlled for multiple confounds known to impact upon HRV (Cyranowski et al., 2011; Fitzpatrick et al., 2019; Humbel et al., 2018; Levine et al., 2016). Three studies received a weak rating as they did not report controlling for or recording any confounders (Campbell et al., 2019; Halamova et al., 2019; Marci et al., 2007). Two studies received a moderate rating despite controlling for several confounds, as they did not state group demographics which could have highlighted further confounding factors (Laborde et al., 2011; Rockliff et al., 2008). The remaining studies only controlled for minimal confounding variables (Davis et al., 2002; Gemignani et al., 2006) or only recorded confounding variables and didn't exclude participants based upon these, for example, smoking (Kleim et al., 2010). The majority of studies did not state, or it was unclear whether researchers and/or participants were blinded to the group and/or research question, and subsequently received a moderate rating as directed by the quality assessment tool. Only two studies stated the researchers were blind to the group and participants were blind to the research question, so were awarded a strong rating for blinding (Campbell et al., 2019; Humbel et al., 2018). All studies were awarded with a strong rating for the data collection method domain due to using valid and reliable methods for obtaining and analysing HRV using either ECG (Cyranowski et

al., 2011; Davis et al., 2002; Fitzpatrick et al., 2019; Gemignani et al., 2006; Halamova et al., 2019; Humbel et al., 2018; Laborde et al., 2011; Levine et al., 2016; Marci et al., 2007; Rockliff et al., 2008) or a Polar chest strap (Campbell et al., 2019; Kleim et al., 2010). Five studies utilised visual inspection to manually remove artefacts from the HRV data (Cyranowski et al., 2011; Fitzpatrick et al., 2019; Humbel et al., 2018; Levine et al., 2016; Rockliff et al., 2008) which is considered as best practice when compared to relying on software to clean the data (Laborde et al., 2017). Reporting of withdrawals and dropouts was rare across the included studies with only two recording this data (Humbel et al., 2018; Kleim et al., 2010). Thus, the remaining ten studies were awarded with a moderate rating as instructed by the quality assessment tool due to this information not being applicable to the study designs. Finally, intervention integrity was considered within the quality assessment but did not contribute to overall ratings. The majority of studies completed a validity check following mental imagery to check participants level of engagement during the task, with only three studies failing to do this (Campbell et al., 2019; Cyranowski et al., 2011; Laborde et al., 2011).

3.6. Study Findings

3.6.1 The Impact of Mental Imagery on HRV

The included studies identified an inconsistent pattern with regards to whether mental imagery significantly changed HRV (summarised in Table 3). Eight out of the twelve studies found that mental imagery was associated with a significantly change in HRV across groups (Cyranowski et al., 2011; Davis et al., 2002; Halamova et al., 2019; Kleim et al., 2010; Laborde et al., 2018; Levine et al., 2016; Marci et al., 2007; Rockliff et al., 2008). Specifically, six of these eight studies found that participants across groups demonstrated a significant reduction in HRV in response to mental imagery (Davis et al., 2002; Halamova et al., 2019; Kleim et al., 2010; Levine et al., 2016; Marci et al., 2007; Rockliff et al., 2008). This reduction in short-term measurements of HRV (HF HRV, RSA, SDNN and RMSSD) demonstrates vagal withdrawal, reflecting a reduction in vagal break and an increase in sympathetic nervous system influence, commonly interpreted as indicative of a stress response (Laborde et al., 2017; Porges, 2007; Thayer & Lane, 2000). Laborde et al. (2011) additionally found

Table 3

Study Findings

Study	Group(s)	Imagery Task	Did Imagery Significantly Change HRV?	If Significant, What Was the Direction of Change?	Were There Significant Group Differences?
Fitzpatrick et al. (2019)	2 Groups *Borderline Personality Disorder (N=30), Healthy Controls (N=30)*	Aversive	**No**	N/A	**No**
Halamova et al. (2019)	2 Groups *High Self-Critics (N=35), Low Self-Critics (N=54)*	Aversive and Positive	**Yes**	↓ in HRV in response to all imagery tasks	**Yes** – low self-critics showed significantly higher HRV at baseline and during self-criticism and self-compassion imagery tasks compared to high self-critics*
Campbell et al. (2019)	2 Groups *Compassion Imagery (N=12), Relaxation Imagery (N=12)*	Positive	**No**	N/A	**No**
Humbel et al. (2018)	2 Groups *High Emotion Dysregulation (N=133), Low Emotion Dysregulation (N=140)*	Aversive	**No**	N/A	**No**
Levine et al. (2016)	3 Groups *Low Worry (N=15), High Worry (N=15), High Worry GAD (N=10)*	Aversive	**Yes**	↓ in HRV but only in the high worry GAD group	**Yes** – significant reduction in HRV from baseline to imagery found only in the high worry GAD group

Laborde et al. (2011)	2 Groups *High Emotion Intelligence (N=NR), Low Emotion Intelligence (N=NR)*	Aversive	**Yes**	↑ in LF/HF Ratio	**Yes** – larger increase in LF/HF ratio in the low emotional intelligence group
Cyranowski et al. (2011)	2 Groups *Depressed (N=15), Non-Depressed (N=15)*	Positive	**Yes****	↑ in RSA	**Yes** – depressed group showed significantly lower RSA compared to nondepressed group at baseline and during imagery
Kleim et al. (2010)	1 Group	Aversive	**Yes**	↓ in HRV	**N/A**
Rockliff et al. (2008)	2 Groups *Reduced HRV (N=11), Increased HRV (N=11)*	Positive	**Yes**	↓ in HRV	**Yes** – reduced HRV group had lower HRV at baseline and during compassion imagery. Both groups showed similar HRV response to neutral control imagery
Marci et al. (2007)	1 Group	Aversive and Positive	**Yes**	↓ in HRV in response to anger imagery but no significant change in HRV for sadness, happiness and neutral imagery tasks	**N/A**
Gemignani et al. (2006)	2 Groups *Low Hypnosis (N=7), High Hypnosis (N=7)*	Aversive	**No**	N/A	**Yes** – low hypnosis group showed a significant reduction in HRV in response to imagery when compared to baseline. No significant changes in HRV in response to imagery for the high hypnosis group
Davis et al. (2002)	2 Groups *Worriers (N=31), Non-Worriers (N=31)*	Aversive	**Yes**	↓ in HRV	**No**

** Authors stated significant difference but did not report the significance values or statistics for this*

*** Significant main effect of time appears to reflect a reduction in RSA following imagery during the recovery period. Non-depressed group returned to baseline RSA following imagery, whereas depressed group appeared to show a reduction in RSA following imagery when compared to baseline.*

Red arrow = indicative of a stress response

Green arrow = indicative of calming response

HRV = Heart Rate Variability
RSA = Respiratory Sinus Arrhythmia
LF/HF Ratio = Ratio of Low and High Frequency Heart Rate Variability
N/A = not applicable
N = number of participants
GAD = Generalised Anxiety Disorder

that participants generally demonstrated a possible stress response to mental imagery, which was reflected in a significant increase in the LF/HF ratio of HRV, thought to reflect greater sympathetic dominance (Shaffer & Ginsberg, 2017). Thus, seven out of the twelve studies found that mental imagery evoked a psychophysiological response indicative of stress.

Of the seven studies that found evidence of a stress response to mental imagery, six had deployed aversive imagery material (Davis et al., 2002; Halamova et al., 2019; Kleim et al., 2010; Laborde et al., 2011; Levine et al., 2016; Marci et al., 2007), although Halamova et al. (2019) used both positive and aversive imagery and found a reduction in HRV to both types of imagery. Rockliff et al. (2008) in contrast used a positive imagery task and similarly identified a reduction in HRV in response. Thus, both aversive and positive mental imagery appear able to evoke a similar pattern of reduction in HRV responding indicative of a stress response.

Whilst Cyranowski et al. (2011) also reported an impact of mental imagery on HRV, their results diverged from the above studies, in that participants demonstrated an increase in RSA in response to positive imagery. Increased RSA is thought to reflect an increase in parasympathetic influence, suggesting psychophysiological calming in response to mental imagery (Laborde et al., 2017; Porges, 2007). However, following the mental imagery task, all participants showed a reduction in RSA during the recovery period. The authors did not report statistical values or significance of the increase in RSA from baseline to mental imagery. Thus, it is unclear whether the significant main effect of time reported within this paper reflects this increase in RSA in response to imagery, or whether the significance lies in the post-task reduction in RSA during the recovery period. However, this study was rated as high quality overall and was strong in relation to controlling for confounders.

Therefore, the reviewed studies provide some limited evidence that HRV can be manipulated using mental imagery, and that the most reliable reported impact was for imagery reducing HRV, suggesting that mental imagery increases physiological stress for participants. The findings of Rockliff et al. (2008) and Halamova et al. (2019) suggests that the affective valence of the

imagery may not determine the direction of the impact on HRV, however methodological issues identified within the quality assessments limit the ability to draw any conclusions from these finding. Rockliff et al. (2008) had a very small sample size and completed a post-hoc group split, affecting the generalisability and reliability of the findings. Halamova et al. (2019) additionally received a weak rating in the quality assessment for the confounders domain due to not reporting controlling for any known factors that impact upon HRV. Thus, further studies are necessary to address this research question.

Contrasting with the majority of studies, four reviewed studies reported no significant main effect of imagery on HRV (Campbell et al., 2019; Fitzpatrick et al., 2019; Gemignani et al., 2006; Humbel et al., 2018). Humbel et al. (2018) and Gemignani et al. (2006) both used ANOVAs to explore the impact of imagery on HRV and found no significant main effects of time. This suggests that mental imagery did not significantly change HRV over the time period of the experimental conditions. However, Gemignani et al. (2006) used a very small sample (N=14), and therefore may have been underpowered. This may explain why there was no significant main effect of time found. In contrast, Humbel et al. (2018), used a large sample (N=273) however, it is worth noting that they did not complete an a priori or post-hoc power analysis, and so it is unclear whether this design was appropriately powered. Across this sample, 112 participants had a diagnosis of anorexia or bulimia nervosa. Research has found that individuals with these diagnoses demonstrate higher HRV reactivity in response to stress (Het et al., 2015). Around half of Humbel et al.'s (2018) sample were individuals with these diagnoses characterised by eating behaviours known to have a significant impact on physical health. Therefore, having healthy controls and individuals with eating disorders within the same group, this may introduce a number of confounding variables with regard to HRV potentially masking any main effect.

Fitzpatrick et al. (2019) found no significant main effect of time using a Wald statistical test. However, this main effect of time was approaching significance (p = .08), with participants across groups demonstrating a reduction in RSA in response to mental imagery. Interestingly,

Fitzpatrick et al. (2019) conducted a power analysis, suggesting that the sample size was adequately powered to detect a main effect if one was present. Whilst Campbell et al. (2019) also found non-significant findings of HRV change in response to mental imagery, this study reported a sample size of just 24 and participants were both older than participants in the other reviewed studies and also had a severe brain injury. It is possible that the failure to find the dominant finding of imagery reducing HRV, was a result of an underpowered study for the effect. Both age and brain injury have additionally been found to reduce resting HRV (King et al., 1997; Umetani et al., 1998), with this lower resting HRV being argued to be associated with reduced HRV reactivity (Porges, 2007). Therefore, both brain injury and older age would appear potentially important confounds that may mask any main effect of imagery on HRV due to participants with these characteristics having potentially less HRV reactivity. Thus, whilst the majority of reviewed papers report a relatively consistent pattern of mental imagery reducing HRV, it appears there are variables and confounds affecting the reliability of these findings, meaning an effect may not always be detected, for example, older age, brain injury, small sample size and mixed eating disorder and healthy control samples.

3.6.2 Group Differences in HRV in Response to Mental Imagery

The main effect of imagery on a reduction of HRV, appears from these reviewed studies to be moderately reliable. The majority of the studies also explored group differences as potentially important variables in determining the impact of imagery on HRV. Nine of the twelve included studies compared HRV change in response to mental imagery between groups based on individual characteristics (e.g. clinical group vs healthy controls) (Cyranowski et al., 2011; Fitzpatrick et al., 2019; Humbel et al., 2018; Levine et al., 2016), specific psychological traits (Davis et al., 2002; Gemignani et al., 2006; Halamová et al., 2019; Laborde et al., 2011), and groups created via a post-hoc group split, based on participant's HRV response to mental imagery (Rockliff et al., 2008). During exploratory post-hoc analysis, Rockliff et al. (2008) found that when compared to the control imagery, some individuals showed an increase in HRV to compassionate imagery, whilst some

showed a decrease. They subsequently split these participants into two groups for the analysis: reduced HRV and increased HRV. However, due to the post hoc nature of this investigation, such comparisons need further explicit empirical study to confirm this result, and the study can be considered only preliminary evidence for individual differences in HRV reactivity.

Out of the nine studies that explored a priori group comparisons, only depression as a group difference appeared to affect HRV, with the depressed group having significantly lower HRV at baseline and during imagery, reflected in a main effect of group (Cyranowski et al., 2011). However, two studies found significant differences in baseline HRV between groups in exploratory analysis, with high self-critics (Halamova et al., 2019) and the reduced HRV group (Rockliff et al., 2008) having a significantly lower resting HRV. The remaining six group comparison studies found no main effect of group and reported no baseline differences between groups (Davis et al., 2002; Fitzpatrick et al., 2019; Gemignani et al., 2006; Humbel et al., 2018; Laborde et al., 2011; Levine et al., 2016). This is an interesting finding given the evidence from a meta-analysis by Alvares et al. (2016) that found individuals with varying mental health diagnoses showed reduced resting HRV compared to healthy controls. Thus, the studies within the current review differed from the findings of this meta-analysis, perhaps due to methodological issues with how the included studies split groups.

Whilst only one study identified a group difference that had a significant main effect on resting HRV, six of the nine studies found that HRV reactivity in response to mental imagery was affected by group (Cyranowski et al., 2011; Gemignani et al., 2006; Halamova et al., 2019; Laborde et al., 2011; Levine et al., 2016; Rockliff et al., 2008), however this interaction (time by group) was only significant for four studies (Halamova et al., 2019; Laborde et al., 2011; Levine et al., 2016; Rockliff et al., 2008). The remaining two studies did not find a significant interaction but found group differences during exploratory analysis (Cyranowski et al., 2011; Gemignani et al., 2006); however, caution is advised when relying solely upon post-hoc analysis. HRV reactivity to imagery appeared to vary between groups defined by levels of self-criticism (Halamová et al., 2019; Rockliff et al., 2008), worry (Levine et al., 2016), emotional intelligence (Laborde et al., 2011), depression (Cyranowski et

al., 2011), and hypnosis susceptibility (Gemignani et al., 2006). Specifically, from those studies it would appear that HRV is reduced more by imagery tasks for individuals reporting high levels of self-criticism, high levels of worry (reaching criteria for GAD), low emotional intelligence, high depression and low hypnosis susceptibility.

The included studies that did not find a significant interaction or HRV reactivity changes between groups were for individuals with a diagnosis of borderline personality disorder and healthy controls (Fitzpatrick et al., 2019), high and low emotion dysregulation (Humbel et al., 2018), and high and low worry (Davis et al., 2002). Interestingly, Davis et al. (2002)'s finding contradicts Levine et al. (2016) who found individuals with high worry scores (reaching criteria for GAD) displayed a reduction in HRV in response to imagery. It is important to note that Davis et al. (2002) instructed participants to breathe in time with a tone during the baseline and imagery task, however, research shows that respiration rate can change HRV reactivity without affecting vagal tone (Shaffer & Ginsberg, 2017). Thus, incorporating breathing tasks during mental imagery may become a confounding variable and indicate there is an effect on HRV when this is not directly related to imagery. Fitzpatrick et al. (2019) and Humbel et al. (2018) additionally did not find HRV reactivity differences per group. However, the primary research questions of both of these studies were not directly related to the impact of imagery on HRV, with both deploying multiple tasks not involving imagery within their designs. Thus, it may be possible that the other tasks completed by participants may have changed their HRV in response to the mental imagery tasks. Therefore, more research is needed with individuals with clinical diagnoses, such as borderline personality disorder and eating disorders, and their HRV reactivity to mental imagery, to draw any conclusions. In summary, when considering how HRV might be affected by mental imagery, it is important to consider characteristics and psychological traits such as worry (reaching criteria for GAD), self-criticism, emotional intelligence, depression and hypnosis susceptibility.

4. Discussion

The use of HRV within psychophysiological research as an index of cardiac vagal tone has increased over the last two decades (Laborde et al., 2017). It is argued that vagal tone reflects the contribution of the parasympathetic nervous system to cardiac regulation and is closely linked to various psychophysiological phenomena (Laborde et al., 2017; Porges, 2007). Mental imagery is a trans-therapeutic approach that is utilised as an intervention across multiple therapy models (Holmes et al., 2007; Pearson et al., 2015), however, there is limited evidence regarding the psychophysiological impact. Within compassion focused therapy, specific intervention techniques (such as breathing and imagery tasks) are deployed with the intention of activating the parasympathetic regulatory system, drawing on evidence and theory regarding its role moderating stress responses (Gilbert, 2010; Porges, 2007; Thayer & Lane, 2000). The current review explored whether mental imagery has a significant impact upon HRV, and if so, in what direction. There was some limited evidence that mental imagery does significantly affect HRV, with the most reliable reported impact being a reduction in HRV in response to imagery. This reduction in HRV represents vagal withdrawal, reflecting a reduction in vagal break and an increase in sympathetic nervous system influence, indicative of a stress response (Porges, 2007; Shaffer & Ginsberg, 2017; Thayer & Lane, 2000). The reduction in HRV was seen in response to aversive imagery (Davis et al., 2002; Halamova et al., 2019; Kleim et al., 2010; Laborde et al., 2011; Levine et al., 2016; Marci et al., 2007), with some emerging evidence that positive imagery triggered the same stress response (Halamova et al., 2019; Rockliff et al., 2008).

Interestingly, the two studies that found a reduction in HRV in response to positive imagery deployed compassion focused imagery tasks (Halamova et al., 2019; Rockliff et al., 2008). This is consistent with Gilbert (2010)'s model of compassion and the subsequent evidence that some individuals find compassionate imagery threatening (Irons & Gilbert, 2005; Kirby et al., 2019). An explantation for this could be due to the nature of compassionate imagery drawing upon memories of attachment, and thus, it is unsurprising that people with less secure attachment patterns find

compassionate imagery more threatening than soothing (Gilbert, 2010; Irons & Gilbert, 2005). According to attachment theory (Bowlby, 1982), our early experiences of caregiving shape the development of our attachment styles. Individuals with a more secure attachment style learn to view others as a source of support and safety, whereas people with less secure attachment patterns view others as unpredictable and unsafe. Research has found that individuals with more secure patterns of relating to others showed greater lingual gyrus activation during aversive mental imagery, when compared to individuals with an avoidant attachment style (Kim et al., 2020). This greater activation indicates that people who have a secure attachment style are more able to engage with aversive imagery, when compared to individuals with less secure attachment patterns. Individuals with secure patterns may have better emotion regulation abilities to engage in threatening imagery (Jain & Fonagy, 2020), in contrast to individuals with less secure attachment styles who may engage more in dissociation as a coping strategy when feeling under threat (Laczkovics et al., 2020). Thus, people's attachment patterns may influence their HRV response to mental imagery; some individuals may find positive imagery more threatening than calming based upon their early life experiences and this may also impact on their ability to engage fully with threatening imagery. Therefore, this highlights the importance of considering differences in attachment security when exploring HRV response to mental imagery.

However, this reduction in HRV in response to positive imagery may have occurred due to respiration changes, and not necessarily due to positive imagery evoking a stress response. It is possible that the positive imagery tasks evoked a reduction in tidal volume and increased respiratory rate resulting in a reduction of HRV, not reflective of parasympathetic withdrawal and a stress response to imagery (Bernardi et al., 2000). Thus, slowing breathing down, which is a common component of compassionate imagery, may cause an increase in low frequency power in the R-R interal, falsly mimicking sympathetic activation (Bernardi et al., 2000). These two studies additionally did not control for respiration which may explain this unexpected pattern of results. Therefore, more research into HRV reactivity in response to positive imagery is necessary, along with self-

reported experience, to draw any firm conclusions about the direction and interpretation of HRV responding to this type of imagery.

The majority of studies explored group differences in HRV response to mental imagery (Cyranowski et al., 2011; Davis et al., 2002; Fitzpatrick et al., 2019; Gemignani et al., 2006; Halamova et al., 2019; Humbel et al., 2018; Laborde et al., 2011; Levine et al., 2016; Rockliff et al., 2008). However, in only three studies participants differed on baseline measures of HRV with people with depression (Gemignani et al., 2006) and high-self-criticism (Halamova et al., 2019; Rockliff et al., 2008) displaying significantly lower resting HRV. Reduced resting HRV in individuals with a diagnosis of depression is widely reported across the literature (Brown et al., 2018; Hartmann et al., 2019; Kemp et al., 2010) and thus, it is interesting that differences in HRV response to imagery between depressed and non-depressed participants was found, suggesting that HRV rates in depression are affected both in terms of baselines and in terms of functionality/reactivity (Cyranowski et al., 2011). Trait self-criticism is additionally strongly related to depression (Brown et al., 2018; Gilbert et al., 2006; Shahar, 2015) which may suggest that people with high self-criticism and people with a diagnosis of depression may have similar patterns of physiological responding. An area for future research could be with individuals with depression versus non-depressed participants high in self-criticism to explore what HRV patterns emerge. Similarly, within the literature it is reported that individuals with GAD show an increased physiological stress responses to perceived threat (Thayer et al., 2000). Thus, it is unsurprising that individual's reaching criteria for GAD showed reduced HRV in response to imagery aiming to induce worry (Levine et al., 2016).

