The Role of Dispositional Mindfulness in Affective and Physiological Reactivity Across the Adult Lifespan

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Summary

Ageing is associated with a number of changes, including an increase in positive affect (Stawski, Sliwinski, Almeida, & Smyth, 2008), reduction in negative affect (Kessler & Staudinger, 2009), and overall enhanced emotion regulation (Gross et al., 1997). One factor that may contribute to these age-related changes is mindfulness, defined as an awareness of and attention to the present moment (Brown & Ryan, 2003). The first paper reviewed the literature regarding dispositional mindfulness, and affective and physiological reactivity across the adult lifespan, and identified a paucity of relevant studies. The second paper investigated the role of dispositional mindfulness on physiological and affect reactivity, using a sample of younger, middle-aged and older adults who completed two mood-induction tasks. A significant correlation was found between dispositional mindfulness and age. Furthermore, older adults reported higher levels of positive affect, and lower levels of negative affect and perceived stress, compared to middle-aged and younger adults. No significant differences were identified in physiological reactivity by age. Finally, dispositional mindfulness was found to be related to positive affect. The findings from the present thesis will contribute to our knowledge of the relationship between dispositional mindfulness, affective and physiological reactivity, and ageing.

Certification by Candidate

I certify that this thesis entitled "The role of dispositional mindfulness in affective and physiological reactivity across the adult lifespan" has not been previously submitted for a degree nor has it been submitted as part of the requirements for a degree to any other university or institution other than Macquarie University.

I also certify that this thesis is an original piece of research and that it has been written by me. Any help or assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis.

Approval for all aspects of the research presented in this thesis was obtained from the Macquarie University Human Research Ethics Committee (reference numbers: 5201200726).

Signed: 

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Chapter One

General Introduction

Thesis Overview

A number of changes occur with the ageing process. Changes in biological functioning, such as a decrease in heart rate variability and changes neural structures have been identified (Levenson, 2000; Lupien, McEwen, Gunnar, & Heim, 2009). Additionally, cognitive processes including attentional bias appear to change due to the ageing process, whereby older adults appear to pay more attention to positive, than negative, stimuli (Carstensen & Mikels, 2005). However, the age-related changes that occur with emotion regulation are particularly important.

Research has identified that enhanced emotion regulation occurs with age. For example, older adults exhibit increased positive affect (Stawski, Sliwinski, Almeida, & Smyth, 2008), decreased negative affect (Kessler & Staudinger, 2009), and more emotional control (Gross et al., 1997), compared to younger adults. In addition, physiological changes have also been identified with ageing, such as changes in neurological connectivity of the regions activated during emotion regulation (Allard & Kensinger, 2014).

Theories of adult development have sought to address the key areas of age-related changes, particularly changes in emotion regulation. For example, socioemotional selectivity theory suggests that ageing is associated with a shift to focusing on meaningful, shorter-term goals. This is in-turn related to enhanced emotion regulation in older adults, as well as attentional bias (deemed the positivity effect) to positive stimuli (Carstensen, Isaacowitz, & Charles, 1999). Socioemotional selectivity theory also suggests that shifting focus to meaningful, shorter-term goals may encourage older adults to live in a more present-focused way (Carstensen, 1995; Charles & Carstensen, 2010). Support for the importance of temporal awareness also comes from the strength and vulnerability integration theory (Charles, 2010). This theory extends socioemotional selectivity theory by incorporating a number of factors identified in the literature as contributing to increased subjective wellbeing in older age. Of

importance is the awareness of a foreshortened future, which is one of the key factors that the strength and vulnerability integration theory incorporates. However, if ageing results in a shift to focus on the present moment, then mindfulness may play a role in these age-related changes.

Awareness of and attention to the present moment is a core idea behind mindfulness (Brown & Ryan, 2003). Mindfulness has been related to enhanced subjective wellbeing and life satisfaction, as well as reductions in psychopathology and physiological stress reactivity (Bränström, Duncan, & Moskowitz, 2011; Brown & Ryan, 2003; Brown, Weinstein, & Creswell, 2012). Dispositional mindfulness also appears to increase with age (Raes, Bruyneel, Loeys, Moerkerke, & De Raedt, 2013). Furthermore, mindful reappraisal is an emotion regulation strategy associated with enhanced positive affect and subjective wellbeing (Hanley & Garland, 2014). Therefore, mindfulness may also be a factor that is associated with age-related changes in emotion regulation.

Another personality trait that may influence emotion regulation is neuroticism. Neuroticism is associated with negative affect and has been linked to a range of negative outcomes such as psychopathology and increased affective reactivity (Watson & Clark, 1992; Ormel et al., 2013). Research regarding the stability of neuroticism with age has produced mixed results; however, overall it appears that levels of neuroticism reduce over the lifespan (Bleidorn et al., 2013). Further, a negative correlation between neuroticism and dispositional mindfulness has been identified (Giluk, 2009). However, the relationship between traits such as neuroticism and mindfulness, and ageing, remains unclear.

Finally, coping strategies have also been identified to impact emotional experience and emotion regulation. Indeed, whether an individual employs an adaptive or maladaptive coping strategy can greatly affect their emotional wellbeing. For example, maladaptive coping strategies have been associated with traits, such as neuroticism (Holahan, Moos, & Schaefer,

1996). Furthermore, it has been posited that mindfulness may be associated with adaptive coping styles (Weinstein, Brown, & Ryan, 2009). Research has shown mixed findings regarding age-related changes in the utilisation of particular coping strategies. However, overall the research tends to support better coping in older age, with decreased use of escapism (Amirkhan & Auyeung, 2007), and increased problem-focused strategies with age (Trouillet, Doan-Van-Hay, Launay, & Martin, 2011). However, further investigation of the relationship between coping strategies, neuroticism, and other factors related to ageing and wellbeing is needed to identify the important factors.