Emotional intelligence appears to be an important construct in determining how HRV responds to imagery, with individuals with low emotional intelligence demonstrating a larger increase in LF/HF ratio, indicative of a larger stress response (Laborde et al., 2011). Emotional intelligence is related to the ability to effectively regulate one's emotions, and has been found to be associated with greater cardiac vagal control (Vanuk et al., 2019). Thus, supporting Laborde et al. (2011)'s finding that individuals with lower emotional intelligence showed a greater stress response,

indicating lower vagal control. Finally, research into HRV and hypnosis susceptibility appears to demonstrate heterogeneous results, with some papers showing no HRV differences between high and low suspectable participants (Ray et al., 2000), and others showing differences in resting physiological responses (Debenedittis et al., 1994). However, the research within this area appears to be relatively low quality, and thus, there are limited conclusions that can be made. In summary, there appears to be certain characteristics and psychological traits that are important to consider with regards to HRV response to mental imagery, such as, worry, self-criticism, emotional intelligence and depression.

These group differences in HRV response suggests that there may be factors that can influence and change people's emotional reaction to mental imagery. This contradicts Holmes et al. (2008)'s theory of mental imagery being a general emotional amplifier of cognition, and suggests that individual differences in attachment, worry, self-criticism, emotional intelligence and depression, might mediate whether imagery increases positive or negative emotions. Mental imagery ability differs on an individual basis and it is not considered a general skill that everyone can do with ease (Kosslyn et al., 1984). Mental imagery ability has been considered as a trait characteristic by some (McCarthy-Jones et al., 2012) with the vividness of imagery fluctuating by individual (Eton et al., 1998). Research has found that the self-reported vividness of imagery can alter emotional response, with people reporting more vividness also reporting a greater emotional reaction (Andrade et al., 2014). The same is true with physiological responses to mental imagery; participants reporting greater mental imagery ability exhibit a greater physiological response to imagery when compared to individual's reporting poorer ability (Miller et al., 1987). Thus, mental imagery ability is an important factor to consider when exploring the impact of imagery upon HRV, as people with lower ability may show less physiological reactivity. However, only one of the reviewed papers took mental imagery ability into account, but only used this to check the groups did not significantly differ based upon imagery ability (Gemignani et al., 2006).

The methodology utilised within this field of research may additionally impact upon whether mental imagery is an emotional amplifier of cognition (Holmes et al., 2008). Within the reviewed papers, the imagery tasks utilised differed in length and methodology. One paper utilised audio stimuli alongside imagery instructions aiming to increase engagement within the task (Laborde et al., 2011). Aversive sounds have additionally been found to evoke a decrease in HRV (Tkaczyszyn et al., 2013). Humbel et al. (2018) additionally used visual stimuli related to the imagery tasks aiming to increase vividness of mental imagery. However, the added stimuli in both papers may have changed participant's HRV response, becoming a confounding factor to consider. Five papers had other tasks within their designs which may have impacted upon HRV response to the imagery task (Cyranowski et al., 2011; Davis et al., 2002; Fitzpatrick et al., 2019; Humbel et al., 2018; Levine et al., 2016). Three papers utilised a stress induction task prior to mental imagery (Cyranowski et al., 2011; Davis et al., 2002; Levine et al., 2016) which may have had lasting effects upon HRV, making it difficult to draw conclusions upon what task evoked HRV change. Fitzpatrick et al. (2019) instructed participants to use either mindfulness or cognitive reappraisal interventions in between mental imagery tasks, aiming to explore whether these aided emotion regulation during aversive mental imagery. Thus, this additive task may have additionally influenced participants physiological responses, making any conclusions regarding HRV changes related to imagery less reliable. Finally, Halamova et al. (2019) did not counterbalance the order of imagery tasks, with all participants completing the aversive self-criticism imagery first. Given the evidence within this review that aversive imagery appears to have a more consistent impact upon HRV, completing this task first may have influenced participant's HRV response to the positive imagery task following this.

Due to the increase in HRV being utilised within the literature in recent years, there have been several papers advising on the standards of measurement and interpretation, including the Task Force paper (Malik et al., 1996). Although these standards are considered to be highly important within HRV research, only four studies cited this paper and described following the standards advised (Campbell et al., 2019; Laborde et al., 2011; Levine et al., 2016; Rockliff et al.,

2008). All the included papers, except Laborde et al. (2011), utilised HRV measures considered reflective of vagal tone within their analysis (e.g. SDNN, RMSSD, RSA or HF HRV). Laborde et al. (2011) utilised the LF/HF ratio which is considered as controversial due to the precise physiological underpinning of this being unclear, thus lowering its predictive value and the conclusions drawn from this measurement (Laborde et al., 2017). The use of differential metrics of HRV within the included studies hinders the comparision between them, and thus cation is advised when comparing these results.

Alongside considering standards of measurement and interpretation of HRV data, there are many other factors and variables that have been found to be important to consider. Research has found that certain tasks that impact upon respiration rate can evoke changes in HRV that are not reflective of vagal tone (Grossman & Taylor, 2007). Thus, highlighting the importance of controlling for respiration when measuring HRV. However, only three of the reviewed studies controlled for respiration (Cyranowski et al., 2011; Fitzpatrick et al., 2019; Gemignani et al., 2006), suggesting that the conclusions drawn from the studies that did not, may not be as reliable. Another factor that may have an impact upon HRV is sex, with differences being found between male and female participants (Chambers & Allen, 2007; Thayer et al., 1998). Half of the reviewed studies utilised a mixed sex sample (Campbell et al., 2019; Fitzpatrick et al., 2019; Halamova et al., 2019; Kleim et al., 2010; Levine et al., 2016; Marci et al., 2007), which could be another confounding factor to consider. The studies additionally varied on their control for confounding variables, with five not stating they controlled for antidepressant medications (Campbell et al., 2019; Halamova et al., 2019; Laborde et al., 2011; Levine et al., 2016; Marci et al., 2007) which can have a significant impact upon HRV in supressing vagal control (Bär et al., 2004; Licht et al., 2008). Thus, studies that did not control for this may have seen a reduction in participant's HRV due to this confounding factor and not as a direct result of the imagery task. Therefore, considering confounding variables and individual characteristics that may change HRV is vital when interpreting this data as it is associated with broad vulnerability factors (Beauchaine & Thayer, 2015; Smith et al., 2020).

4.1 Limitations and Conclusions

Whilst the review was able to identify some more consistent and reliable findings around aversive imagery and HRV and identify some areas for future research, its scope was limited to studies of adult populations. The majority of papers had a relatively young sample (between 20 – 30 years of age) and subsequently, the conclusions drawn from this review may not be generalisable to older adults, adolescents and children, which may be a direction for future research into mental imagery and HRV. The papers that were reviewed were additionally limited to peer-reviewed articles only, thus future reviews within this area may consider reviewing grey literature to reduce the risk of publication bias. Another limitation of the current review is that the screening, selection, data extraction, and quality assessment was completed by one researcher, suggesting that there is vulnerability to bias. However, the researcher utilised a conservative approach throughout these stages to limit this. There was additionally heterogeneity in the imagery tasks that were used within the reviewed studies, with studies ranging in the emotional valence, length, instructions and methods. Thus, drawing conclusions upon these results may be less reliable than if all papers utilised one standardised imagery task. Finally, the review limited itself to a single psychophysiological measure of stress (HRV) and thus it would be important to consider whether similar patterns of results arise when deploying other psychophysiological stress indicators.

In summary, the current review found some limited evidence that HRV can be manipulated using mental imagery. The most reliable reported impact appeared to be that mental imagery reduces HRV, indicative of vagal withdrawal and an increase in sympathetic nervous system influence (Porges, 2007; Thayer & Lane, 2000). There is tentative evidence that the emotional valence of mental imagery may not be a critical factor in the direction of the effect on HRV, with both positive and aversive imagery material associated with reduced HRV responding. However, due to there being variability in the findings of the reviewed papers, it appears that there are other factors that may influence whether mental imagery effects HRV which need to be explored further. There additionally appears to be specific characteristics and psychological traits that are important

to consider with regards to HRV reactivity to mental imagery including worry, self-criticism, emotional intelligence and depression. Future research is necessary to identify the effects of positive imagery on HRV as the current review revealed mixed and null results. It is additionally important for future research to take into account the role of specific individual differences (i.e., imagery ability and attachment security) when exploring the impact of mental imagery upon HRV.

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Chapter II: Empirical Paper

Does Compassionate and Critical Mental Imagery Evoke Larger Affective Responses Compared to Verbal Thought?

Manuscript prepared for submission to Psychology and Psychotherapy: Theory, Research and Practice (see Appendix C for Author Guidelines)

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Abstract

Objectives. Research has found that mental imagery evokes a larger emotional response when compared to verbal thought. To our knowledge this has not been explored within the area of compassion focused therapy. People's early memories of warmth and safeness additionally appear to impact upon their ability to be self-compassionate. In the current study, compassionate and critical mental imagery was compared with verbal thought to explore whether the former evokes a larger emotional response. Early memories of warmth was additionally measured to ascertain whether this moderates this relationship.

Design. This study utilised a mixed experimental design with between-group factors (imagery versus verbal thought) and within-group factors (condition – compassion and critical).

Methods. A large international general population sample were recruited (*N*= 244) and participants were randomised into either the verbal thought or mental imagery group. They then completed a compassion and critical task and their emotional responses were recorded.

Results. Participants did not differ by group in their emotional responding to the critical and compassion tasks on the positive affect measures. Participants did differ on negative affect, with the verbal thought group reporting higher negative emotions in response to the critical task. All participants showed an increase in positive affect in response to the compassion task and an increase in negative affect to the critical task. This relationship was moderated by participants early memories of warmth and safeness.

Conclusions. Both mental imagery and verbal thought appear to evoke similar emotional responses in response to compassion and criticism. People with less early memories of

warmth and safeness may find compassion less soothing and criticism as evoking increased negative affect.

Introduction

Mental imagery is a common human experience characterised by creating a picture in the mind, and often occurs when daydreaming, recalling a past memory, or imagining future events (Holmes & Mathews, 2010). It additionally aids us in planning, remembering, navigating and making decisions (Pearson et al., 2015). Mental imagery is often paired with a sensory experience as if "seeing with the mind's eye or hearing with the mind's ear" (Kosslyn et al., 2001, p. 635). Mental imagery has been found to activate similar brain regions to those that are activated during processing of real life sensory and perceptual events (Holmes & Mathews, 2010). There is a vast amount of research also suggesting that imagery can have an impact upon physiological (McBain & Devilly, 2019; Rockliff et al., 2008) and emotional responding (Holmes & Mathews, 2005; Mathews, 2013), illustrating the power of creating a picture in the mind.

Mental imagery has a larger impact upon affective responding, when compared with verbal thought or representations (Holmes et al., 2008). Holmes and Mathews (2005) provided participants with the same descriptions of negative events (e.g., swimming in the sea and seeing a shark) but changed the instructions of what they wanted them to do with this information. One group were instructed to create a picture in their mind of the event, whilst the other group were instructed to think about the verbal meaning, and asked to rate their emotional experience in response. They found that those in the imagery group, experienced heightened negative emotions, in contrast to the verbal thought group (Holmes & Mathews, 2005). Research has additionally demonstrated that mental imagery elicits a stronger positive emotional response than verbal processing when considering positive events (Holmes et al., 2006; Holmes et al., 2009). In addition, imagery is rated as feeling more 'real' than verbal thought and also has a larger impact upon behaviour and beliefs

(Mathews, 2013). Thus, it appears there are different systems underpinning the processing of mental imagery, compared to verbal thought.

Mental imagery has been found to activate areas of the brain involved with visual perception, including occipital-temporal sensory regions and areas within the visual cortex (Kraemer et al., 2009; Winlove et al., 2018). Research has suggested that emotional episodes may be stored in images within areas involved in autobiographical memory, illustrating the link between visual cognition and emotion within the brain (Conway, 2001). This link between emotion and mental imagery is supported within the neuropsychological literature, with emotive imagery activating the amygdala (Kim et al., 2007; Hoppe et al., 2021). Verbal cognition has been found to stimulate differential areas within the brain, specifically, left perisylvian regions that are involved in verbal working memory and phonological processing (Kraemer et al., 2005; Kraemer et al., 2009). Thus, it appears that mental imagery and verbal thought are underpinned by differential neural processes, with the former being more closely linked to emotion. However, mental imagery ability differs on an individual basis, with some people finding it challenging to create a vivid picture or to control and manipulate the mental image (Kosslyn et al., 1984). Difficulties with vividness of mental imagery has been coined as aphantasia (Zeman et al., 2015), with around two to three percent of the population being thought to experience this difficulty (Faw, 2009). The opposite is additionally true that some people have extreme visual cognition abilities, termed hyperphantasia (Milton et al., 2021). Research has found that individuals with hyperphantasia demonstrate stronger connectivity between the prefrontal cortex and visual network (Milton et al., 2021). Therefore, imagery ability appears to be a differentiated skill that is also underpinned by increased neural activity within the visual cortex.

Mental imagery is important to consider within the context of mental health difficulties as many forms of distress are underpinned by the experience of intrusive emotional imagery (Pearson et al., 2015). For individuals who are experiencing Post-Traumatic Stress Disorder (PTSD), a significant symptom of their distress can be the intrusive mental imagery of the traumatic events (Holmes & Mathews, 2010). Within social anxiety, people are often confronted with distressing imagery of feared scenarios, perpetuating anxiety (Holmes & Mathews, 2010). Mental health diagnoses of psychosis and bipolar can additionally be characterised by experiences of distressing emotional imagery (Pearson et al., 2015). Many psychotherapeutic models utilise imagery as an intervention to reduce distress, for example, within Cognitive Behaviour Therapy (CBT), schema therapy, mindfulness, and Compassion Focused Therapy (CFT; Foa, 1980; Foa & Kozak, 1986; Gilbert, 2009; Hackmann & Holmes, 2004; van den Hout, 2012). Mental imagery thus appears to play an important role in the experience of mental health distress.

CFT, developed by Paul Gilbert, (Gilbert, 2009) is a specific psychotherapeutic approach that relies heavily on mental imagery interventions. Gilbert (2009) developed CFT for individuals who were experiencing high levels of shame and self-criticism, after recognising that these individuals did not seem to benefit from CBT interventions alone. Gilbert observed that these difficulties in changing the way they responded to themselves may have been a result of the inner voice tone and imagery they used (Gilbert, 2010). Thus, CFT places importance on not only the way that one responds to themselves, but also the inner voice tone and imagery they utilise. CFT aims to increase an individual's compassionate abilities through various means such as generating compassionate imagery and developing a warmer, and less critical inner voice tone (Gilbert, 2009). There are several different types of compassionate imagery exercises within CFT; generating an image of a

compassionate other and creating an image of our own compassionate self are two examples of compassionate imagery (Gilbert, 2010). Research into CFT suggests that increasing compassion can protect against mental health difficulties such as anxiety and depression (Gilbert & Procter, 2006; Shapiro et al., 2005), and can be helpful with both clinical (Alliger-Horn et al., 2016) and non-clinical populations (McEwan & Gilbert, 2016; Irons & Heriot-Maitland, 2020).

However, despite the evidence demonstrating that CFT and compassionate imagery are associated with positive mental health (Appelhans & Luecken, 2006; Thayer & Lane, 2007), there is also evidence that developing self-compassion, and receiving compassion from others can be challenging for some individuals (Kirby et al., 2019). For some individuals, compassion can evoke a fear reaction, which can lead to avoidance (Gilbert, 2010), which has been hypothesised to arise from conditioning experiences where affiliative and caring behaviours were paired with aversive and abusive experiences early in life (Gilbert, 2010). Thus, some individuals may find compassion threatening rather than soothing leading to a complex pattern of evidence with regard to the soothing effect of compassion interventions. Research has found that an individual's experiences in early childhood have an impact upon their mental health in adulthood (Gerhardt, 2004; Richter et al., 2009). Individuals who have experienced warm, safe and nurturing parenting and environments are more likely to have higher self-esteem and are at less risk of experiencing mental health difficulties (Cheng & Furnham, 2004; DeHart et al., 2006). Conversely, individuals who have experienced neglectful, rejecting or abusive parenting are at a high vulnerability to mental health problems (Bifulco & Moran, 1998; Rohner, 2004). Individuals who have less experiences and memories of warmth and feelings of safeness, may subsequently be more self-critical and less self-compassionate (Irons et al., 2006).

The finding suggesting that individuals report a larger affective response to mental imagery in comparison to verbal thought (Holmes & Mathew, 2005) has not yet been explored within the context of CFT. This raises the question of whether utilising compassionate imagery would amplify any affective response (positive and negative), in comparison to using a compassionate internal voice tone alone. The current study aims to compare compassionate and critical imagery with verbal thought to explore individuals' emotional responses when responding to an experience of perceived failure. Since some individuals may find compassionate imagery tasks more challenging as a result of their early life experiences, the Early Memories of Warmth and Safeness Scale (EMWSS; Richter et al., 2009) was deployed to explore whether this moderated how participants experienced the tasks. Individual differences in the ease of imagery generation was assessed using the Spontaneous Use of Imagery Scale (SUIS; Reisberg et al., 2003) to explore whether this also moderates the relationship between emotional response and condition. Significant differences were anticipated for the emotional responses to both the critical and compassionate tasks, with larger negative affect expected for the critical task. In contrast, greater positive affect was anticipated for the compassion task, however the study also expected these emotional responses to be amplified by the use of imagery instructions as contrasted with verbal thought instructions. Finally, individual differences in early relational histories (measured by the EMWSS) and ease of imagery generation (measured by the SUIS) were expected to interact with any main effects.

Method

The present study was approved by the Research Review Committee within the Doctorate in Clinical Psychology programme at the University of Liverpool (Appendix D). The University of Liverpool Institute of Population Health Research Ethics Committee additionally provided ethical approval for the project (Appendix E).

Participants

The current study employed a mixed experimental design with between- (group; mental imagery or verbal thought), and within-factors (condition; compassion and critical task). A general population sample of adults aged 18 or over were recruited via online and social media advertisement. Participants were eligible to take part if they were aged 18 or over, English language speaking, and were able to access sound and vision on a computer, tablet, or mobile device to take part. A total of 244 participants completed the study with 122 participants in each group. The total sample were predominantly female (*N*= 178, 73%), White-British (*N*=187, 76.6%), aged between 18 – 39 years of age (*N*= 169, 69.3%), and were employed full-time (*N*=151, 61.9%). The majority of participants completed the study within the United Kingdom (UK; *N*= 205, 84%) and had no prior experience of CFT training or therapy (*N*= 201, 82.4%). A full summary of participant demographics is displayed in Table 1.

An a priori power analysis using G*Power (Faul et al., 2007) indicated that a total of 208 participants (104 per group) would be required to detect a small effect size (f= 0.15), at an alpha level of 0.05 and a power of 0.95, with eight groups (imagery versus verbal thought, taking into account the dichotomised moderators) with two measurement points (compassion and critical) using a repeated-measures ANOVA with a within-between interaction. This is a conservative estimate due to it not being possible to enter moderators into G*Power, therefore they were factored into the groups as categorical variables. Thus

Table 1

Participant demographics

Demographics		Imagery Group		Voice Tone Group	
		Number	Percentage	Number	Percentage
Gender	Female	89	73	89	73
	Male	30	24.6	33	27
	Non-Binary	2	1.6	-	-
	Did Not Disclose	1	0.8	-	-
Age Range	18 – 24	15	12.3	15	12.3
	25 – 29	35	28.7	36	29.5
	30 – 34	15	12.3	25	20.5
	35 – 39	15	12.3	13	10.7
	40 – 44	11	9	8	6.6
	45 – 49	11	9	3	2.5
	50 – 54	7	5.7	8	6.6
	55 – 59	4	3.3	8	6.6
	60 – 64	4	3.3	3	2.5
	65 – 69	2	1.6	2	1.6
	70 – 74	2	1.6	1	0.8
	75+	1	0.8	-	-
Location	UK	109	89.3	96	78.7
	Outside UK	13	10.7	26	21.3
Ethnicity	White: English, Welsh, Scottish, Northern Irish or British	103	84.4	84	68.9
	White: Irish	-	-	2	1.6
	Any Other White Background	7	5.7	8	6.6
	Black, African, Caribbean or Black British: African	3	2.5	3	2.5
	Black, African, Caribbean or Black British: Caribbean	-	-	1	0.8
	Asian or Asian British: Indian	2	1.6	9	7.4
	Asian or Asian British: Pakistani	1	0.8	2	1.6
	Asian or Asian British: Bangladeshi	-	-	2	1.6
	Asian or Asian British: Chinese	-	-	2	1.6
	Any Other Asian Background	1	0.8	5	4.1
	Mixed or Multiple Ethic Groups	2	1.6	2	1.6
	Other	1	0.8	2	1.6
	Do Not Disclose	2	1.6	-	-
Employment Status	Employed Full-Time	75	61.5	76	62.3
	Employed Part-Time	13	10.7	17	13.9
	Unemployed	3	2.5	8	6.6
	Student	14	11.5	12	9.8
	Other	17	13.9	7	5.7
	Did Not Disclose	-	-	2	1.6
CFT Experience	Yes	22	18	21	17.2
	No	100	82	101	82.8

Note. UK = United Kingdom, CFT = Compassion Focused Therapy

the sample appears to provide adequate power for the planned analysis.

Materials

Failure Scenario

A video was created and embedded into the online study that all participants viewed prior to being allocated to either the verbal thought or mental imagery group. The video comprised of audio instructions instructing participants to bring to mind a recent situation where they made a minor mistake. The video had prompts to support participants to bring to mind a vivid memory aiming to induce feelings of failure and lasted around one minute in length.

Mental Imagery Tasks

Videos with audio instructions for the mental imagery tasks were embedded into the online study platform and were recorded by a trained CFT therapist. The critical imagery task aimed to evoke a vivid mental image of participant's critical self and had verbal prompts to support with this. The compassionate imagery task consisted of similar verbal prompts aiming to evoke compassionate self imagery, and both lasted around one minute in length.

Verbal Thought Tasks

Videos with audio instructions were additionally created for the verbal thought tasks. The critical voice tone task aimed to support participants to think about the sound of their voice when they are feeling critical. For the compassionate voice tone task, participants were instructed to bring to mind the voice their voice tone associated with feeling compassionate. Both verbal thought videos lasted around one minute in length (see Appendix F for scripts of the failure scenario, verbal thought and mental imagery tasks).

Measures

Demographics

Participants completed a demographic questionnaire which included questions about gender, age, location, ethnicity, employment status, and prior experience of CFT (formal training or therapy).

Positive and Negative Affect Scale (PANAS)

State dependent affect is commonly assessed using the PANAS (Watson et al., 1988) which comprises of two self-report subscales (10 items each) measuring positive and negative affect, using a 5-point scale (Appendix G). In the current study, the negative affect subscale was used. The negative affect subscale requires participants to rate words related to negative affect such as 'scared', 'irritable' and 'distressed' from 0 'very slightly or not at all' to 4 'extremely'. The PANAS is found to have good validity cross culturally (Buz et al., 2015; Lim et al., 2010; López-Gómez et al., 2015; Terracciano et al., 2003) and good internal reliability (Cronbach's $\alpha > .80$) as well as good test-retest reliability (correlations > .60; Vera-Villarroel et al., 2017).

Types of Positive Affect Scale (ToPAS)

The ToPAS (Gilbert et al., 2008) was utilised as a measure of participants positive affective response (Appendix H). This scale consists of three subscales including 'active positive affect', 'relaxed positive affect' and 'safe/warmth positive affect'. In the current study, the safe/warmth and relaxed positive affect subscales were utilised. Participants are asked to rate 6 words for the relaxed subscale related to positive affect such as 'relaxed', 'peaceful', and 'serene'. For the safe/warmth subscale, participants are required to rate 4 words such as 'safe' and 'secure'. These items are rated on a 5-point scale from 0 'not feeling like this at all' to 4 'feeling like this a lot'. The ToPAS demonstrates good internal reliability with Cronbach's alphas

of 0.83 for the relaxed positive affect subscale and 0.73 for safe/warmth positive affect (Gilbert et al., 2008).

EMWSS

The EMWSS (Richter et al., 2009) was used to explore participants past experiences of feelings of warmth and safeness (Appendix I). The EMWSS is a 21 item self-report questionnaire with statements such as 'I felt cared about' and 'I felt appreciated the way I was'. These statements are rated from 0 'no, never' to 4 'yes, most of the time'. The measure indicates excellent internal consistency with a Cronbach's alpha of 0.97 (Richter et al., 2009).

SUIS

The SUIS (Reisberg et al., 2003) was utilised to explore participants tendency to use imagery in everyday life and ease of imagery-based thinking (Appendix J). The SUIS is a 12 item self-report questionnaire ranging from 5 "completely appropriate" to 1 "never appropriate". Higher scores indicate greater imagery use in everyday life and greater ease of imagery-based thinking. The measure indicates excellent internal consistency ($\alpha > .98$) and good convergent validity (Reisberg et al., 2003; Nelis et al., 2014).

Procedure

Participants accessed the study via a link to the Qualtrics platform and provided with information about the study (Appendix K) before being asked to give informed consent to take part (Appendix L). Following this, participants were asked to complete the baseline questionnaires (SUIS, EMWSS, PANAS and ToPAS) and were then provided with the failure scenario video. Following this, participants were randomly allocated into either the verbal thought or imagery group. Participants within each group then completed the critical and compassionate tasks in counterbalanced order. At the end of each task, participants were

provided with the same statement that appeared on the screen (*"it's okay to feel like this – these situations often trigger difficult feelings but these will pass. Remember that everyone makes mistakes, and it's not the end of the world"*) and were asked to read the statement in either a compassionate or critical voice tone (verbal thought group), or imagine the compassionate or critical image of themselves saying the statement (mental imagery group). After completing each task, participants were asked to complete the PANAS and ToPAS to measure positive and negative affect. Participants were provided with a link to information about accessing support throughout the experiment if they were to feel distressed (Appendix M). After completing the tasks, they were then taken to the debrief page (Appendix N) and were asked to provide their email address if they wished to be entered into a prize draw to win one of nine £50 Amazon vouchers.

Results

Descriptives

Means and standard deviations for the dependent variables and moderators for each group and condition are displayed in Table 2. Independent sample t tests were carried out comparing the verbal thought and mental imagery groups for the demographic information including; age, ethnicity, gender, and experience of CFT. The groups did not significantly differ on these demographics (p>.05). As positive skew and kurtosis seemed to be an issue for the PANAS variable, it was transformed using a reciprocal transformation. The Shapiro-Wilk's test of normality was not used due to this being influenced by large sample sizes. Instead, Q-Q plots and skew and kurtosis descriptive statistics were consulted. Following the transformation of the PANAS, all variables were approximately normally distributed (Appendix O). The assumption of homogeneity of variance was assessed using Levene's test of equality of error variances. Levene's was not statistically significant (p>.05)

for all variables. Thus, three mixed ANOVA's were computed for each of the dependent variables (emotion scores – PANAS, ToPAS Safe/Warmth, ToPAS Relaxed), with three between-subjects factors of group (mental imagery and verbal thought), EMWSS (high and low), and SUIS (high and low), and one within-subjects factor (condition – critical and compassionate tasks). The SUIS and EMWSS were split by the median to transform them into dichotomous variables, i.e., high vs low, to explore whether these scores moderated the relationship between condition and emotional response. See table 3 for descriptives for the dichotomised moderators. Cronbach's Alpha scores for all measures demonstrated good to excellent internal consistency (see Appendix P).

Table 2

Means and standard deviations for the dependent variables and moderators for each group and condition based on raw scores

Measures	Verbal Thought			Mental Imagery		
	Baseline	Critical	Compassionate	Baseline	Critical	Compassionate
PANAS	14.32	18.93	14.69	15.07	16.43	14.07
	(5.42)	(8.10)	(6.56)	(6.05)	(6.87)	(5.04)
ToPAS Safe	15.30	13.11	15.13	15.45	13.88	15.14
	(3.52)	(4.81)	(4.28)	(3.05)	(4.14)	(3.81)
ToPAS Relax	19.27	17.18	20.20	19.07	18.03	19.97
	(5.21)	(7.11)	(6.86)	(5.92)	(6.52)	(6.24)
SUIS	39.34	-	-	37.89	-	-
	(10.09)			(8.20)		
EMWSS	74.20	-	-	73.23	-	-
	(21.66)			(23.81)		

Note. Means are displayed with standard deviations in parentheses. PANAS = Positive and Negative Affect Scale (negative affect subscale), ToPAS = Types of Positive Affect Scale, SUIS = Spontaneous Use of Imagery Scale, EMWSS = Early Memories of Warmth and Safeness Scale.

Table 3

Descriptives including number, mean, and standard deviation for the moderator variables

	N		Mean (SD)	
	Low	High	Low	High
EMWSS	122	122	54.64 (15.09)	92.79 (8.69)
SUIS	119	125	30.94 (5.76)	45.93 (4.90)

Negative Affect (PANAS)

There was a main effect of condition ($F(1, 240) = 94.03$, $p < .001$ with a large effect ($\eta^2 = .281$)), main effect of the EMWSS ($F(1, 240) = 4.18$, $p = .042$ with a small effect ($\eta^2 = .017$)), and group by condition interaction found ($F(1, 240) = 8.01$, $p = .005$ with a small effect ($\eta^2 = .032$)). There were no significant main effects of group ($F(1, 240) = 2.45$, $p = .119$), SUIS ($F(1, 240) = .39$, $p = .531$), condition by EMWSS interaction ($F(1, 240) = .003$, $p = .956$), or condition by SUIS interaction ($F(1, 240) = .39$, $p = .530$). Figure 1 illustrates the changes in negative affect by condition and group.

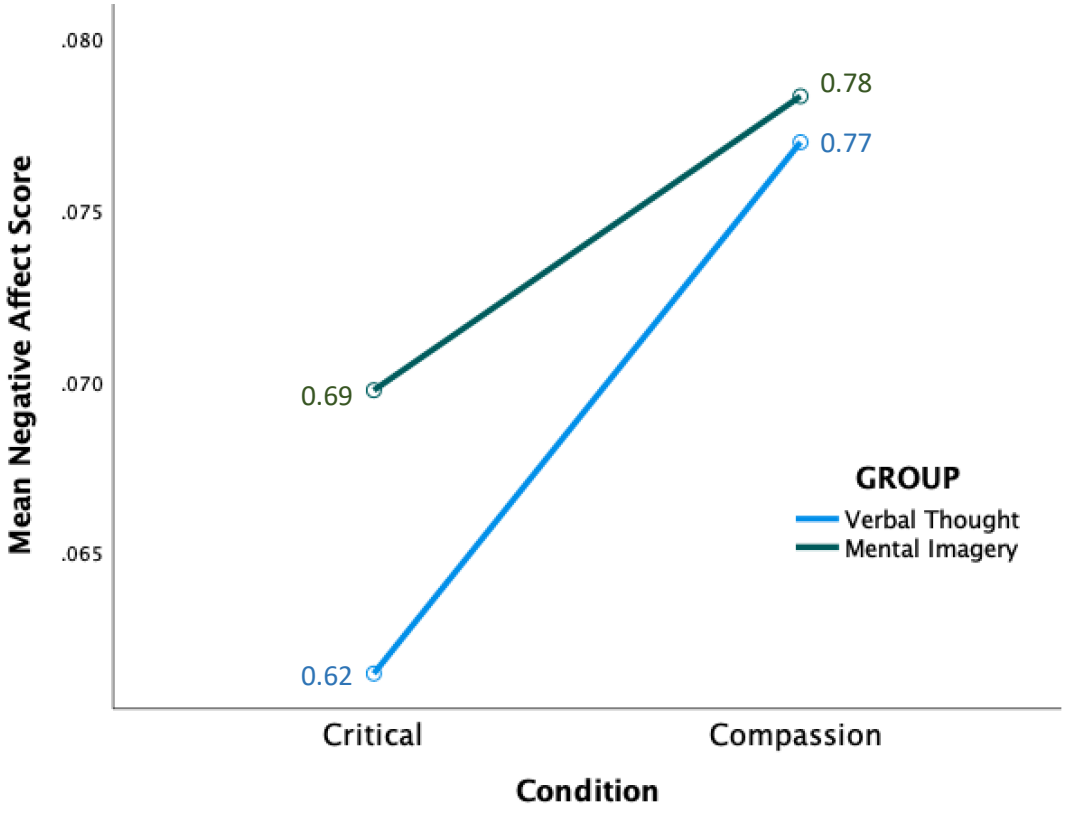

Figure 1. Mean negative affect scores measured using the PANAS negative affect subscale for the critical and compassion tasks for the verbal thought and mental imagery groups. Note that larger scores indicate less negative affect and smaller scores indicate a larger negative emotional response.

Planned contrasts were completed using independent and pairwise t tests for the main effect of condition, EMWSS and the significant interaction that was found. A

Bonferroni correction was utilised to correct for the use of multiple comparisons (0.05/5 = 0.01). Note that following the reciprocal transformation, lower scores indicate larger negative affect and vice versa. Participants rated the critical task as evoking significantly larger negative emotions (*M*= .066, *SD*= .023) compared to the compassion task (*M*= .078, *SD*= .022), *t*(243)= -9.60, *p* < .001 with a medium effect (*d*= .62). For the critical condition there was a significant difference between the verbal thought (*M*= .062, *SD*= .023) and mental imagery group (*M*= .069, *SD*= .020) with the verbal thought group rating the task as evoking larger negative emotions, *t*(242)= -2.603, *p* = .010 with a small effect size (*d*= .33). There were no significant differences found between groups for the compassion task, *t*(242)= -.126, *p* = .900.

Individual differences in EMWSS were explored in relation to affective responding to the tasks. Although people with higher EMWSS scores showed lower negative affect in the compassion condition (*M*= .080, *SD*= .021) compared to participants with lower EMWSS scores (*M*= .075, *SD*= .022), this did not reach significance *t*(242)= -1.88, *p* = .059. High EMWSS participants additionally rated the critical task as evoking less negative affect (*M*= .068, *SD*= .023) compared to participants with low EMWSS scores (*M*= .063, *SD*= .023), again this did not reach significance *t*(242)= -1.86, *p* = .065. Thus, while EMWSS may have some moderating effects, they are clearly not of a significant magnitude to influence negative affective responding consistently.

Positive Affect

ToPAS – Safe/Warmth

There was a main effect of condition, *F*(1, 240) = 75.95, *p* <.001 with a large effect size (η^2 = .24) and main effect of EMWSS, *F*(1, 240) = 25.33, *p* <.001 with a large effect size (η^2 = .94). There were no significant main effect of group (*F*(1, 240) = .718, *p* = .397) or SUIS

(F(1, 240) = 3.23, p = .074), or condition by group (F(1, 240) = 3.56, p = .060), condition by EMWSS (F(1, 240) = .080, p = .777), or condition by SUIS (F(1, 240) = 3.29, p = .071) interactions found. Figure 2 illustrates the changes in feelings of safeness/warmth by condition and group.

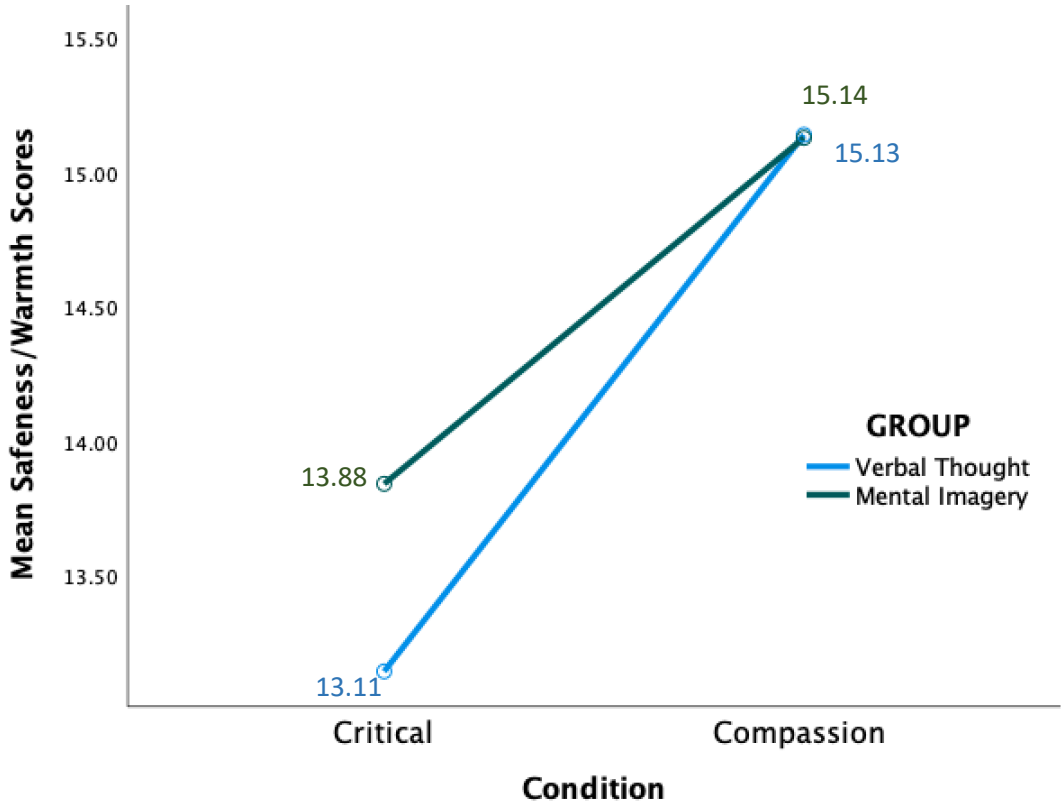

Figure 2. Mean positive affect scores for feelings of safeness/warmth measured using the ToPAS for the critical and compassion tasks for the verbal thought and mental imagery groups. Higher scores indicate larger positive affect.

Due to the significant main effect of condition and EMWSS, planned contrasts were carried out with a Bonferroni correction applied due to the multiple comparisons (0.05/3 = 0.02). Participants rated the compassion task as eliciting larger feelings of safeness/warmth (M= 15.14, SD= 4.04) when compared to the critical task (M= 13.49, SD= 4.49), t(243) = -8.68, p<.001 with a medium effect size (d= .56). People with higher EMWSS showed

significantly higher feelings of safeness/warmth on the compassion task (*M*= 16.36, *SD*= 3.49) compared to people with lower EMWSS (*M*= 13.91, *SD*= 4.19), *t*(242) = -4.96, *p*<.001 with a medium effect size (*d*= .64). The same was true for the critical task with people with high EMWSS showing higher safeness/warmth (*M*= 14.76, *SD*= 4.22) compared to people with low EMWSS (*M*= 12.22, *SD*= 4.41), *t*(242) = -4.60, *p*<.001 with a medium effect size (*d*= .59).

ToPAS – Relaxed

There was a significant main effect of condition, *F*(1, 240) = 58.24, *p* <.001 with a large effect size (η^2 = .20) and main effect of EMWSS, *F*(1, 240) = 28.89, *p* <.001 with a medium effect size (η^2 = .11). There were no significant main effect of group (*F*(1, 240) = .20, *p* = .657) or SUIS (*F*(1, 240) = 2.78, *p* = .097), or condition by group (*F*(1, 240) = 2.54, *p* = .113), condition by EMWSS (*F*(1, 240) = .10, *p* = .753), or condition by SUIS (*F*(1, 240) = 1.59, *p* = .206) interactions found. Figure 3 illustrates the changes in feelings of relaxed state by condition and group.

Due to the main effect of condition and EMWSS, planned contrasts were carried out with a Bonferroni correction applied due to the multiple comparisons (0.05/3 = 0.02). Participants rated the compassion task as eliciting a larger relaxed state (*M*= 20.09, *SD*= 6.54) when compared to the critical task (*M*= 17.61, *SD*= 6.82), *t*(243) = -7.64, *p*<.001 with a small to medium effect (*d*= .49). People with high EMWSS had significantly higher feelings of relaxation after the compassion task (*M*= 22.18, *SD*= 5.82) compared to people with low EMWSS (*M*= 17.99, *SD*= 6.58), *t*(242) = -5.27, *p*<.001 with a medium effect (*d*= .67). The same was true for the critical task with people with high EMWSS showing higher relaxation (*M*= 19.58, *SD*= 6.68) compared to people with low EMWSS (*M*= 15.62, *SD*= 6.38), *t*(242) = -4.74, *p*<.001 with a medium effect (*d*= .61).

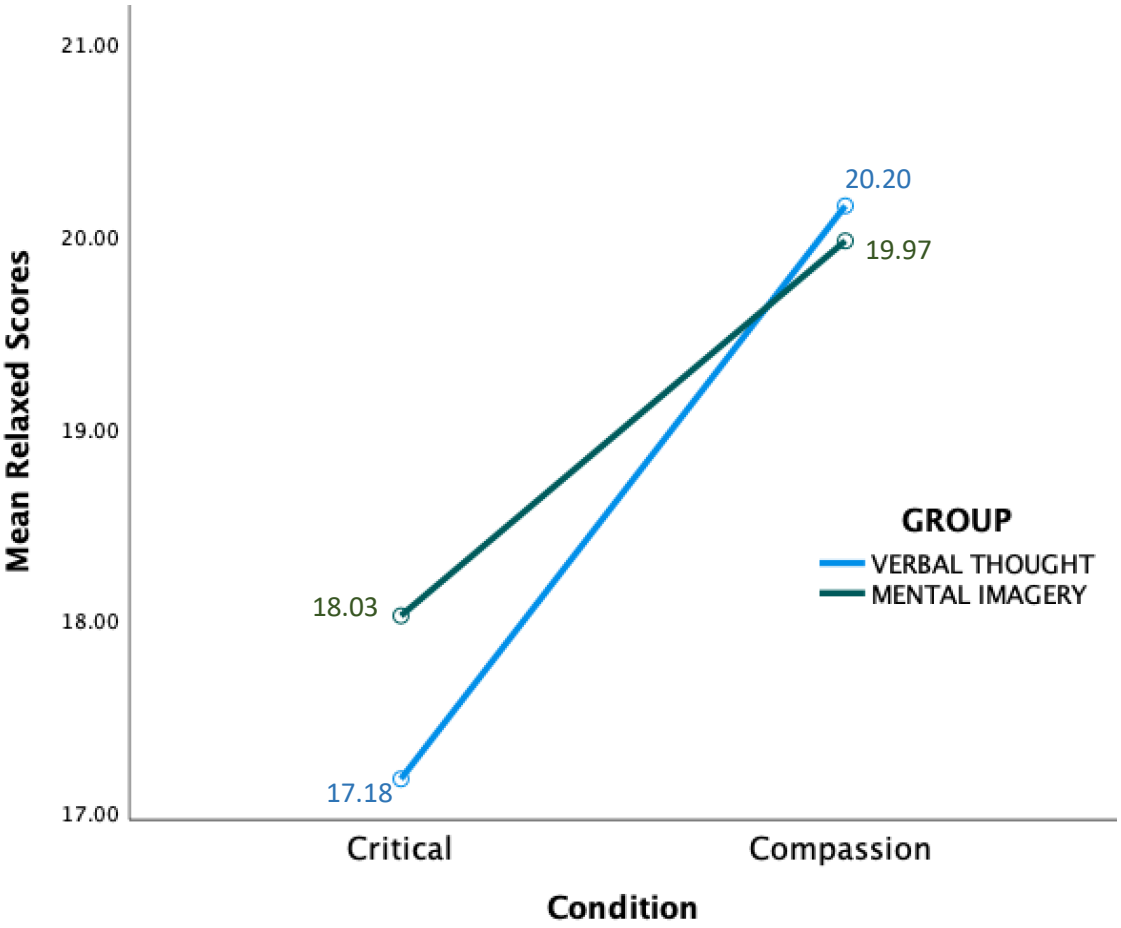

Figure 3. Mean positive affect scores for feelings of relaxation measured using the ToPAS for the critical and compassion tasks for the verbal thought and mental imagery groups. Higher scores indicate larger positive affect.