As noted, there are a number of factors which are affected by age-related changes, including physical reactivity, emotion regulation, coping strategies, and personality traits. These variables have been found to affect each other but the relationships between these factors are not clear. Therefore, the present thesis aims to examine the nature of some of these associations. Specifically it seeks to investigate the relationships between physiological and affective reactivity and ageing, and dispositional mindfulness, whilst controlling for other important factors (namely, coping skills and neuroticism).

Emotion and Ageing

Emotional reactivity can occur as a brief change in emotion, or a more substantial change in affect. Though to understand emotional reactivity and regulation, affect and emotion must each be defined and discussed.

Affect

Affect is the overarching term related to a number of states, including emotion, stress and mood, and includes both positive and negative emotions as well as psychological and

physiological responses (Gross & Thompson, 2007). It has been identified that positive and negative affect are two independent constructs, rather than opposite ends of a continuum (Diener, Larsen, Levine & Emmons, 1985). As such, a two-dimensional model of affect (positive affect-negative affect) is widely accepted, within which differentiation of more complex emotions occurs (Watson & Tellegen, 1985). Furthermore, both positive and negative affect are experienced even in negative situations such as bereavement (Folkman & Moskowitz, 2000). Overall, it is suggested that positive and negative affect are two independent constructs, and that we can experience both affect in unison.

Positive affect is an important factor for subjective wellbeing that works in an antagonistic fashion to negative affect (Garland et al., 2010). Evidence for the role of positive affect in subjective wellbeing is mixed, with some research identifying greater levels of positive affect as holding more benefits for subjective wellbeing (e.g. Catalino and Fredrickson, 2011); whereas, other research suggests stability in positive affect is better for optimal mental health (e.g. Gruber, Kogna, Quoidbach, & Mauss, 2013). Either way, efficient regulation of positive affect is beneficial and could be a protective factor for some psychological disorders, such as mania (Watson, Clark & Tellegen, 1988).

Despite the uncertainty regarding the optimal level of positive affective reactivity, positive affect appears to be associated with factors that are related to subjective wellbeing. For example, Fredrickson and colleagues have identified an association between positive emotions and broad-minded coping (Fredrickson & Joiner, 2002), as well as between positive reappraisal, a style of reframing a stressful event to find benefit or meaning, and dispositional mindfulness (Garland, Gaylord, & Fredrickson, 2011). Furthermore, Moneta, Vulpe and Rogaten (2012) found that base level positive affect was protective for later negative affect, as well as fostering subsequent positive affect. Therefore positive affect plays an important role subjective wellbeing.

Emotional reactivity to stress generally takes the form of increased negative affect, whereby negative affect prepares the body and mind to take action (Garland et al., 2010). Therefore, regulation of negative affect is important for effective reactivity to potential threats. However, adept regulation of negative affect is also important for overall subjective wellbeing. For example, difficulty accepting and regulating negative affect can predict psychological disorders, such as anxiety (Mennin, Heimburg, Turk, & Fresco, 2005). Moreover, awareness and acceptance of negative affect can be detrimental for optimal treatment outcome (Sauer-Zavala et al., 2012). While some research has identified higher levels of negative affect in older samples, this effect generally disappears once current and chronic ill health is accounted for (Kunzmann, Little & Smith, 2000). Therefore negative affect plays a role in psychological distress and emotional reactivity.

Emotion and Emotion Regulation

The term emotion refers to the stress response, episodes of emotion, moods, as well as shorter-lived reactions (Gross, 1999). While a definition of emotion has not been accepted within the field, three key features of emotion have been identified: (1) emotion arises from the meaning attributed to an experience and whether the experience is relevant to an individual's goal, (2) emotion involves changes in subjective experience, physiological systems and behaviour, and (3) emotions are malleable and can be regulated by other ongoing experiences (Gross, 2008).

Gross posits that emotion regulation refers to the conscious and unconscious processes that we use to maintain or change the emotional response, which includes behavioural, physiological and other components (Gross, 1999, 2001). Therefore emotion regulation consists of a set of processes, used to regulate emotion expression and the experience of the other components related to emotion, and falls within the umbrella term of affect regulation

(Gross & Thompson, 2007). Furthermore, emotion regulation is relevant for both positive and negative emotions (Suri & Gross, 2012), and influences the intensity and duration of emotion experience, as well as related behavioural and physiological responses (Gross & Thompson, 2007). From a simplistic view, emotions come about after appraisal of an event or situation (Urry & Gross, 2010). However, Gross and Thompson (2007) posit that there are three core processes of emotion. Firstly, a transactional process occurs between a person and a situation or event. Secondly, attention is directed to this transaction, which then leads to an appraisal and attempt to make meaning of the situation. Finally, after the appraisal is made a response (behavioural, physiological or experiential) is then elicited. While the meaning associated with a situation or event, obtained during the appraisal process, steers the valence and intensity of the emotion experience, Ochsner and Barrett (2001) state that our attention towards and away from particular internal or external cues or situations also plays an important part. Therefore, all three core components of emotion are important.