Discussion

The present study explored whether compassionate and critical mental imagery would evoke larger affective responses, when compared to verbal thought alone. This did not appear true in the current study as participants in the verbal thought and mental imagery groups did not significantly differ in their emotional responses to the tasks for positive affect. For negative affect, participants in the verbal thought group rated the critical task as evoking larger negative emotions, when compared to the imagery group. However, this effect was small and thus, may not be clinically relevant. This was inconsistent with

Holmes' previous findings that mental imagery amplifies emotions when compared to verbal thought (Holmes et al., 2008). It was additionally hypothesised that the compassion task, for both mental imagery and verbal thought groups, would evoke a larger positive emotional response, and the critical tasks would induce more negative affect. This appeared true as across groups as participants rated the critical task as eliciting increased negative affect and the compassion task as inducing increased feelings of safeness/warmth and relaxation. This is consistent with the CFT literature that generally people tend to experience tasks inducing feelings of compassion as soothing and eliciting positive affect (Gilbert et al., 2008).

People's early memories of warmth and safeness appeared to moderate the relationship between emotional response and condition. Participants with higher EMWSS rated the critical and compassion tasks as eliciting larger feelings of safeness/warmth and relaxation, compared to people with lower EMWSS scores. People who scored higher in EMWSS additionally rated both tasks as evoking less negative affect compared to people with lower EMWSS, however, this did not reach significance. Thus, it is unlikely that this finding is clinically relevant due to there only being a very small effect which may not translate as important when working on an individual basis. SUIS scores did not appear to moderate the relationship between emotional response and condition, suggesting that level of imagery use in everyday thinking does not affect emotional response to critical and compassionate responding, in relation to mental imagery or verbal thought. This is perhaps an unexpected finding as previous research has found that individuals with lower imagery ability show a dampened emotional response to evocative mental imagery (Wicken et al., 2021). However, the participants within the Wicken et al. (2021) study had very low imagery

ability, thus perhaps there was more variation in mental imagery ability within the current sample, aiding the detection of correlations with emotion.

The findings of the current study are inconsistent with previous research (see Holmes et al., 2006; Holmes et al., 2009), and Holmes' theory of mental imagery being an 'emotional amplifier' (Holmes et al., 2008). An explanation for this discrepancy may be that the verbal thought task within the current study evoked mental imagery, thus, the groups may not have been sufficiently different to find this effect. Another difference is the present study evoked feelings of criticism and compassion which is possibly already emotionally evocative, regardless of the process in which these are elicited. Utilising critical and compassionate thinking additionally draws upon relational experiences (Gilbert, 2009), which is supported by the finding that people's early affiliative memories moderated their emotional response to the critical and compassionate tasks. Within the Holmes papers, they did not always use evocative content, thus perhaps the emotional response triggered by the verbal thought tasks were heightened due to the emotionally laden content. It is possible that the tasks across groups may have naturally evoked emotionally laden images, in a way that previous studies within this area have not.

The current study is the first to our knowledge to explore imagery versus verbal thought within the area of CFT. It could be suggested that the process of eliciting feelings of compassion and criticism is not so important, as both verbal thought and mental imagery evoked similar patterns of emotional responding. Thus, perhaps any intervention to induce compassion, whether this be generating an internal compassionate voice tone or compassionate mental image, activates the attachment and affiliative systems, creating a soothing affective response (Gilbert et al., 2008). Therefore, individual differences in mental imagery ability may not affect how easily feelings of compassion are evoked if the focus

does not necessarily have to be on creating a vivid mental image. This is supported by the CFT literature that generating a felt sense of compassion is more important than creating a vivid mental picture (Gilbert, 2009). This may be another explanation as to why participants' everyday use of imagery scores did not moderate their emotional responses to the tasks.

People's early experiences, specifically feelings of warmth and safeness, impact on how self-critical and self-compassionate they are as adults (Irons et al., 2006). When things go wrong or people experience perceived failure, their ability to self-reassure is associated with memories of parental warmth as a child (Irons et al., 2006). If people experience more warmth from parental figures, they are more likely to be able to self-reassure and offer themselves self-compassion. However, if they experience less parental warmth growing up, they may be less likely to do this. Thus, parental relationships and memories of feelings of warmth and safeness affect self-to-self relating in adulthood (Irons et al., 2006). Similarly, research by Dragan et al. (2021) found that early attachment relationships are related to emotion regulation ability and the likelihood of feeling soothed and reassured by self-compassion. The findings of the present study are consistent with this theoretical stance, in that participants who experienced less warmth and feelings of safeness appeared to find compassionate imagery less soothing and evoking larger negative affect. Thus, it appears from the literature and the current study that early life experiences moderate the relationship between people's emotional response to compassionate and critical responding.

Limitations

The current study took place on online platform due to the coronavirus pandemic, and thus, there may have been confounding variables that were not controlled for. For example, participants being disrupted during tasks, lack of concentration, noise levels, and

competing attentional demands. This may have reduced engagement levels in the tasks, however, efforts were made to encourage engagement as participants were required to wait until the videos had ended to click onto the next page. An area for future research is to explore whether longer critical and compassion tasks may increase emotional responses, as it may be that the mental imagery tasks in the current study were not long enough to generate self-compassionate imagery. Due to the possible limitation of the verbal thought and mental imagery conditions not being sufficiently distinct, future research could explore whether a difference would be found in emotional response between groups if the tasks were more different. It would additionally be interesting to explore whether variations in the specific scenarios and tasks affects emotional responding for the different verbal thought and imagery conditions. The differential components involved in generating a felt sense of compassion are important to explore further to test out the hypothesis that compassionate verbal thought and imagery evoke similar affective responding. The current study utilised a general population sample and so limited conclusions can be drawn upon the application of the findings to clinical populations. Thus, future research could explore whether there are differences in emotional response to compassionate imagery versus verbal thought within clinical populations, so this can be generalised to use within CFT. Finally, future research could utilise a manipulation check to assess participants level of engagement in the task to ascertain whether this effects their emotional response.

Clinical Implications

As reported findings are consistent with the theoretical stance presented by Gilbert (Gilbert, 2009), the findings provide empirical support for the clinical applications associated with the compassionate mind approach. Not only does generating feelings of compassion appear helpful for clinical populations, but there is increasing evidence of the application of

this approach with the general public (Irons & Heriot-Maitland, 2020). The current study found that compassionate imagery and verbal thought evoked similar affective responses, with participants in both groups experiencing larger feelings of safeness/warmth and relaxation and reduced negative emotions. Thus, this suggests that when generating mental images and feelings of compassion, people's imagery ability and the vividness of this should not have an effect upon how soothed they feel in response. If people find it more difficult to create a vivid image in mind of giving themselves compassion, generating an internal compassionate voice tone is enough to elicit feelings of warmth and relaxation. People's early life experiences of warmth and memories of safeness may also impact upon their ability to feel soothed by compassion initially. Therefore, this is important to consider within clinical intervention as people with limited experiences of warmth and safeness may experience compassion as more threatening initially (Kirby et al., 2019), and may require more support in working through their blocks to compassion. It may be worth considering using a measure of fears of compassion within clinical populations in an attempt to predict how soothing or threatening an individual may find compassion interventions initially, as EMWSS have been found to be negatively correlated with fears of compassion (Gilbert et al., 2011; Matos et al., 2017).

In conclusion, the current study explored how different instructions affected self-reported emotional responses to an imagined voice of self-reassurance. The results indicated clear differences in emotional responses (positive and negative) depending on whether their imagined self-reassurance was critical or compassionate in tone. This difference is striking in that the actual wording for reassurance remained the same, with only the imagined criticism or compassion varying. In this context, no difference was observed between groups where participants were asked to increase mental imagery of the

reassurance, or primarily use verbal thought. Whilst this contradicts previous studies observing that imagery amplifies emotion, it may be that both conditions inadvertently activated significant emotional imagery due to their content and nature. Alternatively, it may be that the procedural differences between both sets of instructions were not sufficiently different to create the between condition manipulation needed to observe an effect. The present study thus contributes to a growing body of research indicating that compassionate self-reassurance can have significant positive emotional consequences. Furthermore, the interactions with self-reported early memories of warmth and safeness indicates that this individual difference is significant when moderating the benefit of compassionate approaches.

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Appendix A – Author Guidelines for Psychophysiology

HOME | ABOUT | CONTRIBUTE | BROWSE

Author Guidelines

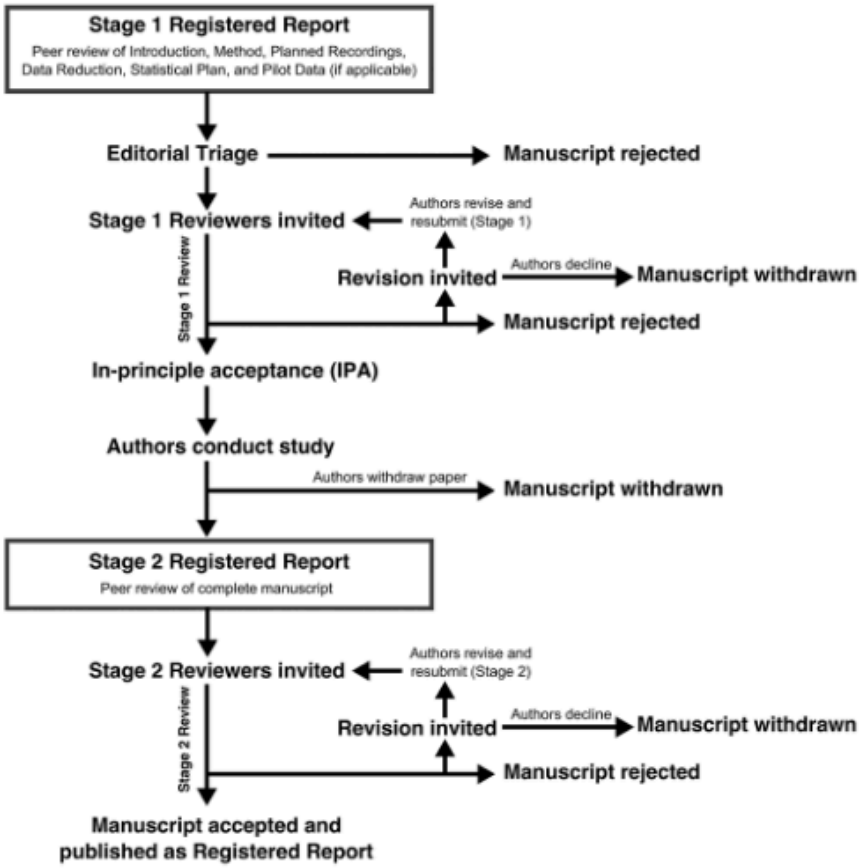
Journal Aims and Scope

Founded in 1964, *Psychophysiology* is the most established journal specifically dedicated to the dissemination of **psychophysiological science**. The journal continues to play a key role in advancing **human neuroscience** in its many forms and methodologies (including central and peripheral measures), covering research on the interrelationships between the physiological and psychological aspects of brain and behavior. Typically, studies published in *Psychophysiology* include psychological independent variables and noninvasive physiological dependent variables (hemodynamic, electromagnetic and optical brain imaging and/or peripheral measures such as respiratory sinus arrhythmia, electromyography, pupillography, and many others). The vast majority of studies published in the journal involve human participants. Research based on animal models is published only occasionally, usually in the context of special topic issues where this work is central to the topic and to psychophysiological theory. For additional information regarding the aims and scope of the journal see Fabiani, 2015.

Manuscript Types

Psychophysiology publishes **original articles** reporting experimental studies in any area of psychophysiological research. It also welcomes **theoretical papers, evaluative reviews** of literature (including meta-analyses), and **methodological developments** (e.g., novel experimental and recording procedures and statistical analyses directly relevant to psychophysiological research and providing integration with psychophysiological theory). **Selected archival documents of the Society for Psychophysiological Research** (such as award citations and obituaries) are also published in the journal. A few times a year the *Journal* also publishes **special issues** on topics central to psychophysiology. Letters to the Editor or commentary papers on other articles are not accepted.

In 2020 *Psychophysiology* introduced **registered reports** as a new additional format for the journal. Briefly, for registered reports, the submission and related reviews are performed in 2 stages. Stage-1 is based on a manuscript consisting of a thoroughly developed introduction and methods sections. Stage-1 manuscripts are reviewed on the basis of their theoretical merits, research design, clarity, interest to the field etc. If the Stage-1 submission is *provisionally* accepted, the authors are admitted to a second review (Stage 2) at the time they submit the completed manuscript. Acceptance at this stage is likely, presuming the data are clean, meaningful, correctly interpreted, and if the authors followed their outlined procedures from Stage 1.



Manuscript Submission and Review: Transparency, Data Sharing, and Transfer/Cascading

- Manuscripts should be submitted electronically at **Manuscript Central**. *Psychophysiology* requires the corresponding author to provide an **ORCiD** ID when submitting a manuscript, but all other authors are strongly encouraged to link their ORCiD IDs. We also recommend that the ORCiD IDs associated with manuscripts are made publicly available. Communications about the paper directed to the Editor-in-Chief should be included in a cover letter. Authors submitting an article targeted for a "special issue" should choose **special issue** as the manuscript type and choose the appropriate special issue title from the related pull-down menu on Manuscript Central. They should also report this information in the cover letter.
- *Psychophysiology* follows **publication ethics and best practices,** including **COPE**.
- Articles with multiple authors are reviewed with the assumption that all authors have approved the submitted manuscript and concur with its submission to *Psychophysiology*. We require a **CRediT** (contributor role taxonomy) statement so that authors can specify their diverse contributions to the manuscript. Changes to the authors' list are locked after submission. If changes are needed, please contact the Editorial Office.
- *Psychophysiology* requires that all authors disclose any potential sources of conflict of interest (financial or otherwise), which may be perceived as influencing an author's objectivity. When appropriately disclosed, the existence of a conflict of interest does not preclude publication in this journal. It is the responsibility of the corresponding author to review this policy with all authors and to collectively list in the online submission system ALL pertinent commercial and other relationships. If no conflict of interest is present, authors should explicitly state so when submitting.
- **Review process.** The Editorial Office will acknowledge receipt of the manuscript, provide it with a manuscript reference number, and in most cases assign it to a Senior Editor for pre-review. The Senior Editor may provide a decision or assign for review to one of the Associate Editors on the **Editorial Board** (the Action Editor), who will typically select two referees to review each manuscript. Once assigned, correspondence should be directed to

the specific Action Editor. Every effort is made to provide the author with a decision letter within 8 weeks of manuscript assignment. If the Action Editor requests that revisions be made to a manuscript before acceptance for publication, a maximum of 3 months will be allowed for preparation of the revision, except in unusual circumstances (to be determined by the Action Editor upon author's request for extension). Please note that names and affiliations of authors are not blinded during the review process, and that reviewers are anonymous unless they explicitly choose to sign their reviews.

- **Transparency and data sharing.** *Psychophysiology* encourages authors to share their data, materials, and software code supporting their study by archiving them in an appropriate public repository. A **registered report format** (see **Manuscript Types** tab) is available for manuscripts for which authors have registered their research plans with the journal.
- **No costs are associated with publication.** There are no costs associated with publication in *Psychophysiology* of an accepted article or related color figures. However, costs may be incurred if authors opt to publish Open Access (see Copyright and Other Information), and/or if language editing is required (see **Manuscript Preparation and Style** tab).
- **The Neuroscience Peer Review Consortium (NPRC) and Other Cascading Options.** *Psychophysiology* offers a number of transfer options to papers that are rejected. First, *Psychophysiology* is a member of the Neuroscience Peer Review Consortium (**NPRC**) which is an alliance of neuroscience journals formed to reduce the time and duplication of effort placed on peer reviewers of neuroscience papers. When choosing the NPRC option, authors should request that the Editorial Office of *Psychophysiology* transfers the reviewers' reports of their rejected manuscript to another NPRC journal. When manuscripts are transferred to *Psychophysiology* by another NPRC Journal, they should include a detailed description of the changes made to the article on the basis of the previous set of reviews. The Editors of *Psychophysiology* will use the forwarded reviewers' reports and authors' response at their discretion, either directly to make a decision, or to request further reviews if they feel such are necessary.
- Second, *Psychophysiology* also offers the option for papers that are favorably reviewed but ultimately rejected to be automatically transferred (cascaded) to one of the following journals published by Wiley: ***Brain and Behavior***, ***European Journal of Neuroscience***, or ***Physiological Reports***. Recommendation for cascading will occur at the discretion of the Action Editor, typically for one of two reasons: (a) The article's content is not suitable for *Psychophysiology* but may be a good fit for one of these journals; (b) The manuscript is scientifically sound but does not reach the high bar required for publication in *Psychophysiology*, as we need to be selective due to a very high submission rate. In the latter case, the manuscript as well as the reviews can be automatically transferred if the author(s) wish to do so.

Manuscript Preparation and Style

- **English as a second language.** All manuscripts must be in written in English, using English (UK or American) spelling. We strongly recommend that authors who are not native speakers of English avail themselves of professional language editing services before submission, as this will increase their chances of favorable reviews, by eliminating obstacles created by language difficulties. **Wiley English Editing Services** provide our authors the option for premium services, which allow for as many rounds of editing as needed for one flat fee. This means that authors will receive English language editing support to improve the readability of the manuscript by the reviewers and will be able to utilize these services again should revisions be requested.
- **Overall format.** Electronic submissions should be in Word format (.doc or .docx). Authors should feel free to embed figures in their manuscript if they so wish, but we do ask that they also *upload high resolution figures separately*. *At first submission*, citations can be in any format, but should be consistent. *Revised and resubmitted manuscripts* should be formatted as follows: Manuscripts should be double-spaced with 1" margins. Font (Times Romans, Arial or similar) should not be smaller than 11 points. Manuscript preparation, including citations, should follow the guidelines provided by the **APA manual 6th edition**. However, departing from APA format, article sections are numbered (e.g., 1, 1.1, 1.1.2, etc.), following current online journal format. Digital Object Identifiers (DOIs) must now be added to references whenever available, even when referencing print sources. Please use the following format to report DOI's: https://www.doi.org/...
- **Manuscript elements and order.** The pages of the manuscript should be arranged as follows: **First page.** Title page containing title, names and institutional affiliations, and short title (50 characters, maximum). Please include name, address, phone, and email information for the corresponding author on this page. **Second page.** An abstract of not more than 250 words, including statement of the problem, method, results, and conclusions of experimental and methodological articles or summary of major issues, source of observations, and conclusions of theoretical and review articles. In most data papers, the abstract should make clear not just what empirical relationship was evaluated but what was the primary substantive or methodological issue that motivated the study. Abstracts should be continuous without subheadings. **Third page.** The first page of the Introduction (section 1.). **Subsequent pages.** Unless there are compelling reasons for variation, subsequent

pages will include Method (section 2.), Results (section 3.), and Discussion (section 4.), with subsections as needed. Further sections are ordered as follows, with each section beginning on a new page: References, Author Notes, Footnotes, Tables, Figure Captions, and Figures. The Author Note includes grant funding sources, any acknowledgments, a conflict of interest statement, and the name and email address for reprints. Grant funding sources should be also provided at submission and will be linked with the published paper. Each table and figure should be on a separate page. **Supplementary materials.** Optional supplementary material (e.g., ancillary analyses, additional figures, audio or video files) can be uploaded together with the required manuscript files.

Please use common formats accessible to most readers (e.g., Text: pdf; Audio: MP3, AAC, WMA. Video: QuickTime, MPEG, AVI). Supplementaru materials are hosted on the Journal web site and permanently linked to the paper via the DOI.

- Authors should construct figures with notations and data points of sufficient size to permit legible reduction to one column of a two-column page. As a guide, no character should be smaller than 1 mm wide after reduction. Standard errors of the mean should be depicted whenever possible. For details please about accepted file formats and resolution see **Information about electronic artwork**. Color figures will be reproduced at no cost.
- **Impact statements.** To help readers appreciate the relevance and crucial contribution of each paper, article titles are accompanied by an impact statement in the Table of Contents. When preparing impact statements, authors should use key words that facilitate search engine optimization (SEO) and that are consistent with their title, headers, and abstract. For additional information, authors should consult the **Author toolkit**, which provides guidelines on **SEO best practices**. Impact statements are short highlights (a few sentences, approximately 50-75 words total) in which author(s) explain why their article is important and novel, and how it advances current knowledge. Please note that these are not short abstracts but statements explaining why this article is important and should be read. **This link includes some examples of successful impact statements**.
- **Manuscript length.** Our suggested maximum article length is 30 typewritten pages (excluding references), and shorter manuscripts are welcome. Please consult with the editorial office if your manuscript departs significantly from these guidelines.
- **Abbreviations, acronyms, and units of measurement.** The use of idiosyncratic abbreviations and acronyms, except for those that are quite common in this journal (e.g., EEG, EMG, EOG, ERP, SCL, fMRI, etc.) is strongly discouraged. For units of measurement, metric system units, as specified by the International System of Units, should be used.
- **Copy-editing and page proofs.** The publisher reserves the right to copy-edit manuscripts. The corresponding author will receive page proofs for final proofreading. These are handled electronically and should be checked and returned within 2 days of receipt. Although the journal will copyedit manuscripts for formatting consistency, authors assume the responsibility of ensuring that their manuscript does not contain grammatical or spelling errors. Manuscripts that have not been adequately proofread before submission will be returned.