Gross and Thompson (2007) discuss the process model of emotion regulation, which includes five key stages in the emotion regulation process: situation selection, situation modification, attention deployment, cognitive change/appraisal, and response modulation. Situation selection and modification assist to change the internal and external environment; attention deployment is marked by distraction from or concentration towards the situation; cognitive change refers to appraisal of the situation and evaluation of its meaning to the individual; and, finally, response modulation refers to direct regulation of emotion and related components (Gross & Thompson, 2007). Therefore, there are a number of stages at which emotion regulation strategies can be implemented.

Timing is an important factor in the process model, as differing emotion regulation strategies can be used most effectively at particular stages of emotion regulation (Gross, 2001). Emotion regulation strategies can also be divided into two categories, antecedent-

focused or response-focused, depending upon the stage of implementation (Gross, 2001). Antecedent-focused emotion regulation refers to processes that occur prior to the appraisal stage and prior to an emotional experience and associated response. An example of an antecedent-focused strategy is reappraisal, which is a cognitive strategy that involves changing an individuals' thoughts regarding a situation (Gross, 2008). Cognitive reappraisal therefore leads to a change in emotional appraisal of the situation. Alternatively, response-focused emotion regulation refers to processes implemented after an emotion response has already been generated (Gross & Thompson, 2007). An example of a response-focused strategy is suppression, which refers to a process of ignoring or masking emotion-based behaviours (Gross, 2008).

Suppression and reappraisal are two frequently investigated emotion regulation strategies. Suppression is a response-focused strategy and can be defined as a type of avoidance (Amstadter, 2008; Gross, 2001). Furthermore, suppression has been identified as an ineffective emotion regulation strategy, which can lead to increased negative affect, cognitive load and physiological reactivity (Campbell-Sills, Barlow, Brown, & Hoffman, 2006; John & Gross, 2004; Joorman & Vandelind, 2014). Reappraisal is another commonly investigated emotion regulation strategy (Gross, 2001). Specific styles of reappraisal are now also gaining strength in the literature, such as positive reappraisal and mindful reappraisal (Garland et al., 2011; Hanley, Garland, & Black, 2014). Mindful reappraisal is an emotion regulation strategy, which is a two-stage process. Firstly, detachment and decentering from stress appraisals occurs, resulting in a state of mindfulness, followed by positive reappraisal of the stressor (Hanley et al., 2014). This strategy incorporates the use of mindfulness and positive reappraisal, which are two distinct but related emotion regulation processes that are both associated with enhanced positive wellbeing (Garland, Gaylord, & Park, 2009). Therefore, further investigation into the role of mindfulness, particularly in affective and

physiological reactivity in ageing, would be beneficial to our understanding of this interrelated process.

Changes in Affect and Emotion with Age

Ageing has been associated with reduced experience of negative affect, sometimes referred to as a paradox of ageing (Maher, 2012). Studies have shown a reduction of negative affect with age (Kessler & Staudinger, 2009; Lawton, Kleban, & Dean, 1993; Stawski et al., 2008). For example, Windsor and Antsey (2010) identified a significant age-related decrease in negative affect, whereby the older adults showed the lowest level of negative affect, compared to the younger and middle-aged adults. In addition, they found that negative affect showed a decrease over time for the younger and middle-aged adults, providing evidence for an age-related change. Older adults, compared to younger adults, also show less negative affect reactivity to stressful tasks (Luong & Charles, 2014). Furthermore, older adults have shown attenuated levels of negative affect, with less variability in negative affect over a period of two months (Röcke, Li & Smith, 2009). Wrzus and colleagues highlight differential negative affect reactivity in older adults based on the type of stressor. For example, older adults showed similar, or reduced, negative affective reactivity to younger participants when responding to low resource demanding stressors. However, older adults showed higher negative reactivity than younger participants when responding to complex situations that affect multiple facets of life (Wrzus, Müller, Wagner, Lindenberger, & Riediger, 2013). Finally, there is evidence for a decline in neural reactivity to negative stimuli in older age, which is not due to dampening of neural activation (Kisley, Wood, & Burrows, 2007) but rather due to the increased attentional bias towards positive stimuli (Windsor & Antsey, 2010). This suggests that there are a number of changes in the experience of negative affect, due to ageing.

Ageing is also significantly related to changes in positive affect. Research has frequently identified increased positive affect in older adults (Mroczek & Kolarz, 1998; Stawski et al., 2008), as well as enhanced stability of positive affect (Mroczek, 2001), compared to younger adults. A relationship between age and positive affect has also been identified, which has been linked to the positivity effect of attentional bias in older adults (Mather & Carstensen, 2005); whereby increased age has been associated with increased recognition accuracy of positive affect, such as happiness (Williams et al., 2006). Furthermore, there is evidence to suggest that it is not just the experience of positive affect that changes but also the meaning of positive affect. For example, Lawton et al. (1993) found that younger and older adults require different factor loading for positive affect, suggesting that the experience of positive affect may be different for the two groups. Finally, positive affect has also been linked to other beneficial processes. For example, increases in positive affect predicted higher levels of mindfulness, and vice versa, suggesting an upward-spiral effect between positive affect and mindfulness disposition (Catalino & Fredrickson, 2011). Therefore, there are important changes in the regulation of both positive and negative emotion with age.

Just as maturation in emotion regulation processes is important for emotion development through childhood and adolescence (Gross & Thompson, 2007), development may continue throughout adulthood alongside the social and situational changes that occur in life (John & Gross, 2004). Research into emotion regulation in adulthood has identified changes across the lifespan. Overall older adults appear to be better skilled at regulating emotion (Kessler & Staudinger, 2009), including increased suppression (Nolen-Hoeksema & Aldao, 2011), and enhanced positive refocus skills (Phillips, Henry, Hosie, & Milne, 2008). Older adults also have greater skill at down-regulating negative emotions during a difficult task than younger adults (Scheibe & Blanchard-Fields, 2009). Furthermore, emotion regulation in older age has also been shown to be a cross-cultural phenomenon, rather than

culturally specific (Gross et al., 1997). Therefore, there is evidence for an association between ageing and enhanced emotion regulation, which may in part explain the changes in affective reactivity across adulthood.

Some research has purported that differences in emotional expression in ageing may be due to a dampened affective response (Jorm, 2000). However, this has not been found to be the case (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Further, multiple studies have found that older adults experience high intensity positive and negative affect similar to younger adults (Phillips et al., 2008; Stanley & Isaacowitz, 2011). Rather than experience reduced affect, older adults show greater emotional control and mood stability than younger and middle-aged adults (Gross et al., 1997; Lawton, Kleban, Rajagopal, & Dean, 1992). During negative mood-induction tasks, older adults are also better able to maintain affective and physiological homeostasis, compared to younger adults (Levenson, Carstensen, & Gottman, 1994). This suggests that psychological reactivity, by way of positive and negative emotion, is not diminished due to ageing, and that older adults may experience a more stable emotional experience than other age groups.

Theories of Adult Development

A number of negative factors occur in older age that may shape subjective wellbeing, such as changes in financial and functional independence, loss of social support, and physical impairment. However, there is evidence that older adults maintain a high level of emotional wellbeing, at a similar or higher level to younger adults (Charles & Carstensen, 2010). Moreover, older adults may be skilled at replacing lost resources, leading to enhanced emotion regulation and wellbeing (Urry & Gross, 2010). The high level of psychological and emotional wellbeing evident in older adulthood has been the focus of a number of theories.

However, here we will discuss two of these theories, which are most applicable for the current research.

Socioemotional Selectivity Theory

Socioemotional selectivity theory is a theory of adult development, which has received substantial support in the literature. This theory focuses on the importance of differential social and emotional goals at various stage of adulthood, from younger through to older adulthood (Carstensen, 1992, 1995). More specifically, Carstensen posits that there are three primary goals in adulthood: "emotion regulation, development and maintenance of self-concept, and information-seeking" (Carstensen, 1995, 152), which vary in salience across adulthood (Carstensen, 1995; Carstensen et al., 1999). Socioemotional selectivity theory suggests that during early and mid-adulthood, the acquisition of knowledge and resources, and preparation for future goals, is central (Carstensen et al., 1999). For older adults, however, social motives become focused on the regulation of emotion (Carstensen et al., 1999).

Perception of time is a central factor for socioemotional selectivity theory. The theory states that the perception of an expansive future leads to knowledge-focused goals (Charles & Carstensen, 2007). However, perception of a foreshortened future gives way to goals that focus on emotion and meaning, as well as a tendency to be more present-focused (Carstensen, 1995; Charles & Carstensen, 2010). While this shift to more meaningful goals typically occurs in older adults, it has also been identified in young adults with incurable illness (Carstensen & Fredrickson, 1998). Therefore, according to socioemotional selectivity theory, healthy younger adults focus on the acquisition of knowledge, skills and resources to set them in good stead for their future. In comparison, older adults become more focused on producing or maintaining a meaningful and fulfilling existence.

A change in cognitive processing that has been identified in older adults, termed the positivity effect, has also been discussed within the framework of socioemotional selectivity theory. The positivity effect refers to the enhanced attention to and memory of positive stimuli, in older age (Mather & Carstensen, 2005). Indeed, previous studies that have reported findings that may support the positivity effect, such as older adults reporting higher levels of positive affect (Lawton et al., 1993), and better maintenance of positive affect immediately after a stressor (Scott, Sliwinski, & Blanchard-Fields, 2013). In sum, socioemotional selectivity theory appears to suggest that ageing is associated with shifts in attentional bias to focus on positive stimuli, along with enhanced emotion regulation and a focus on the meaningful goals.

Strength and Vulnerability Integration Theory

An extension of socioemotional selectivity theory is the strength and vulnerability integration theory. Strength and vulnerability integration theory proposes that reduced negative, and stable or increased positive, emotional experiences of older adults results from enhanced emotion regulation strategies, resulting in a greater subjective wellbeing (Charles, 2010). Furthermore, the theory explains enhanced subjective wellbeing in older adults as occurring due to an amalgamation of life experience and the positivity effect, as well as the impact of the perception of time on goals derived from socioemotional selectivity theory (Charles, 2010). In addition, this theory incorporates the reduction in physiological reactivity to negative events (namely, reductions in the cardiovascular and neuroendrocrine systems), and overall cognitive decline, as important factors to consider when investigating affective reactivity across the lifespan (Luong & Charles, 2014).

However, it is suggested that age-related differences in affective and physiological reactivity are not stable across all circumstances. For example, strength and vulnerability

integration theory proposes that when negative experiences cannot be avoided, the age differences in emotion regulation will disappear (Charles & Luong, 2013). As an increased use of distancing strategies, and increased attention to positive stimuli, has been associated with increased age, this suggests that these strategies may be useful to reduce negative reactivity to stressors. As such, when these strategies are removed older adults show attenuated affective reactivity (Charles & Luong, 2013). Overall, strength and vulnerability integration theory provides an integration of the current theories supported in the literature. The theory also highlights the importance of age when investigating lifespan changes in emotion regulation, and affective and physiological reactivity across the lifespan (Piazza, Charles, Stawski, & Almeida, 2013).