Guidelines for Reporting Results and Analytic Considerations

- *Psychophysiology* receives manuscripts using a variety of methodologies. For best practices we ask that authors follow the **Guidelines Articles** published in the journal. As an example of what needs to be reported in a result section, please see the **published outline created for ERP and EEG articles**.
- **Repeated measures.** Authors submitting articles involving within-subjects repeated-measures variables should consult **Jennings et al. (1987)** for journal policy concerning repeated-measures designs. The Huynh–Feldt, Greenhouse–Geisser, or similar correction should be undertaken for univariate repeated-measures ANOVA tests involving more than one degree of freedom, in which case the uncorrected degrees of freedom, the corrected p value, and the epsilon value should be reported. Consideration should also be given to the use of more recent analytic approaches to repeated measures/longitudinal data [see: **Hedecker & Gibbons (2006)**; see also **Kristjansson, Kircher, & Webb (2007)**]. In addition, we ask that authors explicitly mention how they deal with validity assumptions when group sizes are unequal with regard to omnibus and sub-effect hypotheses (i.e., main and interaction effect tests, simple-effect tests, and multiple-comparison tests). It is recommended that, when applicable, non-pooled and/or corrected degrees-of-freedom statistics be used (see **Keselman, 1998**).
- **Effect sizes and confidence intervals.** When describing results, authors are strongly encouraged to report measures of effect size in addition to probability values. If effect sizes are not reported, sufficient detail should be provided to enable effect size computation. In addition, whenever possible, confidence intervals should be reported to reduce the focus on point estimations and facilitate comparisons across studies. Power analyses are strongly encouraged and required when relatively small samples are involved and/or when reporting null effects.

- **Individual differences.** *Psychophysiology* receives many articles that report on relationships between psychophysiological measures and other trait-like individual differences variables (e.g., self-report personality measures). For such papers, the editorial board encourages authors to report the internal reliability of psychophysiological measures whenever possible (e.g., correlation between odd and even trials), as well as the reliability of the instruments used to assess the individual differences. Such reliability estimates depend on the population and measurement context, so these should also be mentioned. We recognize that this may not be possible for all measures.

Appendix B – Quality Assessment Tool for Quantitative Studies

Quality Assessment Tool for Quantitative Studies Dictionary

The purpose of this dictionary is to describe items in the tool thereby assisting raters to score study quality. Due to under-reporting or lack of clarity in the primary study, raters will need to make judgements about the extent that bias may be present. When making judgements about each component, raters should form their opinion based upon information contained in the study rather than making inferences about what the authors intended.

A) SELECTION BIAS

(Q1) Participants are more likely to be representative of the target population if they are randomly selected from a comprehensive list of individuals in the target population (score very likely). They may not be representative if they are referred from a source (e.g. clinic) in a systematic manner (score somewhat likely) or self-referred (score not likely).

(Q2) Refers to the % of subjects in the control and intervention groups that agreed to participate in the study before they were assigned to intervention or control groups.

B) STUDY DESIGN

In this section, raters assess the likelihood of bias due to the allocation process in an experimental study. For observational studies, raters assess the extent that assessments of exposure and outcome are likely to be independent. Generally, the type of design is a good indicator of the extent of bias. In stronger designs, an equivalent control group is present and the allocation process is such that the investigators are unable to predict the sequence.

Randomized Controlled Trial (RCT)

An experimental design where investigators randomly allocate eligible people to an intervention or control group. A rater should describe a study as an RCT if the randomization sequence allows each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. If the investigators do not describe the allocation process and only use the words 'random' or 'randomly', the study is described as a controlled clinical trial.

See below for more details.

Was the study described as randomized?

Score YES, if the authors used words such as random allocation, randomly assigned, and random assignment.

Score NO, if no mention of randomization is made.

Was the method of randomization described?

Score YES, if the authors describe any method used to generate a random allocation sequence.

Score NO, if the authors do not describe the allocation method or describe methods of allocation such as alternation, case record numbers, dates of birth, day of the week, and any allocation procedure that is entirely transparent before assignment, such as an open list of random numbers of assignments.
If NO is scored, then the study is a controlled clinical trial.

Was the method appropriate?

Score YES, if the randomization sequence allowed each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. Examples of appropriate approaches include assignment of subjects by a central office unaware of subject characteristics, or sequentially numbered, sealed, opaque envelopes.

Score NO, if the randomization sequence is open to the individuals responsible for recruiting and allocating participants or providing the intervention, since those individuals can influence the allocation process, either knowingly or unknowingly.

If NO is scored, then the study is a controlled clinical trial.

Controlled Clinical Trial (CCT)
An experimental study design where the method of allocating study subjects to intervention or control groups is open to individuals responsible for recruiting subjects or providing the intervention. The method of allocation is transparent before assignment, e.g. an open list of random numbers or allocation by date of birth, etc.

Cohort analytic (two group pre and post)
An observational study design where groups are assembled according to whether or not exposure to the intervention has occurred. Exposure to the intervention is not under the control of the investigators. Study groups might be non-equivalent or not comparable on some feature that affects outcome.

Case control study
A retrospective study design where the investigators gather 'cases' of people who already have the outcome of interest and 'controls' who do not. Both groups are then questioned or their records examined about whether they received the intervention exposure of interest.

Cohort (one group pre + post (before and after)
The same group is pretested, given an intervention, and tested immediately after the intervention. The intervention group, by means of the pretest, act as their own control group.

Interrupted time series
A time series consists of multiple observations over time. Observations can be on the same units (e.g. individuals over time) or on different but similar units (e.g. student achievement scores for particular grade and school). Interrupted time series analysis requires knowing the specific point in the series when an intervention occurred.

C) CONFOUNDERS

By definition, a confounder is a variable that is associated with the intervention or exposure and causally related to the outcome of interest. Even in a robust study design, groups may not be balanced with respect to important variables prior to the intervention. The authors should indicate if confounders were controlled in the design (by stratification or matching) or in the analysis. If the allocation to intervention and control groups is randomized, the authors must report that the groups were balanced at baseline with respect to confounders (either in the text or a table).

D) BLINDING

(Q1) Assessors should be described as blinded to which participants were in the control and intervention groups. The purpose of blinding the outcome assessors (who might also be the care providers) is to protect against detection bias.

(Q2) Study participants should not be aware of (i.e. blinded to) the research question. The purpose of blinding the participants is to protect against reporting bias.

E) DATA COLLECTION METHODS

Tools for primary outcome measures must be described as reliable and valid. If 'face' validity or 'content' validity has been demonstrated, this is acceptable. Some sources from which data may be collected are described below:

Self reported data includes data that is collected from participants in the study (e.g. completing a questionnaire, survey, answering questions during an interview, etc.).

Assessment/Screening includes objective data that is retrieved by the researchers. (e.g. observations by investigators).

Medical Records/Vital Statistics refers to the types of formal records used for the extraction of the data.

Reliability and validity can be reported in the study or in a separate study. For example, some standard assessment tools have known reliability and validity.

F) WITHDRAWALS AND DROP-OUTS

Score **YES** if the authors describe BOTH the numbers and reasons for withdrawals and drop-outs.

Score **NO** if either the numbers or reasons for withdrawals and drop-outs are not reported.

The percentage of participants completing the study refers to the % of subjects remaining in the study at the final data collection period in all groups (i.e. control and intervention groups).

G) INTERVENTION INTEGRITY

The number of participants receiving the intended intervention should be noted (consider both frequency and intensity). For example, the authors may have reported that at least 80 percent of the participants received the complete intervention. The authors should describe a method of measuring if the intervention was provided to all participants the same way. As well, the authors should indicate if subjects received an unintended intervention that may have influenced the outcomes. For example, co-intervention occurs when the study group receives an additional intervention (other than that intended). In this case, it is possible that the effect of the intervention may be over-estimated. Contamination refers to situations where the control group accidentally receives the study intervention. This could result in an under-estimation of the impact of the intervention.

H) ANALYSIS APPROPRIATE TO QUESTION

Was the quantitative analysis appropriate to the research question being asked?

An intention-to-treat analysis is one in which all the participants in a trial are analyzed according to the intervention to which they were allocated, whether they received it or not. Intention-to-treat analyses are favoured in assessments of effectiveness as they mirror the noncompliance and treatment changes that are likely to occur when the intervention is used in practice, and because of the risk of attrition bias when participants are excluded from the analysis.

Component Ratings of Study:

For each of the six components A – F, use the following descriptions as a roadmap.

A) SELECTION BIAS

Strong: The selected individuals are very likely to be representative of the target population (Q1 is 1) **and** there is greater than 80% participation (Q2 is 1).

Moderate: The selected individuals are at least somewhat likely to be representative of the target population (Q1 is 1 or 2); **and** there is 60 - 79% participation (Q2 is 2). 'Moderate' may also be assigned if Q1 is 1 or 2 and Q2 is 5 (can't tell).

Weak: The selected individuals are not likely to be representative of the target population (Q1 is 3); **or** there is less than 60% participation (Q2 is 3) **or** selection is not described (Q1 is 4); and the level of participation is not described (Q2 is 5).

B) DESIGN

Strong: will be assigned to those articles that described RCTs and CCTs.

Moderate: will be assigned to those that described a cohort analytic study, a case control study, a cohort design, or an interrupted time series.

Weak: will be assigned to those that used any other method or did not state the method used.

C) CONFOUNDERS

Strong: will be assigned to those articles that controlled for at least 80% of relevant confounders (Q1 is 2); **or** (Q2 is 1).

Moderate: will be given to those studies that controlled for 60 – 79% of relevant confounders (Q1 is 1) **and** (Q2 is 2).

Weak: will be assigned when less than 60% of relevant confounders were controlled (Q1 is 1) **and** (Q2 is 3) **or** control of confounders was not described (Q1 is 3) **and** (Q2 is 4).

D) BLINDING

Strong: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); **and t**he study participants are not aware of the research question (Q2 is 2).

Moderate: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); **or** the study participants are not aware of the research question (Q2 is 2); **or b**linding is not described (Q1 is 3 and Q2 is 3).

Weak: The outcome assessor is aware of the intervention status of participants (Q1 is 1); **and** the study participants are aware of the research question (Q2 is 1).

E) DATA COLLECTION METHODS

Strong: The data collection tools have been shown to be valid (Q1 is 1); **and** the data collection tools have been shown to be reliable (Q2 is 1).

Moderate: The data collection tools have been shown to be valid (Q1 is 1); **and** the data collection tools have not been shown to be reliable (Q2 is 2) **or** reliability is not described (Q2 is 3).

Weak: The data collection tools have not been shown to be valid (Q1 is 2) **or** both reliability and validity are not described (Q1 is 3 and Q2 is 3).

F) WITHDRAWALS AND DROP-OUTS - a rating of:

Strong: will be assigned when the follow-up rate is 80% or greater (Q2 is 1).

Moderate: will be assigned when the follow-up rate is 60 – 79% (Q2 is 2) **OR** Q2 is 5 (N/A).

Weak: will be assigned when a follow-up rate is less than 60% (Q2 is 3) or if the withdrawals and drop-outs were not described (Q2 is 4).

QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1 Very likely
2 Somewhat likely
3 Not likely
4 Can't tell

(Q2) What percentage of selected individuals agreed to participate?

1 80 - 100% agreement
2 60 – 79% agreement
3 less than 60% agreement
4 Not applicable
5 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

B) STUDY DESIGN

Indicate the study design

1 Randomized controlled trial
2 Controlled clinical trial
3 Cohort analytic (two group pre + post)
4 Case-control
5 Cohort (one group pre + post (before and after))
6 Interrupted time series
7 Other specify _____
8 Can't tell

Was the study described as randomized? If NO, go to Component C.

No Yes

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

1 Yes
2 No
3 Can't tell

The following are examples of confounders:

1 Race
2 Sex
3 Marital status/family
4 Age
5 SES (income or class)
6 Education
7 Health status
8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

1 80 – 100% (most)
2 60 – 79% (some)
3 Less than 60% (few or none)
4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

1 Yes
2 No
3 Can't tell

(Q2) Were the study participants aware of the research question?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?

1 Yes
2 No
3 Can't tell

(Q2) Were data collection tools shown to be reliable?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?

1 Yes
2 No
3 Can't tell
4 Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell
5 Not Applicable (i.e. Retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK	
See dictionary	1	2	3	Not Applicable

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell

(Q2) Was the consistency of the intervention measured?

1 Yes
2 No
3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

4 Yes
5 No
6 Can't tell

H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

1 Yes
2 No
3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

1 Yes
2 No
3 Can't tell

GLOBAL RATING

COMPONENT RATINGS

Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	**SELECTION BIAS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
B	**STUDY DESIGN**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
C	**CONFOUNDERS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
D	**BLINDING**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
E	**DATA COLLECTION METHOD**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
F	**WITHDRAWALS AND DROPOUTS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	Not Applicable

GLOBAL RATING FOR THIS PAPER (circle one):

1	STRONG	(no WEAK ratings)
2	MODERATE	(one WEAK rating)
3	WEAK	(two or more WEAK ratings)

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No Yes

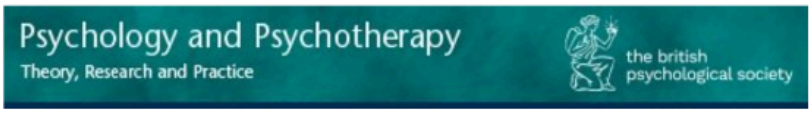
If yes, indicate the reason for the discrepancy

1	Oversight
2	Differences in interpretation of criteria
3	Differences in interpretation of study

Final decision of both reviewers (circle one):

1	**STRONG**
2	**MODERATE**
3	**WEAK**

Appendix C – Author Guidelines for Psychology and Psychotherapy: Theory, Research and Practice



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PAPTRAP AUTHOR GUIDELINES

Sections

1. Submission
2. Aims and Scope
3. Manuscript Categories and Requirements
4. Preparing the Submission
5. Editorial Policies and Ethical Considerations
6. Author Licensing
7. Publication Process After Acceptance
8. Post Publication
9. Editorial Office Contact Details

1. SUBMISSION

Authors should kindly note that submission implies that the content has not been published or submitted for publication elsewhere except as a brief abstract in the proceedings of a scientific meeting or symposium.

Once the submission materials have been prepared in accordance with the Author Guidelines, manuscripts should be submitted online at http://www.editorialmanager.com/paptrap

Click here for more details on how to use Editorial Manager.

All papers published in the *Psychology and Psychotherapy: Theory Research and Practice* are eligible for Panel A: Psychology, Psychiatry and Neuroscience in the Research Excellence Framework (REF).

Data protection:

By submitting a manuscript to or reviewing for this publication, your name, email address, and affiliation, and other contact details the publication might require, will be used for the regular operations of the publication, including, when necessary, sharing with the publisher (Wiley) and partners for production and publication. The publication and the publisher recognize the importance of protecting the personal information collected from users in the operation of these services, and have practices in place to ensure that steps are taken to maintain the security, integrity, and privacy of the personal data collected and processed. You can learn more at https://authorservices.wiley.com/statements/data-protection-policy.html.

Preprint policy:

This journal will consider for review articles previously available as preprints. Authors may also post the submitted version of a manuscript to a preprint server at any time. Authors are requested to update any pre-publication versions with a link to the final published article.

2. AIMS AND SCOPE

Psychology and Psychotherapy: Theory Research and Practice is an international scientific journal with a focus on the psychological aspects of mental health difficulties and well-being; and psychological problems and their psychological treatments. We welcome submissions from mental health professionals and researchers from all relevant professional backgrounds. The Journal welcomes submissions of original high quality empirical research and rigorous theoretical papers of any theoretical provenance provided they have a bearing upon vulnerability to, adjustment to, assessment of, and recovery (assisted or otherwise) from psychological disorders. Submission of systematic reviews and other research reports which support evidence-based practice are also welcomed, as are relevant high quality analogue studies and Registered Reports. The Journal thus aims to promote theoretical and research developments in the understanding of cognitive and emotional factors in psychological disorders, interpersonal attitudes, behaviour and relationships, and psychological therapies (including both process and outcome research) where mental health is concerned. Clinical or case studies will not normally be considered except where they illustrate particularly unusual forms of psychopathology or innovative forms of therapy and meet scientific criteria through appropriate use of single case experimental designs.

All papers published in *Psychology and Psychotherapy: Theory, Research and Practice* are eligible for Panel A: Psychology, Psychiatry and Neuroscience in the Research Excellence Framework (REF).

3. MANUSCRIPT CATEGORIES AND REQUIREMENTS

- Articles should adhere to the stated word limit for the particular article type. The word limit excludes the abstract, reference list, tables and figures, but includes appendices.

Word limits for specific article types are as follows:

- Research articles: 5000 words
- Qualitative papers: 6000 words
- Review papers: 6000 words
- Special Issue papers: 5000 words

In exceptional cases the Editor retains discretion to publish papers beyond this length where the clear and concise expression of the scientific content requires greater length (e.g., explanation of a new theory or a substantially new method). Authors must contact the Editor prior to submission in such a case.

Please refer to the separate guidelines for **Registered Reports**.

All systematic reviews must be pre-registered.

Brief-Report COVID-19

For a limited time, the *Psychology and Psychotherapy: Theory, Research and Practice* are accepting brief-reports on the topic of Novel Coronavirus (COVID-19) in line with the journal's main aims and scope (outlined above). Brief reports should not exceed 2000 words and should have no more than two tables or figures. Abstracts can be either structured (according to standard journal guidance) or unstructured but should not exceed 200 words. Any papers that are over the word limits will be returned to the authors. Appendices are included in the word limit; however online supporting information is not included.

4. PREPARING THE SUBMISSION

Free Format Submission

Psychology and Psychotherapy: Theory, Research and Practice now offers free format submission for a simplified and streamlined submission process.

Before you submit, you will need:

- Your manuscript: this can be a single file including text, figures, and tables, or separate files – whichever you prefer. All required sections should be contained in your manuscript, including abstract, introduction, methods, results, and conclusions. Figures and tables should have legends. References may be submitted in any style or format, as long as it is consistent throughout the manuscript. If the manuscript, figures or tables are difficult for you to read, they will also be difficult for the editors and reviewers. If your manuscript is difficult to read, the editorial office may send it back to you for revision.
- The title page of the manuscript, including a data availability statement and your co-author details with affiliations. *(Why is this important? We need to keep all co-authors informed of the outcome of the peer review process.)* You may like to use this template for your title page.

Important: the journal operates a double-blind peer review policy. Please anonymise your manuscript and prepare a separate title page containing author details. *(Why is this important? We need to uphold rigorous ethical standards for the research we consider for publication.)*

- An ORCID ID, freely available at https://orcid.org. *(Why is this important? Your article, if accepted and published, will be attached to your ORCID profile. Institutions and funders are increasingly requiring authors to have ORCID IDs.)*

To submit, login at https://www.editorialmanager.com/paptrap/default.aspx and create a new submission. Follow the submission steps as required and submit the manuscript.

If you are invited to revise your manuscript after peer review, the journal will also request the revised manuscript to be formatted according to journal requirements as described below.

Revised Manuscript Submission

Contributions must be typed in double spacing. All sheets must be numbered.

Cover letters are not mandatory; however, they may be supplied at the author's discretion. They should be pasted into the 'Comments' box in Editorial Manager.

Parts of the Manuscript

The manuscript should be submitted in separate files: title page; main text file; figures/tables; supporting information.

Title Page

You may like to use this template for your title page. The title page should contain:

- A short informative title containing the major key words. The title should not contain abbreviations (see Wiley's best practice SEO tips);
- A short running title of less than 40 characters;
- The full names of the authors;
- The author's institutional affiliations where the work was conducted, with a footnote for the author's present address if different from where the work was conducted;
- Abstract;
- Keywords;
- Data availability statement (see Data Sharing and Data Accessibility Policy);
- Acknowledgments.

Authorship

Please refer to the journal's Authorship policy in the Editorial Policies and Ethical Considerations section for details on author listing eligibility. When entering the author names into Editorial Manager, the corresponding author will be asked to provide a CRediT contributor role to classify the role that each author played in creating the manuscript. Please see the Project CRediT website for a list of roles.

Abstract

Please provide an abstract of up to 250 words. Articles containing original scientific research should include the headings: Objectives, Design, Methods, Results, Conclusions. Review articles should use the headings: Purpose, Methods, Results, Conclusions.

Keywords

Please provide appropriate keywords.

Acknowledgments

Contributions from anyone who does not meet the criteria for authorship should be listed, with permission from the contributor, in an Acknowledgments section. Financial and material support should also be mentioned. Thanks to anonymous reviewers are not appropriate.

Practitioner Points

All articles must include Practitioner Points – these are 2-4 bullet point with the heading 'Practitioner Points'. They should briefly and clearly outline the relevance of your research to professional practice. (The Practitioner Points should be submitted in a separate file.)

Main Text File

As papers are double-blind peer reviewed, the main text file should not include any information that might identify the authors.

The main text file should be presented in the following order:

- Title
- Main text
- References
- Tables and figures (each complete with title and footnotes)
- Appendices (if relevant)

Supporting information should be supplied as separate files. Tables and figures can be included at the end of the main document or attached as separate files but they must be mentioned in the text.

- As papers are double-blind peer reviewed, the main text file should not include any information that might identify the authors. Please do not mention the authors' names or affiliations and always refer to any previous work in the third person.
- The journal uses British/US spelling; however, authors may submit using either option, as spelling of accepted papers is converted during the production process.