Coping

Coping strategies

Coping refers to the way in which an individual attempts to reduce or eliminate harm, threat, loss or related distress (Carver & Connor-Smith, 2010). Coping strategies include both cognitive and behavioural strategies, and can be categorized as problem-focused or emotion-focused, whereby problem-focused relates to behavioural strategies to change the situation to remove the stressor, and emotion-focused relates to cognitive strategies to reduce distress (Sideridis, 2006). Strategies can be also be differentiated as approach- or avoidant-coping, depending on whether the strategy leads the individual to approach the situation to resolve the issue, or to avoid the situation and manage the resulting emotion response (Holahan et al., 1996). Coping is related to emotion regulation; though, coping strategies specifically focus on reducing the negative impact of a stressor and is related to a process that occurs over longer periods of time (Gross & Thompson, 2007).

The choice of coping strategy that is implemented, whether it is one or a combination of strategies, can impact on the emotional wellbeing of an individual. For example, the use of adaptive social and personal coping strategies has been found to reduce the incidence of depression and general psychological distress (Holahan et al., 1996). Research also shows that depression has been associated with increased use of maladaptive coping, such as wishful thinking and self-blame (Hori et al., 2013); and anxiety has been associated with maladaptive coping strategies such as denial and behavioural disengagement strategies, and shown an inverse association with active coping strategies (Carver, Scheier, & Weinstraub, 1989). Overall, this suggests that the style of coping strategies employed can affect an individuals' resulting subjective wellbeing.

The choice of coping strategy can also affect physiological reactivity. For example, Suzuki, Kumano and Sakano (2003) found that employing different strategies resulted in differential physiological changes; active coping resulted in increased cardiovascular reactivity, and avoidant coping resulted in increased skin conductance. The authors suggest that different types of coping result in activation of differential psychophysiological systems. Furthermore, a study of depressed patients showed that along with their preference for maladaptive coping strategies, they also experience blunted plasma cortisol reactivity to a stressor task. This suggests that the types of coping strategies employed affect physiological reactivity.

Personality traits have been associated with patterns of coping style. For example, research has identified an association between maladaptive coping strategies and neuroticism (Holahan et al., 1996). Mindfulness has also been associated with decreased use of avoidant coping strategies, and some evidence of increased use of approach coping strategies (Weinstein et al., 2009). However, these findings have not been successfully replicated

(Josefsson, Lindwall, & Broberg, 2014). Therefore, further investigation regarding the association between traits and coping styles is required.

Ageing and Changes in Coping Strategies

The inclination for different coping strategies across adulthood has been a topic of interest for a number of decades (Lazarus and DeLongis, 1983). However, the research has produced mixed results, sometimes identifying differences in coping strategies across the lifespan, and sometimes not. Past research has identified similarities between the coping strategies employed by younger and older adults (McCrae, 1982). However, despite the overall similarities, McCrae found that middle-aged and older adults were less likely to employ two particular maladaptive strategies (hostile reaction and escapist fantasy). These results have been replicated in further studies, identifying similar active coping styles, and reduced escapism, in older adults (Aldwin, 1991; Aldwin, Sutton, Chiara, & Spiro, 1996; Amirkhan & Auyeung, 2007). Moreover, additional research has found an increase of problem-focused strategies with age, but found that emotion-focused strategies did not vary by age (Trouillet et al., 2011). Finally, more recent research has identified a reduction in both approach and avoidance coping in older adults (Brennan, Holland, Schutte, & Moos, 2012). Certainly, the variability of results regarding coping strategies and ageing still warrants further investigation. Considering the detrimental consequences associated with maladaptive coping strategies, such as poor physical and psychological health (Mohr et al., 2014; Mortiz et al., 2016), and the age-related decreases in negative affect (and increase in positive affect) already discussed, further research into the types of coping strategies used throughout the adult lifespan in required.

Stress and Physiological Reactivity

Stress has been referred to as a dynamic process that seeks to attain homeostasis, and can be defined as "a nonspecific deviation from the normal resting state" (Selye, 1955, p. 626). Moreover, psychological stress has been specifically defined as "a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p. 21). Carver and Connor-Smith (2010) extend the understanding of 'endangering wellbeing', as including the threat or loss of resources (which can refer to various types, such as financial, physical, personal qualities, etc).

When a stressful appraisal is made the body undergoes changes, specifically in: the central nervous system, the autonomic nervous system, and the endocrine system. The central nervous system includes the brain and spinal cord (Seaward, 2004), and stress reactivity in this system results in neurological activation of a number of neurological areas including the hypothalamus, hippocampus and amygdala (Allen, Kennedy, Cryan, Dinan, & Clarke, 2014). The autonomic nervous system is comprised of the sympathetic and parasympathetic nervous systems, and consists of antagonistic processes designed to maintain equilibrium of functions such as heart rate (Xhyheri, Manfrini, Mazzolini, Pizzi, & Bugiardini, 2012). Stressors activate the sympathetic nervous systems, which is the same system activated by during fight-or-flight response, and causes physiological changes such as dilation of pupils, enhanced respiratory function, reduced digestive function, and increased heart rate (Seaward, 2004). The opposing system, the parasympathetic nervous system, is responsible for conserving energy and when activated returns the body to homeostasis by countering the physiological changes of the sympathetic nervous system (Seaward, 2004). Finally, the endocrine system is comprised of glands, hormones, circulation system, and target organs; and is closely involved in the psychophysiological stress response (Seaward, 2004). The hypothalamic-pituitary-

adrenal (HPA) axis is a core component of the stress reactivity process. The hypothalamus activates the HPA axis under conditions of fear or threat, whereby stimuli are deemed threatening which activates the hypothalamus, then activating the pituitary gland, and finally the adrenal gland. Hormones are released at each stage, triggering activation of the next stage of the axis (Lupien et al., 2009).

Ageing and Physiological Reactivity to Stress

Studies of ageing that assess physiological functioning have found that older adults show a number of physiological changes to other age groups. For example, one study identified greater variation, but not overall mean level, of cortisol in older adults (Heaney, Phillips, & Carroll, 2012), while other studies have identified attenuated diurnal patterns with age (Nater, Hoppmann, & Scott, 2013; Wang et al., 2014). Older adults have also been found to generally have reduced heart rate and heart rate variability compared to younger adults (Antelmi et al., 2004; Takahashi et al., 2012), though some research suggests that older adults may experience greater cardiovascular reactivity when responding to more complex stressors that affect multiple facets of life (Wrzus et al., 2013). In addition to the loss of specific synapses in the prefrontal cortex and losses of plasticity in medial prefrontal cortex due to ageing (McEwen & Morrison, 2013), a reduction of grey matter volume (in the medial prefrontal cortex) has been identified in older adults (Williams et al., 2006), as well as reduced amygdala reactivity to negative stimuli (Mather, 2012). Elevated plasma glucocorticoid levels have also been identified in older age, which may also be associated with age-related neurological degeneration and increased blood pressure (Lupien, Maheu, Tu, Fiocco, & Schramek, 2007; Lupien et al., 2009). Furthermore, some age-related changes in physiological reactivity to stressors have been identified. For example, older adults appear to have reduced physiological reactivity during marital conflict tasks (Levenson et al., 1994).

Older adults also display attenuated salivary alpha amylase, heart rate, heart rate variability and cortisol compared to younger adults (Levenson, 2000; Strahler, Mueller, Rosenloecher, Kirschbaum, & Rohleder, 2010; Rhebergen et al., 2015). However, the research into physiological differences by age are limited and require further investigation.

As discussed, a number of changes have been identified in physiological reactivity due to ageing. However, changes in physiological functioning have also been identified with other factors such as emotion regulation (Denson, Grisham, & Moulds, 2011). In addition, personality traits such as neuroticism and mindfulness have been found to correlate to cortisol levels (Davidson et al., 2003; Nater, Hoppmann, & Klumb, 2010). Therefore, research into changes in physiological reactivity and functioning would benefit from inclusion of a range of factors including age, emotion regulation and personality traits.

Personality Traits Related to Emotion Regulation

Neuroticism

Neuroticism is a personality trait related to an individual's tendency to experience negative emotions (Costa, Terracciano, & McCrae, 2001), and is strongly associated with negative affect (Watson & Clark, 1992). Neuroticism has been associated with psychopathology, such as anxiety and depression (Clark, Watson, & Mineka, 1994; Koorevaar et al., 2013), as well as negative bias in attention, increased affective reactivity and poor coping skills (Ormel et al., 2013). Furthermore, an individual's level of neuroticism can significantly impact their affective reactivity to stressors (Mroczek & Almeida, 2004). Therefore, neuroticism is an important factor to consider when investigating affective reactivity.

Ageing and Neuroticism

Some research shows a reduction in neuroticism over the lifespan, suggesting increased emotional stability with ageing (e.g. Williams et al., 2006; Mroczek & Spiro, 2003). Further, a decrease in neuroticism over the lifespan has been found in cross-cultural studies (Bleidorn et al., 2013), though the change may be a quadratic decline over the lifespan (Mroczek & Spiro, 2003). However, other research suggests that neuroticism shows inconsistent patterns of change across the lifespan (Allemand, Zimprich, & Hendricks, 2008; Roberts, Walton, & Viechtbauer, 2006). Some research also suggests that cohort may impact on changes of neuroticism over the lifespan. For example, Roberts et al. (2006) investigated cohort effects in their meta-analyses and although the authors did not identify a cohort effect for emotional stability in their study, other research has identified significant cohort effects for trajectory of change in personality traits including neuroticism (Mroczek & Spiro, 2003). Therefore further research into the mean levels and trajectory of change of neuroticism in different age groups, and cohorts, across the lifespan is needed.

A strong relationship has been identified between neuroticism and dispositional mindfulness; whereby higher levels of neuroticism are associated with lower levels of mindfulness (Giluk, 2009). Though neuroticism and mindfulness appear to be traits of opposing characteristics, the relationship between the two variables is uncertain (Thompson & Waltz, 2007). Furthermore, neuroticism has been implicated in the relationship between age and positive affect (Mroczek & Kolarz, 1998). This suggests that further investigation of the role of neuroticism in the age-related changes of positive affect is required.