References

References in published papers are formatted according to the Publication Manual of the American Psychological Association (6th edition). However, references may be submitted in any style or format, as long as it is consistent throughout the manuscript.

Tables

Tables should be self-contained and complement, not duplicate, information contained in the text. They should be supplied as editable files, not pasted as images. Legends should be concise but comprehensive – the table, legend, and footnotes must be understandable without reference to the text. All abbreviations must be defined in footnotes. Footnote symbols: †, ‡, §, ¶, should be used (in that order) and *, **, *** should be reserved for P-values. Statistical measures such as SD or SEM should be identified in the headings.

Figures

Although authors are encouraged to send the highest-quality figures possible, for peer-review purposes, a wide variety of formats, sizes, and resolutions are accepted.

Click here for the basic figure requirements for figures submitted with manuscripts for initial peer review, as well as the more detailed post-acceptance figure requirements.

Legends should be concise but comprehensive – the figure and its legend must be understandable without reference to the text. Include definitions of any symbols used and define/explain all abbreviations and units of measurement.

Supporting Information

Supporting information is information that is not essential to the article, but provides greater depth and background. It is hosted online and appears without editing or typesetting. It may include tables, figures, videos, datasets, etc.

Click here for Wiley's FAQs on supporting information.

Note: if data, scripts, or other artefacts used to generate the analyses presented in the paper are available via a publicly available data repository, authors should include a reference to the location of the material within their paper.

General Style Points

For guidelines on editorial style, please consult the APA Publication Manual published by the American Psychological Association. The following points provide general advice on formatting and style.

- **Language:** Authors must avoid the use of sexist or any other discriminatory language.
- **Abbreviations:** In general, terms should not be abbreviated unless they are used repeatedly and the abbreviation is helpful to the reader. Initially, use the word in full, followed by the abbreviation in parentheses. Thereafter use the abbreviation only.
- **Units of measurement:** Measurements should be given in SI or SI-derived units. Visit the Bureau International des Poids et Mesures (BIPM) website for more information about SI units.
- **Effect size:** In normal circumstances, effect size should be incorporated.
- **Numbers:** numbers under 10 are spelt out, except for: measurements with a unit (8mmol/l); age (6 weeks old), or lists with other numbers (11 dogs, 9 cats, 4 gerbils).

Appendix D – Research Review Committee Approval

D.Clin.Psychology Programme
Division of Clinical Psychology
Whelan Building, Quadrangle
Brownlow Hill
LIVERPOOL
L69 3GB

Tel: 0151 794 5530/5534/5877
Fax: 0151 794 5537
www.liv.ac.uk/dclinpsychol

Chloe Smith
Clinical Psychology Trainee
Doctorate in Clinical Psychology Programme
University of Liverpool
L69 3GB

24 March 2021

RE: Does compassionate imagery evoke a larger affective response compared to compassionate thinking?
Trainee: Chloe Smith
Supervisors: Katy Lobley and Luna Centifanti

Dear Chloe,

Thank you for your notification of amendment to your proposal submitted to the Chair of the D.Clin.Psychol. Research Review Committee.

I can now confirm that your proposal (*version number 2, dated January 2021)* meets the requirements of the committee and have been approved by the Committee Chair.

Please take this Chairs Action decision as ***final*** approval from the committee. However, as part of the review process the Chair included some things that you could consider going forward (included below).

You may now progress to the next stages of your research.

I wish you well with your research project.

Dr Ross White
Vice Chair D.Clin.Psychol. Research Review Committee

Appendix E – University of Liverpool Ethics Approval

Institute of Population Health Research Ethics Committee

12 May 2021

Dear Dr Lobley

I am pleased to inform you that your application for research ethics approval has been approved. Application details and conditions of approval can be found below. Appendix A contains a list of documents approved by the Committee.

Application Details

Reference:	9930
Project Title:	Does the way we respond to ourselves after failure affect the way we feel?
Principal Investigator/Supervisor:	Dr Katy Lobley
Co-Investigator(s):	Miss Chloe Smith, Dr Luna Centifanti, Miss Emma Limon
Lead Student Investigator:	-
Department:	School of Psychology
Approval Date:	12/05/2021
Approval Expiry Date:	Five years from the approval date listed above

The application was **APPROVED** subject to the following conditions:

Conditions of approval

Please note: this approval is subject to the University's research restrictions during the pandemic, as laid out on the research ethics webpages. Therefore, wherever possible, research should be conducted via remote means which avoid the need for face-to-face contact with human participants during the pandemic. The process for requesting an exemption to these restrictions is described on the research ethics webpages.

- All serious adverse events must be reported to the Committee (ethics@liverpool.ac.uk) in accordance with the procedure for reporting adverse events.
- If you wish to extend the duration of the study beyond the research ethics approval expiry date listed above, a new application should be submitted.
- If you wish to make an amendment to the study, please create and submit an amendment form using the research ethics system.
- If the named Principal Investigator or Supervisor changes, or leaves the employment of the University during the course of this approval, the approval will lapse. Therefore it will be necessary to create and submit an amendment form within the research ethics system.
- It is the responsibility of the Principal Investigator/Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

Institute of Population Health Research Ethics Committee

iphethics@liverpool.ac.uk

IPH-REC

Appendix - Approved Documents

(Relevant only to amendments involving changes to the study documentation)

The final document set reviewed and approved by the committee is listed below:

Document Type	File Name	Date	Version
Study Proposal/Protocol	Study Flow Chart Project 1 and 2	26/03/2021	1
Questionnaire	SUIS questionnaire	26/03/2021	1
Questionnaire	early-memories-of-warmth-and-safeness-scale	26/03/2021	1
Questionnaire	three-types-of-positive-affect-scale	26/03/2021	1
Questionnaire	PANAS negative affect subscale	26/03/2021	1
Questionnaire	ECR-SF	26/03/2021	1
Risk Assessment	Risk Assessment Ethics	26/03/2021	1
Evidence Of Peer Review	Chloe Smith Proposal RRC Approval letter 24.03.2021[1]	26/03/2021	1
Evidence Of Peer Review	Emma Limon Proposal RRC Approval letter 24.03.2021[1]	26/03/2021	1
Advertisement	Poster v2	19/04/2021	2
Participant Consent Form	Consent form V2	19/04/2021	2
Participant Consent Form	Consent form V2	19/04/2021	2
Advertisement	Poster v2	19/04/2021	2
Participant Information Sheet	Participant Information Sheet V3	27/04/2021	3
Debriefing Material	Debrief Information V2	27/04/2021	2
Participant Information Sheet	Participant Information Sheet V3	27/04/2021	3
Questionnaire	Forms of Self-Criticism and Self-Reassurance Scale (Item 9 Removed)	28/04/2021	V2

Appendix F – Scripts for the Failure Scenario, Verbal Thought, and Mental Imagery Tasks

Instructions for Voice Tone and Imagery Conditions:

Failure Scenario Instructions:

Bring to mind a recent situation where you made a minor mistake, or accident. You may have broken something, lost something, forgotten something, given wrong information, sent the wrong email, but try to make sure this example didn't have major consequences for you. It should be something which triggered some feelings of frustration, disappointment or embarrassment…

Take your time to settle on a memory…

Once you've got a situation in mind, please click for the next instruction.

Bringing Situation to Mind:

With this situation in mind, take a few minutes to think about it a little more. You may find it helpful to close your eyes…Where were you when the mistake happened? What were you doing? Were other people around? Remember the moment where you had the most intense feelings of frustration, embarrassment or upset. This might be at the same time as the mistake happened, or later when you realised the mistake. Bring to mind the feelings that came up. Try to remember the feelings in your body as well as your emotions, whether you heart raced, you felt hot or cold, whether there were feelings of tension?

(15 seconds of silence)

When you've got this situation clear in your mind, please click for the next instruction.

Voice Tone Conditions:

'As usual' Voice Tone Condition

Bring to mind again the original situation where you made a mistake, and the feelings you had, for a few moments. You may find it helpful to close your eyes. We're now going to see what happens when we respond to ourselves in these types of situations. So inside your mind, with your usual tone of voice and expressions imagine yourself saying the following sentence that appears on screen. **(15 seconds of silence before ending the recording to allow for the sentence to appear on screen)**

On screen - "It's okay to feel like this – these situations often trigger difficult feelings but these will pass. Everyone makes mistakes, and it's not the end of the world"

Critical Voice Tone Condition

*Bring to mind again the original situation where you made a mistake, and the feelings you had, for a few moments. You may find it helpful to close your eyes. Now imagine how you might sound to yourself if you had a harsh, critical voice tone of voice. Bring to mind the sound of that kind of voice tone that comes with an attitude of criticism, blame and sometimes anger. Think about the loudness of your voice, how quickly you speak, how harsh your tone is when imagining a critical tone of voice. With the difficult situation in mind, imagine reading the sentence on the screen with this critical voice tone in mind…***(15 seconds of silence before ending the recording to allow for the sentence to appear on screen)**

On screen - "It's okay to feel like this – these situations often trigger difficult feelings but these will pass. Remember that everyone makes mistakes, and it's not the end of the world"

Compassionate Voice Tone Condition

Bring to mind again the original situation where you made a mistake and the feelings you had, for a few moments. You may find it helpful to close your eyes. Now imagine how your

*voice sounds when you are feeling warmth, caring, wise and supportive. Bring to mind the sound of that kind of voice which comes with this attitude of compassion, understanding. It might be the kind of voice that helps you'd speak to someone you care about, when you're trying to be supportive and kind. You might consider the loudness of your voice, how quickly you speak, how gentle your tone is. With the difficult situation in mind, imagine reading the sentence on the screen with this kind and caring voice tone in mind…***(15 seconds of silence before ending the recording to allow for the sentence to appear on screen)**

On screen - "It's okay to feel like this – these situations often trigger difficult feelings but these will pass. Remember that everyone makes mistakes, and it's not the end of the world"

Mental Imagery Conditions

Critical Imagery Condition

*Bring to mind again the original situation where you made a mistake and the feelings you had for a few moments. You may find it helpful to close your eyes. Now bring to mind how you look and sound when you are feeling critical, harsh, judging and blaming. Try to create a vivid picture of yourself in your mind of how your face appears, the expression in your face and eyes, imagining a frown of disapproval. Creating a strong image in your mind, picture the position and gestures of your body when you are feeling critical and angry. With that image of your critical self in mind, bring to mind the sound of that kind of voice tone that comes with this image. With that image and sound of yourself in mind, imagine your critical self saying the sentence that appears on the screen…(***15 seconds of silence before ending the recording to allow for the sentence to appear on screen)**

On screen - "It's okay to feel like this – these situations often trigger difficult feelings but these will pass. Remember that everyone makes mistakes, and it's not the end of the world"

Compassionate Imagery Condition

Bring to mind the original situation where you made a mistake and the feelings you had, for a few moments. You may find it helpful to close your eyes. Now bring to mind how you look and sound when you are feeling caring, understanding, warm and friendly. Try to create a vivid picture of yourself in your mind of how your face appears when you feel like this, the relaxation and expression in your face and eyes, and a slight smile in the eyes and mouth. Creating a strong image in your mind, picture the position and gestures of your body when you are feeling supportive and friendly. With that image of your compassionate self in mind, bring to mind the sound of that kind of voice tone that comes with this image. With that image and sound in mind, imagine this warm and supportive image of yourself saying the sentence that you see on the screen… **(15 seconds of silence before ending the recording to allow for the sentence to appear on screen)**

On screen - "It's okay to feel like this – these situations often trigger difficult feelings but these will pass. Remember that everyone makes mistakes, and it's not the end of the world"

Appendix G – Positive and Negative Affect Scale – Negative Affect Scale

Below are a number of words that describe different feelings and emotions. **Read each item and indicate to what extent you feel this way now:**

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Scared	○	○	○	○	○
Irritable	○	○	○	○	○
Afraid	○	○	○	○	○
Upset	○	○	○	○	○
Distressed	○	○	○	○	○
Jittery	○	○	○	○	○
Nervous	○	○	○	○	○
Ashamed	○	○	○	○	○
Hostile	○	○	○	○	○
Guilty	○	○	○	○	○

Appendix H – Types of Positive Affect Scale

Below are a series of words that describe different positive emotions. **Please rate to what extent you are feeling these emotions now** using the scale 0 (not feeling like this at all) to 4 (feeling like this a lot)

	0 (not feeling like this at all)	1	2 (somewhat feeling like this)	3	4 (feeling like this a lot)
Secure	○	○	○	○	○
Calm	○	○	○	○	○
Laid Back	○	○	○	○	○
Serene	○	○	○	○	○
Safe	○	○	○	○	○
Warm	○	○	○	○	○
Content	○	○	○	○	○
Tranquil	○	○	○	○	○
Peaceful	○	○	○	○	○
Relaxed	○	○	○	○	○

Appendix I – Early Memories of Warmth and Safety Scale

THE Compassionate Mind FOUNDATION

EARLY MEMORIES OF WARMTH AND SAFENESS SCALE

This scale explores some of your emotional memories of your childhood. Below is a set of questions that tap various feelings you may have experienced when you were young. Please read each item carefully and circle the number to the right of the statement that best describes your feelings during childhood. Use the scale below.

0 = No, never	1 = Yes, but rarely	2 = Yes, sometimes	3 = Yes, often	4 = Yes, most of the time

1. I felt safe and secure	0 1 2 3 4
2. I felt appreciated the way I was	0 1 2 3 4
3. I felt understood	0 1 2 3 4
4. I felt a sense of warmth with those around me	0 1 2 3 4
5. I felt comfortable sharing my feelings and thoughts with those around me	0 1 2 3 4
6. I felt people enjoyed my company	0 1 2 3 4
7. I knew that I could count on empathy and understanding from people close to me when I was unhappy	0 1 2 3 4
8. I felt peaceful and calm	0 1 2 3 4
9. I felt that I was a cherished member of my family	0 1 2 3 4
10. I could easily be soothed by people close to me when I was unhappy	0 1 2 3 4
11. I felt loved	0 1 2 3 4
12. I felt comfortable turning to people important to me for help and advice	0 1 2 3 4
13. I felt part of those around me.	0 1 2 3 4
14. I felt loved even when people were upset about something I had done	0 1 2 3 4
15. I felt happy	0 1 2 3 4
16. I had feelings of connectedness	0 1 2 3 4
17. I knew I could rely on people close to me to console me when I was upset	0 1 2 3 4
18. I felt cared about	0 1 2 3 4
19. I had a sense of belonging	0 1 2 3 4
20. I knew that I could count on help from people close to me when I was unhappy	0 1 2 3 4
21. I felt at ease	0 1 2 3 4

1

THE Compassionate Mind FOUNDATION

SCORING

Simply sum the scale items

DESCRIPTION

Early Memories of Warmth and Safeness Scale (EMWSS)

This scale was designed to measure recall of feeling warm, safe and cared for in childhood. The 21 items included statements such as "I felt cared about", "I felt appreciated the way I was" and "I felt part of those around me". The response measure consisted of a Likert-type scale with participants required to rate how frequently each statement applied to them in their childhood (0 = No, never; 1 = Yes, but rarely, 2 = Yes, sometimes, 3 = Yes, often, 4 = Yes, most of the time). The scale contained the following instruction: "This scale explores positive and pleasant emotional memories of childhood. Please read each item carefully and circle the number to the right of the statement that best describes your own emotional memories from childhood. Use the scale below". The scale had a Cronbach's alpha of 0.97 (Richter et al., 2009).

REFERENCE

Richter, A., Gilbert, P. & McEwan, K. (2009). Development of an early memories of warmth and safeness scale and its relationship to psychopathology. *Psychology and Psychotherapy: Theory, Research and Practice*, 82, 171-184.

Appendix J – Spontaneous Use of Imagery Scale

SUIS

Please read each of the following descriptions and indicate the degree to which each is appropriate for you. Do not spend a lot of time thinking about each one, but respond based on your thoughts about how you do or do not perform each activity. If a description is always completely appropriate, please write "5"; if it is never appropriate, write "1"; if it is appropriate about half of the time, write "3"; and use the other numbers accordingly.

_____ 1. When going to a new place, I prefer directions that include detailed descriptions of landmarks (such as the size, shape and color of a gas station) in addition to their names.

_____ 2. If I catch a glance of a car that is partially hidden behind bushes, I automatically "complete it," seeing the entire car in my mind's eye.

_____ 3. If I am looking for new furniture in a store, I always visualize what the furniture would look like in particular places in my home.

_____ 4. I prefer to read novels that lead me easily to visualize where the characters are and what they are doing instead of novels that are difficult to visualize.

_____ 5. When I think about visiting a relative, I almost always have a clear mental picture of him or her.

_____ 6. When relatively easy technical material is described clearly in a text, I find illustrations distracting because they interfere with my ability to visualize the material.

_____ 7. If someone were to tell me two-digit numbers to add (e.g., 24 and 31), I would visualize them in order to add them.

_____ 8. Before I get dressed to go out, I first visualize what I will look like if I wear different combinations of clothes.

_____ 9. When I think about a series of errands I must do, I visualize the stores I will visit.

_____ 10. When I first hear a friend's voice, a visual image of him or her almost always springs to mind.

_____ 11. When I hear a radio announcer or DJ I've never actually seen, I usually find myself picturing what they might look like.

_____ 12. If I saw a car accident, I would visualize what had happened when later trying to recall the details.

Appendix K – Participant Information Sheet

Participant Information

Title: Does the way we respond to ourselves after failure affect the way we feel, and is this influenced by our early life experiences? Version 3 – 27.04.2021

You are being invited to take part in this research project, which is being completed as part of Emma Limon and Chloe Smith's Doctorate in Clinical Psychology at the University of Liverpool. Before you decide to take part in this research project it is important for you to understand why the research is being done and what it will involve. Please take time to read this information carefully and decide if you want to take part. You can discuss it with others too if you wish. The Principal Investigators (Emma Limon and Chloe Smith) can be contacted via email (contact information below) if there is anything that is not clear or if you would like more information.

Purpose of the project

Compassion-focused therapy* (and compassionate mind training) uses a range of techniques to encourage people to be more compassionate towards themselves and others, including generating imagined inner voice tones and images. Sometimes imagining being compassionate to themselves can make people feel better but this is not always the case and some people can find this difficult, upsetting or anxiety provoking.

In this project we are interested in investigating whether people's early life experiences (attachment style, early memories of warmth and safety) and traits (level of trait self-criticism and level of trait self-reassurance) affects how they experience generating critical and compassionate responses to an imagined scenario. An example of the kind of thing you will be asked to do would be to imagine a situation similar to losing your keys or phone, and then imaging thinking reassuring thoughts (like 'everyone makes mistakes') to yourself.

*Key word definitions are provided at the bottom of this page.

Why have I been chosen to take part?

This research project is open to anyone 18+ years old with access to a mobile, laptop or desktop device with internet access, including those within and outside of the United Kingdom. Participants must also be able to read English to a sufficient level to be able to read the instructions and the measures. You must also have access to a device with speakers as part of the study involves audio instructions.

Do I have to take part?

You do not have to take part in this research project, your participation is entirely voluntary. You can withdraw your data before the 10th July 2021 without the need to provide any reason for this. If you withdraw for any reason this will not prevent you being able to complete this study (or other studies) in future.

What will happen if I agree to take part?

If you agree to take part you will be asked to complete an online study which will

involve completion of questionnaires and imagery exercises (bringing images/voice tones to your mind). The study will take approximately **20-30 minutes** and should be completed in a quiet, distraction free and comfortable space. Please allocate enough time to complete the study as the whole study needs to be completed in one sitting, **you are not able to stop the study and come back to it at a later time.** You will have no direct contact with the Principal Investigators during the study but can ask any questions via email using the 'contact information' below.

How will my data be managed?
The University processes personal data as part of its research and teaching activities in accordance with the lawful basis of 'public task', and in accordance with the University's purpose of advancing education, learning and research for the public benefit. Under UK data protection legislation, the University acts as the Data Controller for personal data collected as part of the University's research. The Research Supervisor acts as the Data Processor for this study, and any queries relating to the handling of your personal data can be sent to klobley@liverpool.ac.uk.

How will my data be collected?	This project will be completed anonymously. You will be provided with a unique ID in order to allow you to withdraw your data in future (should you wish). You will be asked to provide your email address if you should wish to a) be entered into the prize draw and/or b) you wish to receive a summary of the results when the project is completed. Your email address will be stored separately from your data and will only be accessible to the Principal Investigators (Emma Limon and Chloe Smith) for the purpose of contacting you in the event that you win the prize draw and/or with the summary of results. It will not be possible to identify your responses by the email address details that you provide.
How will my data be stored?	The data from this research project will be stored and destroyed in accordance with the University of Liverpool's Research Data Management policy (https://www.liverpool.ac.uk/media/livacuk/computingservices/research-data-management/researchdatamanagementpolicy.pdf).
How long will my data be stored for?	The storing of your data will remain the responsibility of the Principal Investigators until completion of the doctoral program. Following this, the Research Supervisor (Dr Katy Lobley) will be responsible for the data for a minimum of 5 years.
What measures are in place to protect the security and confidentiality of my data?	Data will be stored securely in accordance with the University of Liverpool's Research Data Management policy (https://www.liverpool.ac.uk/media/livacuk/computingservices/research-data-management/researchdatamanagementpolicy.pdf).

Will my data be anonymised?	Yes
How will my data be used?	The results will form part of Emma Limon and Chloe Smith's doctoral thesis projects. It is also intended that the research will be published in a peer reviewed journal (but may also be published in other relevant forums). Participants will be asked to provide their email address if they wish to access a summary of the results when the project is complete. If any individual data are presented, the data will be completely anonymous.
Who will have access to my data?	Principal investigators: Emma Limon and Chloe Smith. Research supervisors: Dr Katy Lobley and Dr Luna Centifanti
Will my data be archived for use in other research projects in the future?	Data may also be shared (anonymously) with other researchers for the purpose of improving knowledge in the field.
How will my data be destroyed?	Data will be destroyed by the research supervisor (Dr Katy Lobley) after a minimum of 5 years.