Mindfulness

Mindfulness stems from Buddhist philosophy and has been defined as attention to and awareness of the present moment, with particular focus on curiosity, experiential openness and acceptance (Brown & Ryan, 2003; Nyklíček, 2011). Dispositional mindfulness is a personality characteristic and has been associated with a reduction in negative affect, negative rumination and psychological distress (Arch & Craske, 2006; Arch & Craske, 2010; Coffey & Hartman, 2008; Kiken & Shook, 2014; Ostafin, Brooks, & Laitem, 2014), and enhanced subjective wellbeing and life satisfaction (Bränström et al., 2011; Brown & Ryan, 2003; Harrington, Loffredo, & Perz, 2014). Furthermore, a higher level of mindfulness has been shown to buffer individuals' affective and physiological reactivity (Brown et al., 2012; Bullis, Bøe, Asnaani, & Hofmann, 2014; Feltman, Robinson, & Ode, 2009; Fogarty et al., 2015). Increased mindfulness has also been associated with reduced grey matter volume in a region of the amygdala associated with neurological stress reactivity and emotion expression (Taren, Creswell, & Gianaros, 2013). Therefore, the mindfulness-based practice of awareness and acceptance of the present moment, may be advantageous for psychological and physiological health.

A higher level of dispositional mindfulness has been associated with a number of benefits. For example, increased mindfulness is related to lower levels of generalised anxiety disorder (Roemer et al., 2009), along with other anxiety and depressive disorders (Brown & Ryan, 2003). This is further supported by research showing the benefits of dispositional mindfulness on cognitive function in community-dwelling older adults (Fiocco & Mallya, 2015). In addition, mindfulness-based treatments have also been found effective in reducing anxiety and depressive symptoms (Eisendrath et al., 2008; Kabat-Zinn et al., 1992), and reducing physiological reactivity (Malinowski, Moore, Mead, & Gruber, 2015). Dispositional mindfulness may also lead to enhanced acceptance of negative emotions, therefore allowing

for times of mixed emotions, which has been found to be beneficial for an individuals' health (Hershfield, Scheibe, Sims, & Carstensen, 2012). Interestingly, research has also identified that higher levels of mindfulness moderates the negative outcomes associated with neuroticism (Barnhofer, Duggan & Griffith, 2011; Feltman et al., 2009). Therefore, dispositional mindfulness may play an important role in both enhancing wellbeing, as well as reducing psychological distress and negative outcomes related to neuroticism.

A number of factors, through which mindfulness enhances subjective wellbeing, have been suggested in the literature. For example, Jimenez, Niles and Park (2010) found that self-acceptance mediated the relationship between mindfulness and depressive symptoms. Kiken and Shook (2012) also found that negative rumination partially mediates the relationship between mindfulness and psychological distress. Garland et al. (2011) investigated the effect of mindfulness-based stress and pain reduction treatment in adults and found that positive reappraisal and mindfulness reciprocally enhanced each other, and suggested that by increasing dispositional mindfulness levels, a broadening of awareness may ensue leading to reduced psychological distress. These results suggest that regardless of the trajectory of neuroticism across adulthood, dispositional mindfulness could be involved in reducing the impact of neuroticism on subjective wellbeing and that increasing dispositional mindfulness may have significant effects on both positive and negative facets of wellbeing. However, there is currently limited information available and further research regarding potential mechanisms of change is required.

Ageing and Mindfulness

A number of studies have identified a significant association between dispositional mindfulness and age. For example, in a study of the Swedish population aged 18 to 60 years of age, Bränström et al. (2011) found that mindfulness levels increased with age. In particular,

a significant positive relationship was identified between the acting with awareness subscale of the mindfulness measure and age. Another study also identified a significant positive correlation between dispositional mindfulness and age, using a different measure of mindfulness (Raes, et al., 2013). Furthermore, Raes and colleagues also identified that mindfulness partially mediates the negative relationship between age and negative affect, providing support for the role of mindfulness in both ageing and negative affect.

Only a small amount of research has also been conducted on the effect of mindfulness in older adults. For example, de Frias and Whyne (2015) found that dispositional mindfulness buffers the effects of stress in older adults. This suggests that mindfulness is important in subjective wellbeing across adulthood, but that further research is needed to investigate the role of mindfulness in ageing, and affective and physiological reactivity, beyond correlational studies.

Conclusion

Evidence suggests that ageing results in a number of changes; for example ageing is associated with enhanced emotion regulation (Gross et al., 1997; Kessler & Staudinger, 2009), reduced negative affect (Gross et al., 1997; Windsor & Antsey, 2010), increased positive affect (Stawski et al., 2008), and generally more adaptive coping styles (Amirkhan & Auyeung, 2007). Furthermore, ageing has been associated with changes in traits; for example, decreased neuroticism (Bleidorn et al., 2013) and increased mindfulness (Bränström et al., 2011). Dispositional mindfulness has also been associated with reduced negative affect and reactivity (Arch & Craske, 2006; Arch & Craske, 2010), enhanced wellbeing (e.g., Bränström et al., 2011), and age (Raes et al., 2013). However, it is unclear how these variables may interact, and specifically how trait variables may interact with age-related affective and physiological reactivity. This thesis proposes that dispositional mindfulness may be

associated with age-related changes in affective and physiological reactivity. As such, the present research aims to investigate the relationship between ageing and dispositional mindfulness, and examine how the relationship may be related to affective and physiological reactivity.