Are there possible disadvantages and/or risks in taking part?
The study will require sitting in front of a mobile, laptop or desktop device for the duration of the study therefore there may be risks associated with inactivity, we would encourage you to think about whether this will be possible and comfortable for you to do prior to agreeing to take part in the study. Imagining situations where things have gone wrong can lead to mild temporary upset, which for most people should not have a significant impact upon their wellbeing. However, for a minority of individuals it is possible that imagining failure situations might trigger more significant distress that impacts upon their day and wellbeing. In such situations participants are advised to seek additional support (e.g. Samaritans UK – Freephone: 116 123, NHS website for a list of mental health charities and organisations – https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/) and during the study all participants will be provided with signposting to additional useful support services. Similarly, the questionnaires used can sometimes prompt people to recall difficult experiences, feelings or memories, and for some individuals there is a risk that completing the questionnaires may trigger significant distress. Where this is the case, we would advise participants to seek support as above.

What are the possible benefits of taking part?
There may not be any direct benefits to you from taking part in this research. If you decide to take part, you will be contributing to understandings about how people experience compassion (and criticism) and will be offered to access a summary of the results following completion of the project should you wish. Following completion of the study you will be asked if you wish to be entered into a draw to win **1 of 9 £50 Amazon vouchers.**

What if I want to withdraw my data?
Should you wish to withdraw your data from the research project you can do so by

emailing the Principal Investigators and stating the **'participant's unique ID'** that you will be provided with by the 10th July 2021. If you do not have this unique ID, then it will not be possible to identify your data.

What if I am unhappy or if there is a problem?
If you are unhappy, or if there is a problem, please feel free to let us know by contacting Emma Limon or Chloe Smith (principal investigators, email details below) and we will try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with then you should contact the Research Ethics and Integrity Office at ethics@liv.ac.uk. When contacting the Research Ethics and Integrity Office, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.
The University strives to maintain the highest standards of rigour in the processing of your data. However, if you have any concerns about the way in which the University processes your personal data, it is important that you are aware of your right to lodge a complaint with the Information Commissioner's Office by calling 0303 123 1113.

Who is organising and funding the research?
This research is being completed as part of the Doctorate in Clinical Psychology at the University of Liverpool. The project has been reviewed by the University of Liverpool Institute of Population Health Research Ethics Committee (Reference Number – 9930).

Contacts for further information
Principal investigator: Emma Limon (Trainee Clinical Psychologist)
- elimon@liverpool.ac.uk
Principal investigator: Chloe Smith (Trainee Clinical Psychologist)
– c.r.smith@liverpool.ac.uk

Research supervisor(s):
Dr Katy Lobley (Senior University Clinical Tutor) - klobley@liverpool.ac.uk,

Key word definitions:	
Compassion	A recognition that all people suffer and a motivation to help reduce suffering (where possible)
Compassion-focused therapy	A psychotherapy which encourages people to develop compassion towards themselves and others, usually with people who may find compassion difficult and who may be experiencing psychological distress
Compassionate mind training	The compassion-focused techniques used in compassion-focused therapy, which can also be taught to people who are not currently experiencing psychological distress as a means of maintaining or improving wellbeing
Attachment style	The ways in which a person thinks, feels and behaves in relationships
Trait self-criticism	How critical a person is of themselves when something goes wrong
Trait self-reassurance	How able a person is to reassurance themselves when something go wrong
Imagery exercises	Being asked to imagine something in your mind

Appendix L – Participant Consent Form

Participant consent form

Version number & date: Version 2 19.04.2021
Research ethics approval number: 9930.
Title of the research project: Does the way we respond to ourselves after failure affect the way we feel?
Name of researcher(s): Emma Limon and Chloe Smith

Please initial box

1. I confirm that I have read and have understood the information sheet dated 19.04.2021 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that this study involves taking part in an online questionnaire. ☐
3. I understand that my participation is voluntary and that I am free to stop the study at any time without giving any reason and without my rights being affected. ☐
4. I understand that I can request to withdraw my data from the research by contacting Emma Limon (elimon@liverpool.ac.uk) or Chloe Smith (c.r.smith@liverpool.ac.uk) and providing the 'participant's unique ID'. I understand that without the unique ID the data will be unable to be withdrawn. ☐
5. I understand that my data will be held securely and in line with data protection requirements at the University of Liverpool, will be accessed by the Principal Investigators (Emma Limon and Chloe Smith) and Research Supervisors (Dr Katy Lobley and Dr Luna Centifanti), will be retained for a minimum of 5 years and may be shared (anonymously) for use by other authorised researchers to support other research in the future. ☐
6. I confirm that I am 18+ years of age and agree to take part in this study. ☐

Appendix M – Support Information

If further information/support is required please see list of resources below.

Information/support resources

Within the UK
Samaritans UK: A UK-based charity who provide listening support to anyone who needs someone to listen without judgement or pressure 24 hours a day, 7 days a week, 365 days a year. http://www.samaritans.org Email: Jo@samaritans.org. Freephone: 116 123

NHS website with signposting to mental health charities and organisations: https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/

Within and outside of the UK
United for Global Mental Health: List of helplines for a range of countries https://unitedgmh.org/mental-health-support

The World Federation for Mental Health: An international membership organization founded in 1948 to advance, among all peoples and nations, the prevention of mental and emotional disorders, the proper treatment and care of those with such disorders, and the promotion of mental health. https://wfmh.global/

If it feels like further support is required please contact your local healthcare provider (e.g. GP).

If you have any further queries about the project you can send them to the principal investigators: Emma Limon (elimon@liverpool.ac.uk) and Chloe Smith (c.r.smith@liverpool.ac.uk)

Appendix N – Participant Debrief Information

Debrief information (Version 2 – 27.04.2021)

Thank you for taking part in this study.

Title: Does the way we respond to ourselves after failure affect the way we feel, and is this influenced by our early life experiences?

This purpose of this study was to investigate whether people's early life experiences (attachment style, early memories of warmth and safety) and traits (level of trait self-criticism and level of trait self-reassurance) affects how they experience generating critical and compassionate responses to an imagined scenario. In compassion focused therapy individuals often talk about extremely distressing situations, and the task we asked you to do (imagining reassuring thoughts in different ways) is how therapists try to build up compassion in those individuals towards some very difficult experiences and feelings they've had. The study wanted to explore whether in a much less distressing situation (imagining common everyday mistakes or upsets) this way of imagining different thoughts could change the emotional intensity for people. We also looked at how different specific instructions might have made a difference to the emotional impact of the research activity. We are expecting to find that instructions that increase imagery intensity or have particularly warm voice tones have more positive effects of emotions.

You can withdraw your data by contacting the principal investigators: Emma Limon (elimon@liverpool.ac.uk) and Chloe Smith (c.r.smith@liverpool.ac.uk) by email and providing your unique ID by 10th July 2021. Please note as this survey is completed anonymously it will not be possible to remove your data in your unique ID is not provided therefore, please make note of this (at the top of the page) before clicking next and exiting the survey.

Efforts were made to ensure that the content of the project is not emotionally distressing however if any distress has arisen during the project there are a list of information/support resources below.

Also if you have any further queries please do not hesitate to contact the principal investigators on the email addresses above.

Information/support resources

Within the UK

Samaritans UK: A UK-based charity who provide listening support to anyone who needs someone to listen without judgement or pressure 24 hours a day, 7 days a week, 365 days a year. www.samaritans.org. Email: Jo@samaritans.org. Freephone: 116 123

NHS website with signposting to mental health charities and organisations: https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/

Within and outside of the UK

United for Global Mental Health: List of helplines for a range of countries
https://unitedgmh.org/mental-health-support

The World Federation for Mental Health: An international membership organization founded in 1948 to advance, among all peoples and nations, the prevention of mental and emotional disorders, the proper treatment and care of those with such disorders, and the promotion of mental health. ttps://wfmh.global/

If it feels like further support is required, please contact your local healthcare provider (e.g. GP).

If you would like to learn more about compassion-focused therapy (or compassionate mind training) please visit The Compassionate Mind Foundation:
https://www.compassionatemind.co.uk/
Click next to be directed to the email address page where you will be asked if you wish to be entered into the prize draw for a chance to win a £50 Amazon voucher.

Appendix O – Descriptives and Q-Q Plots for Testing the Assumption of Normality

Skew and Kurtosis Scores:

- Note that the TRANS_PANAS scores are following a reciprocal transformation.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PANAS1_TOT	244	10.00	37.00	14.6926	5.74347	32.987	2.019	.156	4.205	.310
PANAS_CRITICAL	244	10.00	45.00	17.6803	7.60038	57.766	1.241	.156	.986	.310
PANAS_COMPAS	244	10.00	42.00	14.3811	5.84489	34.163	1.956	.156	4.074	.310
TRANS_PANAS1	244	.03	.10	.0754	.02025	.000	-.560	.156	-.533	.310
TRANS_PANAS_CRIT	244	.02	.10	.0656	.02282	.001	.005	.156	-1.096	.310
TRANS_PANAS_COMP	244	.02	.10	.0777	.02154	.000	-.637	.156	-.734	.310
TOPAS1_TOTS	244	4.00	20.00	15.3730	3.28675	10.803	-.610	.156	-.060	.310
TOPAS_S_CRIT	244	4.00	20.00	13.4918	4.49187	20.177	-.393	.156	-.736	.310
TOPAS_S_COMP	244	4.00	20.00	15.1352	4.04122	16.331	-.685	.156	-.177	.310
TOPAS1_TOTR	244	6.00	30.00	19.1721	5.56472	30.966	-.137	.156	-.372	.310
TOPAS_R_CRIT	244	6.00	30.00	17.6066	6.81810	46.487	.045	.156	-.853	.310
TOPAS_R_COMP	244	6.00	30.00	20.0861	6.54431	42.828	-.299	.156	-.660	.310
Valid N (listwise)	244									

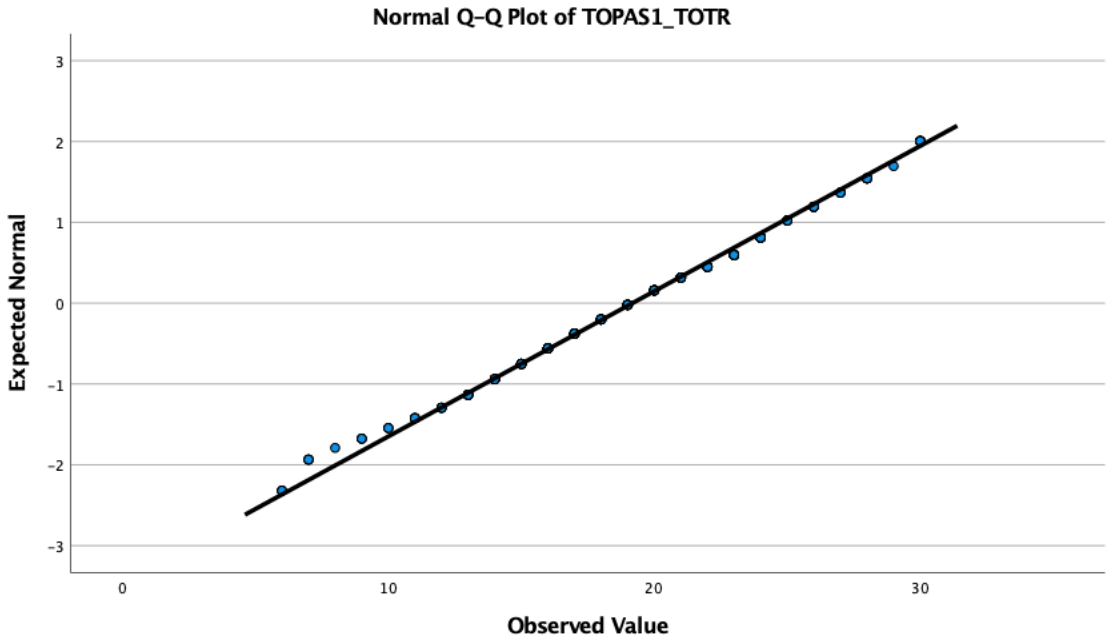
- Due to the slight negative skew of the ToPAS scores, these were reverse scored then a reciprocal, log and square root transformation was carried out to ascertain whether this made the more normally distributed. However, these transformations tended to make the skew and kurtosis worse, therefore, the ToPAS was not transformed as they were only slightly negatively skewed.

Descriptive Statistics

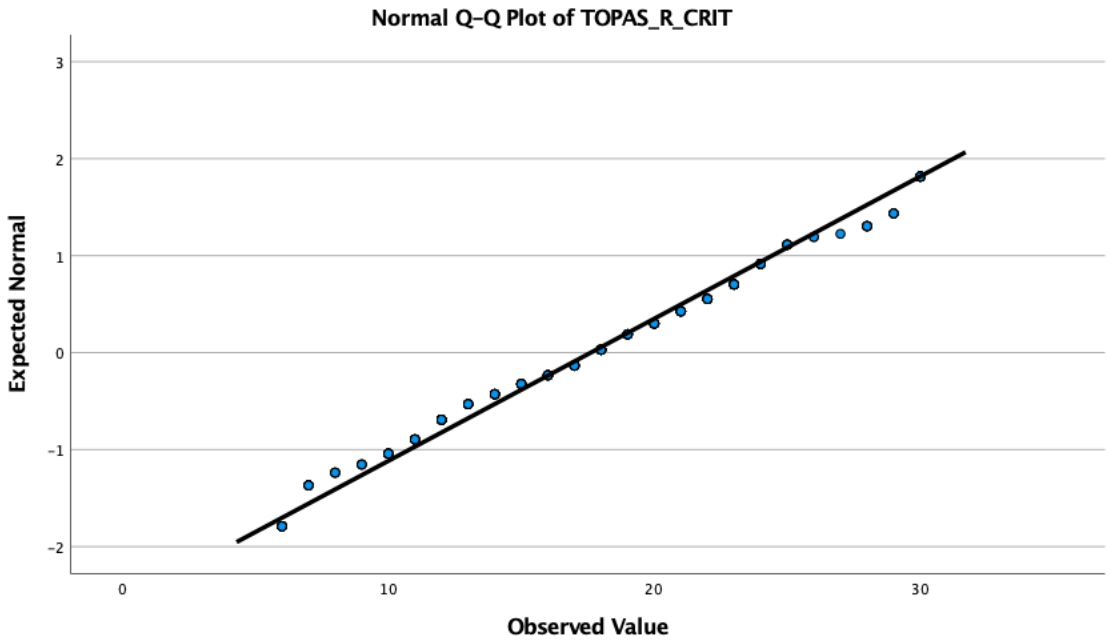
	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
RECIP_TOPAS1_R	244	.04	1.00	.1406	.18935	.036	3.904	.156	14.965	.310
RECIP_TOPAS_CRIT_R	244	.04	1.00	.1542	.23655	.056	3.054	.156	8.100	.310
RECIP_TOPAS_COMP_R	244	.04	1.00	.2027	.27242	.074	2.353	.156	4.155	.310
RECIP_TOPAS1_S	244	.06	1.00	.2936	.26484	.070	1.872	.156	2.428	.310
RECIP_TOPAS_CRIT_S	244	.06	1.00	.2493	.26945	.073	2.089	.156	3.165	.310
RECIP_TOPAS_COMP_S	244	.06	1.00	.3456	.33316	.111	1.276	.156	-.020	.310
LOG_TOPAS1_R	244	.00	1.40	1.0007	.29496	.087	-1.700	.156	3.380	.310
LOG_TOPAS_CRIT_R	244	.00	1.40	1.0294	.35549	.126	-1.663	.156	2.377	.310
LOG_TOPAS_COMP_R	244	.00	1.40	.9152	.38602	.149	-1.160	.156	.560	.310
LOG_TOPAS1_S	244	.00	1.23	.6581	.31038	.096	-.719	.156	-.209	.310
LOG_TOPAS_CRIT_S	244	.00	1.23	.7677	.34620	.120	-.895	.156	.018	.310
LOG_TOPAS_COMP_S	244	.00	1.23	.6348	.37602	.141	-.533	.156	-.893	.310
SQRT_TOPAS1_R	244	1.00	5.00	3.3209	.89602	.803	-.620	.156	.244	.310
SQRT_TOPAS_CRIT_R	244	1.00	5.00	3.4992	1.07401	1.154	-.734	.156	-.008	.310
SQRT_TOPAS_COMP_R	244	1.00	5.00	3.1159	1.09989	1.210	-.372	.156	-.640	.310
SQRT_TOPAS1_S	244	1.00	4.12	2.2609	.71923	.517	-.040	.156	-.648	.310
SQRT_TOPAS_CRIT_S	244	1.00	4.12	2.5958	.87921	.773	-.196	.156	-.795	.310
SQRT_TOPAS_COMP_S	244	1.00	4.12	2.2617	.86761	.753	.056	.156	-.923	.310
Valid N (listwise)	244									

Q-Q Plots for the ToPAS Relaxed Subscale:

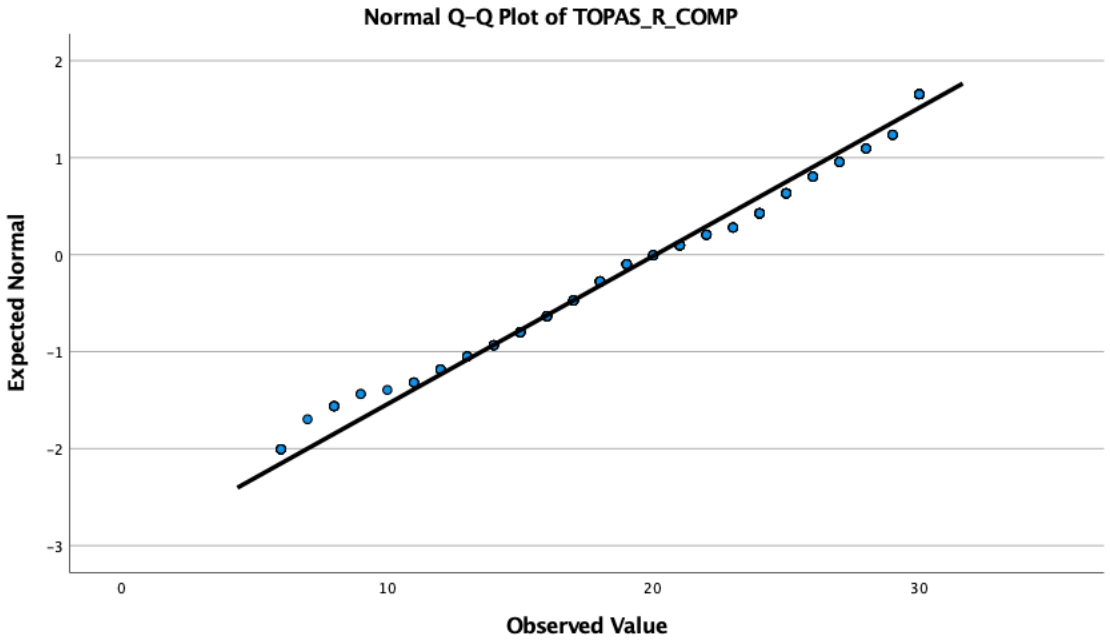
- Baseline



- Critical Condition

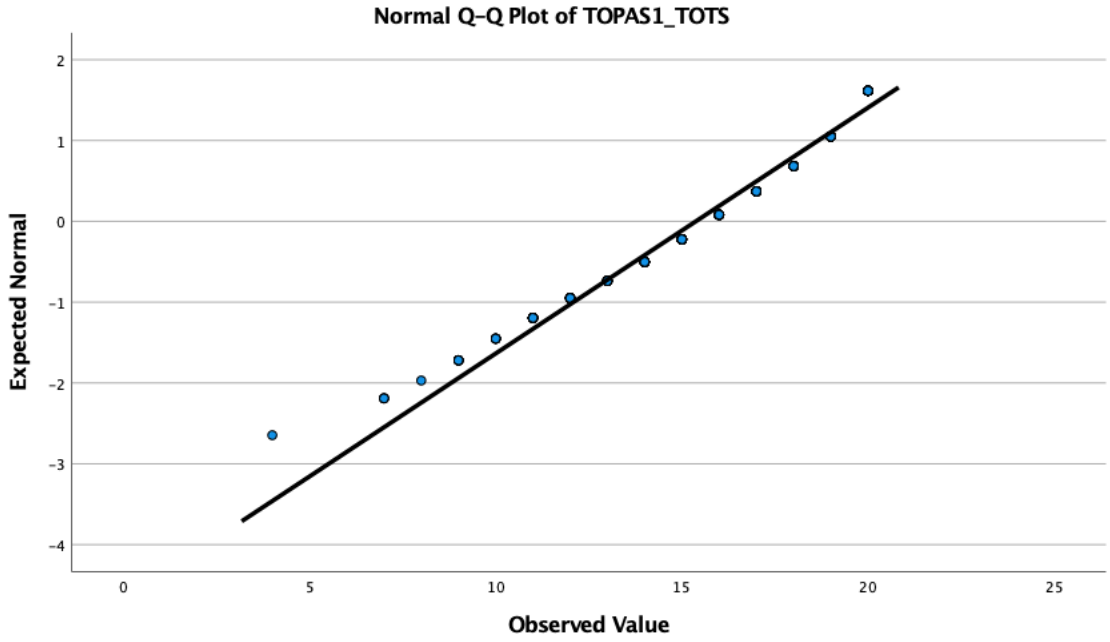


- Compassion Condition

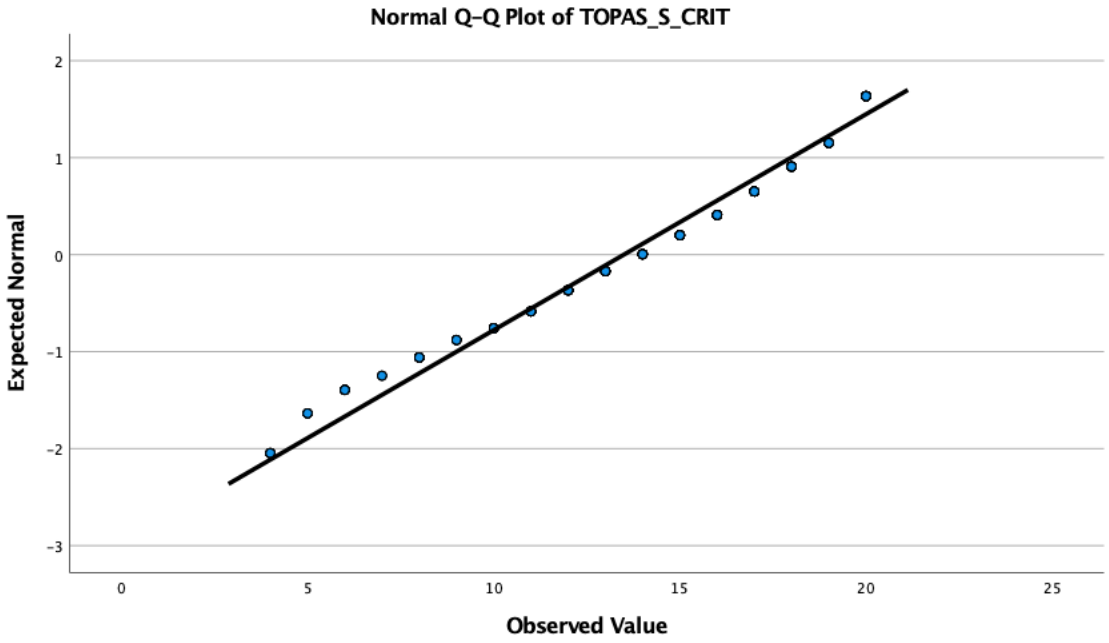


Q-Q Plots for the ToPAS Safe/Warmth Subscale:

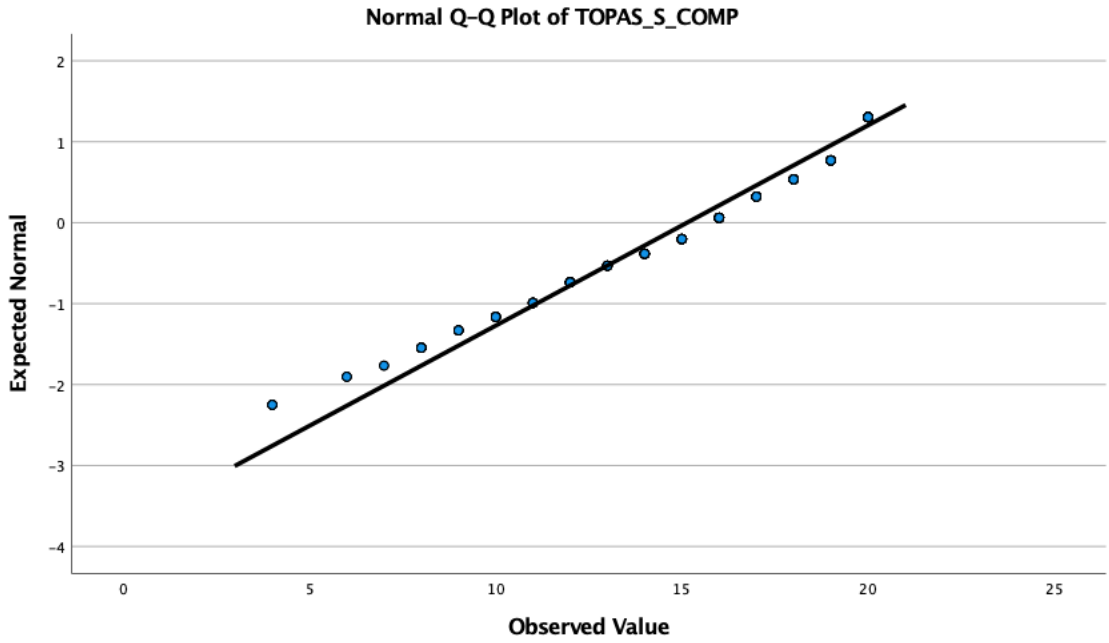
- Baseline



- Critical Condition

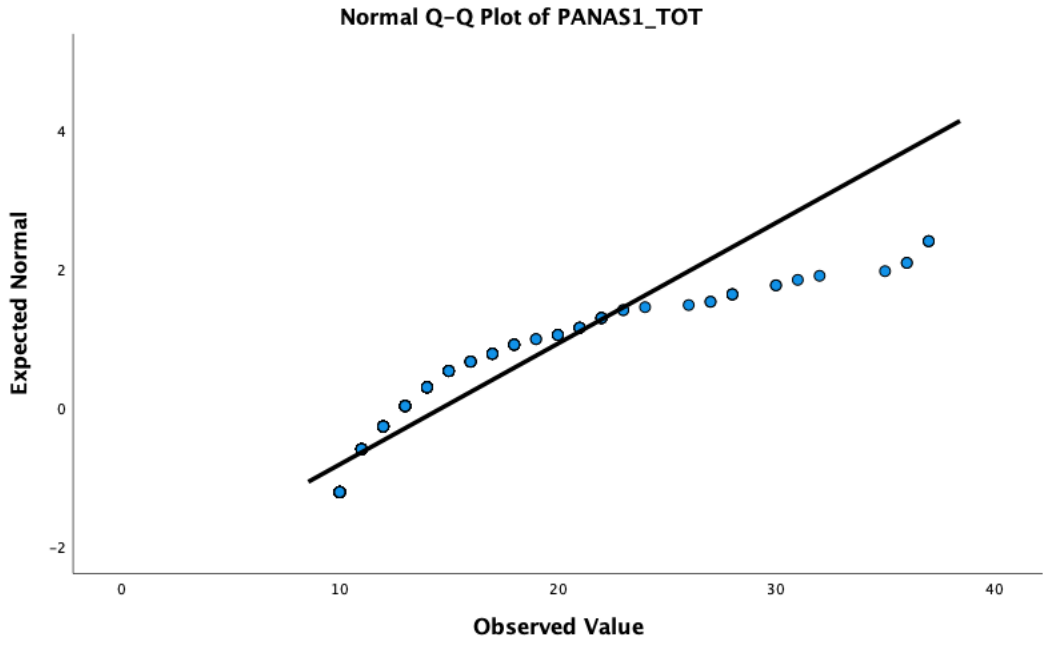


- Compassion Condition

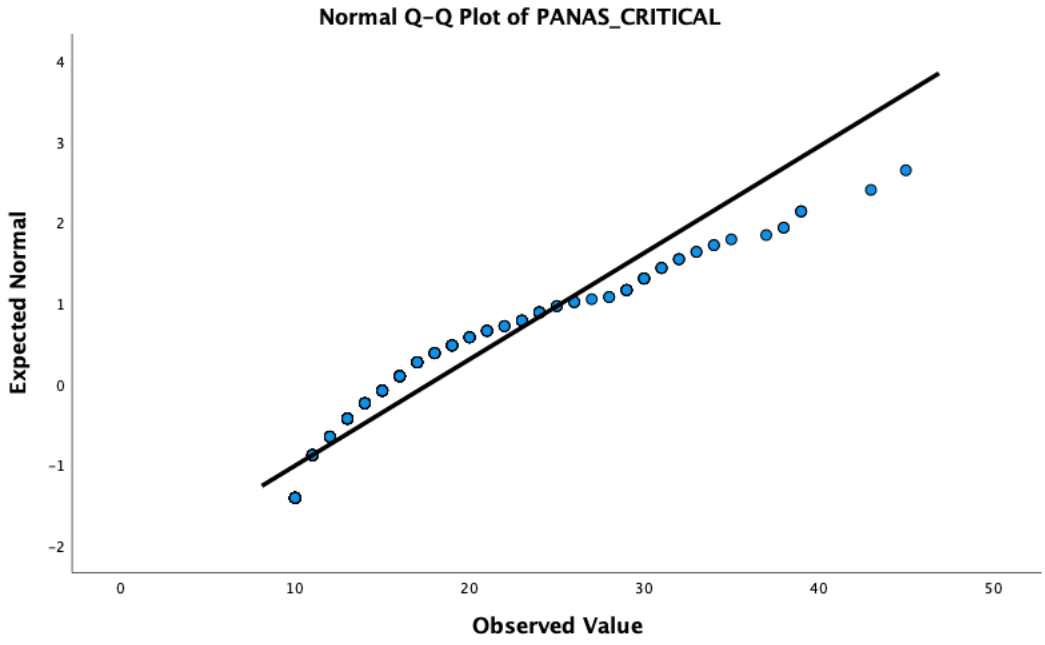


Q-Q Plots for the PANAS before the reciprocal transformation:

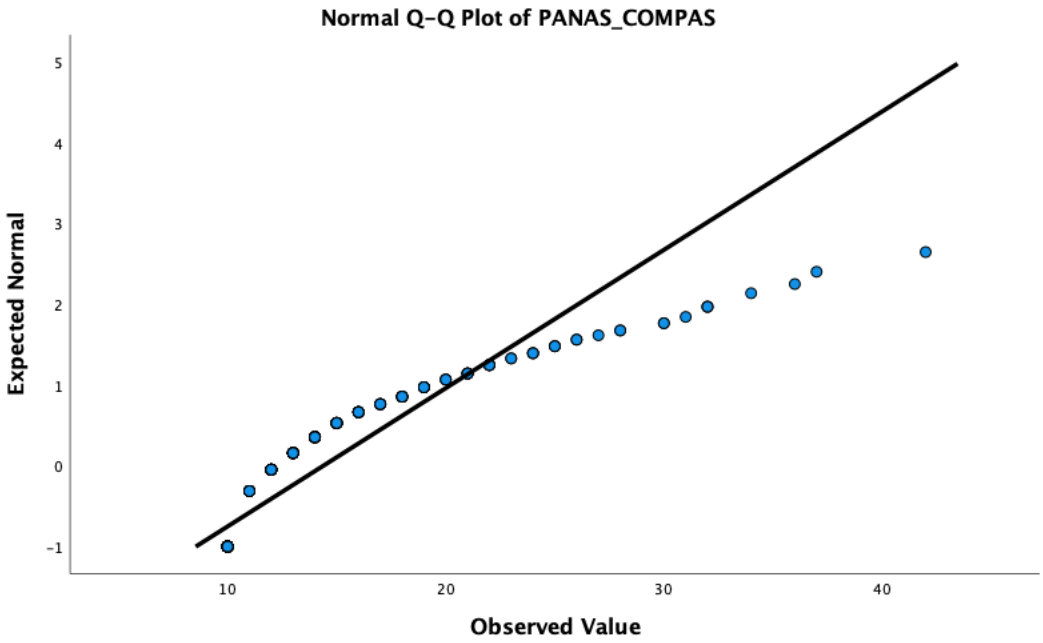
- Baseline



- Critical Condition

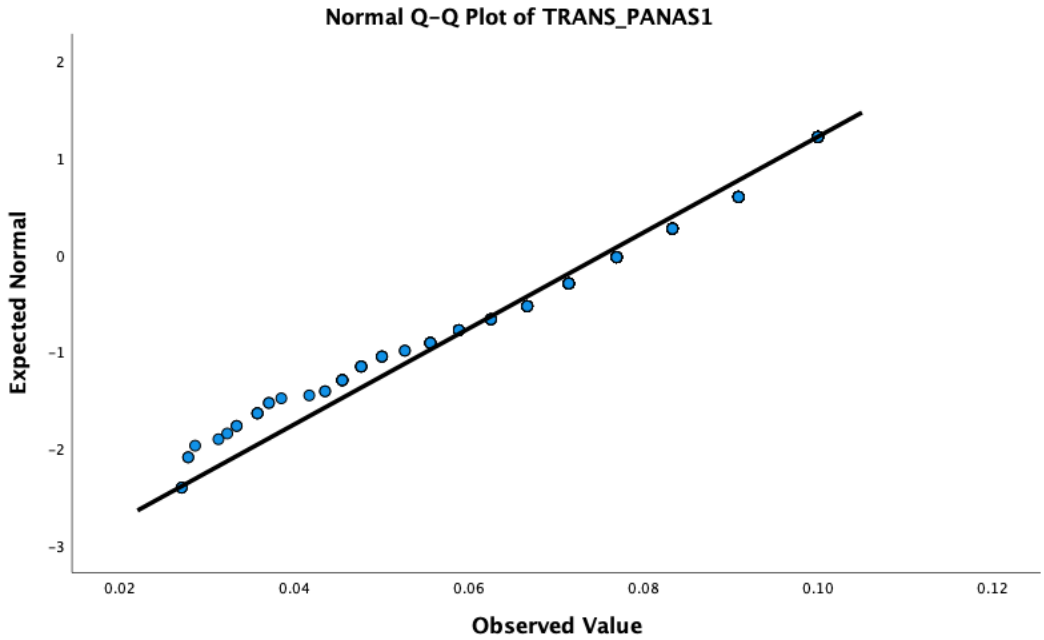


- Compassion Condition

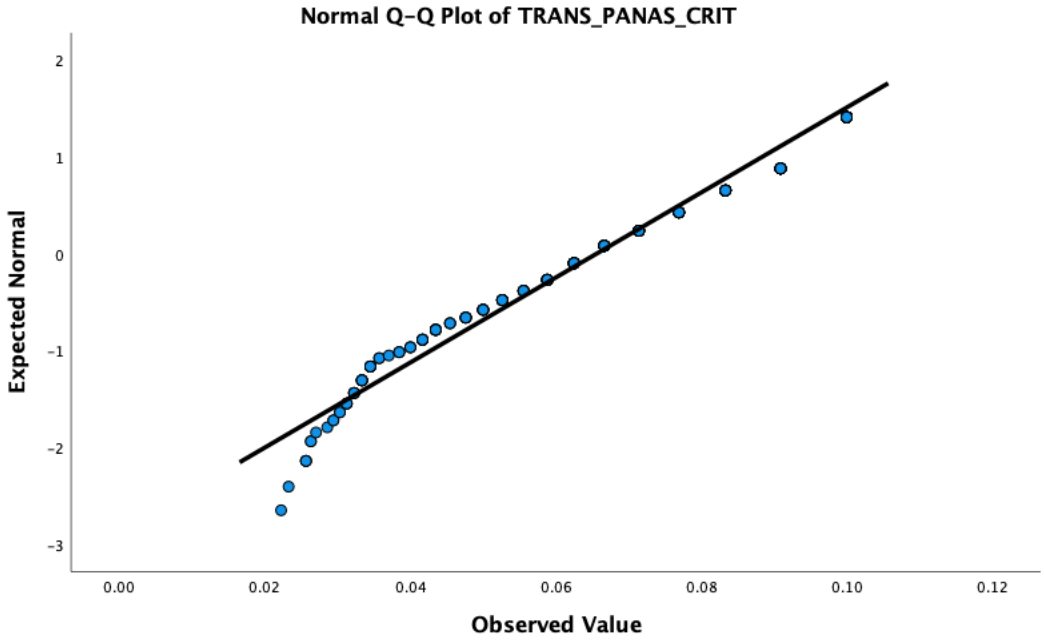


Q-Q Plots for the PANAS after the reciprocal transformation:

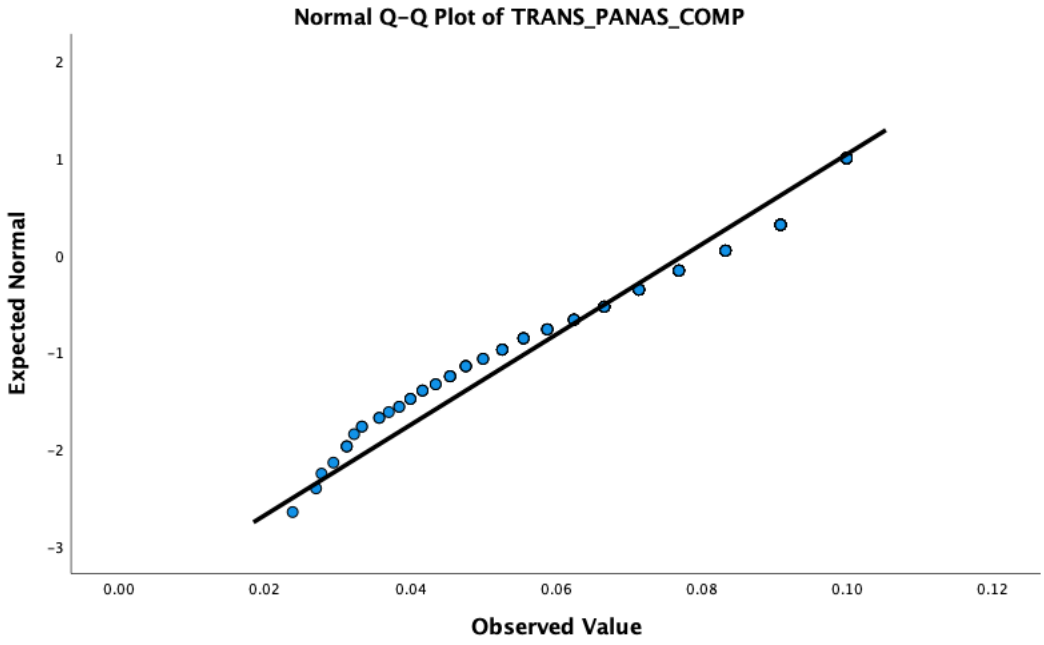
- Baseline



- Critical Condition



- Compassion Condition



Appendix P – Cronbach's Alpha Scores for the Dependent and Moderator Variables

Cronbach's Alpha Scores for the EMWSS:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.980	.980	21

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
EMOWSS_Q1	69.16	451.750	.782	.677	.979
EMOWSS_Q2	69.59	443.677	.821	.755	.979
EMOWSS_Q3	69.92	441.762	.850	.794	.979
EMOWSS_Q4	69.32	445.207	.861	.781	.979
EMOWSS_Q5	70.17	443.281	.763	.708	.979
EMOWSS_Q6	69.74	448.215	.758	.629	.979
EMOWSS_Q7	69.85	441.484	.851	.761	.979
EMOWSS_Q8	69.81	450.479	.755	.669	.979
EMOWSS_Q9	69.42	441.403	.835	.752	.979
EMOWSS_Q10	69.74	446.073	.815	.702	.979
EMOWSS_Q11	69.11	445.768	.845	.801	.979
EMOWSS_Q12	69.78	441.556	.816	.753	.979
EMOWSS_Q13	69.58	441.248	.855	.767	.979
EMOWSS_Q14	69.87	442.962	.789	.670	.979
EMOWSS_Q15	69.28	451.025	.825	.747	.979
EMOWSS_Q16	69.55	442.000	.883	.803	.978
EMOWSS_Q17	69.62	439.602	.864	.842	.978
EMOWSS_Q18	69.14	445.625	.875	.843	.978
EMOWSS_Q19	69.46	439.956	.871	.809	.978
EMOWSS_Q20	69.58	440.147	.861	.830	.979
EMOWSS_Q21	69.61	445.510	.823	.733	.979

Cronbach's Alpha Scores for the SUIS:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.816	.816	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SUIS_Q1	35.47	72.793	.263	.111	.820
SUIS_Q2	36.23	70.250	.390	.176	.809
SUIS_Q3	34.97	69.049	.493	.285	.801
SUIS_Q4	34.99	70.886	.404	.206	.808
SUIS_Q5	34.80	70.470	.469	.283	.803
SUIS_Q6	36.79	74.163	.262	.097	.818
SUIS_Q7	35.48	67.611	.438	.256	.806
SUIS_Q8	35.62	65.576	.560	.404	.794
SUIS_Q9	35.55	64.481	.652	.497	.785
SUIS_Q10	35.23	66.436	.622	.462	.789
SUIS_Q11	35.48	67.287	.515	.338	.798
SUIS_Q12	35.20	67.432	.542	.365	.796

Cronbach's Alpha Scores for the PANAS:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.900	.900	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PANAS1_Q1	14.16	35.701	.648	.599	.891
PANAS1_Q2	13.78	35.225	.595	.435	.895
PANAS1_Q3	14.20	34.694	.752	.697	.884
PANAS1_Q4	14.07	34.305	.712	.597	.886
PANAS1_Q5	14.13	34.665	.728	.604	.885
PANAS1_Q6	14.10	35.368	.654	.486	.890
PANAS1_Q7	13.88	34.120	.691	.546	.888
PANAS1_Q8	14.24	35.543	.643	.537	.891
PANAS1_Q9	14.42	39.109	.480	.300	.900
PANAS1_Q10	14.20	36.098	.605	.492	.893

Cronbach's Alpha Scores for the ToPAS Relaxed:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.926	.926	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
TOPAS1_Q2	15.25	25.305	.790	.638	.912
TOPAS1_Q3	15.48	24.844	.727	.559	.920
TOPAS1_Q4	15.90	24.344	.784	.628	.912
TOPAS1_Q8	15.77	24.367	.794	.679	.911
TOPAS1_Q9	15.57	23.788	.837	.747	.905
TOPAS1_Q10	15.47	24.253	.785	.648	.912

Cronbach's Alpha Scores for the ToPAS Safeness:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.858	.859	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
TOPAS1_Q1	11.22	7.554	.719	.531	.812
TOPAS1_Q5	10.92	7.726	.717	.532	.814
TOPAS1_Q6	11.11	7.655	.691	.489	.824
TOPAS1_Q7	11.35	7.374	.686	.480	.828