Present Thesis

The present thesis aims to investigate the role of dispositional mindfulness with regards to ageing, and affective and physiological reactivity. The present thesis consists of a general introduction to the literature, a systematic review, an experimental study and a final discussion encompassing the findings from each section of the thesis. The literature review presented in this general introduction outlines the findings so far in each of the key areas of research related to this topic. Study One (reported in Chapter Two) presents a systematic review of the literature regarding the current status of research into dispositional mindfulness, ageing, and affective and physiological reactivity. Study Two (reported in Chapter Three) investigated the role of dispositional mindfulness, along with a number of other predictors of subjective wellbeing, regarding physiological and psychological reactivity. Using an experimental design, physiological and psychological reactivity data were collected from participants across a broad age range (18 to 90 years of age). The relationship between ageing and dispositional mindfulness was investigated. Thereafter, the role of dispositional mindfulness along with other important factors related to emotion regulation, were investigated to assess their role in physiological and affective reactivity to mood-induction tasks. Finally, the general discussion presents a review of the findings from each paper and assimilates the findings with current research perspectives. Implications for both theoretical and clinical research are discussed, as well as the strengths and limitations of the thesis. This

thesis concludes with suggestions for future research, which may further strengthen this field of research.

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Chapter Two

Study One

The role of dispositional mindfulness in affective and physiological reactivity across the adult lifespan: A systematic review.

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Ms Jacqueline Frei was responsible for the design of this study, data collection, data entry, analysis and write-up of this paper. Dr Viviana Wuthrich provided research supervision and was involved in reviewing the manuscript. Dr Kerry-Ann Grant and Professor Ronald Rapee provided research supervision.

Abstract

Research has shown that affective and physiological changes occur with age. While the research into physiological changes is variable, studies consistently show that ageing results in increased positive affect and reduced negative affect. One concept that may shed light on these ageing related changes is dispositional mindfulness. A systematic review was conducted to assess the literature regarding dispositional mindfulness and its role in affective and physiological changes that come with age. Twenty-nine studies were identified that investigated dispositional mindfulness and affective or physiological reactivity in adults. Dispositional mindfulness was related to decreased negative affect reactivity, enhanced wellbeing, and reduced physiological reactivity; and was positively correlated with age. While mindfulness-based treatments generally did not show enhanced treatment outcome for more mindful participants, these treatment studies showed good psychological outcomes for participants who experienced an increase in mindfulness due to the treatment. Overall, dispositional mindfulness is posited as a potential factor in the age-related changes of affect and physiology. A significant limitation is the restricted age range for most studies, with very few investigating adults from multiple age groups. Future research should assess the full age spectrum in adulthood.

Mindfulness, which has been defined as the conscious attention to and awareness of the present moment (Brown & Ryan, 2003), is associated with a number of benefits relating to enhanced wellbeing. For example, studies have found that dispositional mindfulness is associated with increased subjective wellbeing and life satisfaction (Bränström, Duncan, & Moskowitz, 2011; Brown & Ryan, 2003; Fiocco & Mallya, 2015), greater long-term recovery from stressors (Diaz, Jiménez, & Lopes, 2014) and appears to buffer affective and physiological reactivity to stress (Barnhofer, Duggin, & Griffith, 2011; Brown, Weinstein, & Crewsell, 2012; Bullis, Bøe, Asnaani, & Hofmann, 2014; Fogarty et al., 2015). Furthermore, mindfulness has also been negatively correlated with psychopathology, rumination, and neuroticism (Brown & Ryan, 2003; Feltman, Robinson, & Ode, 2009). As such, dispositional mindfulness appears to play an important role in subjective wellbeing.

Furthermore, dispositional mindfulness appears to change with age; yet only a few studies have specifically investigated this relationship. One such study investigated dispositional mindfulness in a Swedish sample of adults aged 18 to 60 years (Bränström et al., 2011). It was found that mindfulness increased across adulthood, and the *acting with awareness* facet of mindfulness in particular showed significant positive association with age. Raes, Bruyneel, Loeys, Moerkerke and De Raedt (2013) also investigated the association between dispositional mindfulness and ageing. In their sample of adults, aged 18 to 85 years of age, mindfulness was positively associated with age. Further, Raes and colleagues found that mindfulness partially mediated the relationship between age and negative affect. Therefore, older adults report higher levels of dispositional mindfulness than younger adults, and the level of mindfulness may mediate the level of negative affect that older adults experience. However, with limited research to draw assumptions upon, the association between dispositional mindfulness and ageing is still not clear and further investigation is needed.

Affective reactivity was once believed to diminish with age. Though more recent research has shown that older adults experience a similar intensity of positive and negative affect as younger adults (e.g., Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Interestingly, despite the similar intensity of emotions, the levels of experienced positive and negative affect appears to differ across adulthood. For example, a reduction in negative affect and increase in positive affect has been identified in older, compared to younger, adults (Mroczek & Kolarz, 1998). Older adults also appear to have superior recovery from negative affect and stability in their experience of positive affect (Carstensen et al., 2000) and have been found to exhibit more emotional control than younger adults (Gross et al., 1997). Indeed, research has identified differences in the use of emotion regulation strategies between younger, middle-aged and older adults. For example, older adults have been found to direct their attention towards positive and away from negative stimuli (Isaacowitz, Toner & Neupert, 2009). This suggests that older adults show a preference to attend to positive stimuli, which could be seen as an adaptive emotion regulation strategy to increase positive, or decrease negative, emotion. One study also found that older adults recovered from a negative mood-induction task faster than younger adults (Larcom & Isaacowitz, 2009). As older adults have been found to attend to positive stimuli, and recover faster from negative emotions, it may be suggested that with age comes an ability to detach emotionally from stressful events and utilise more adaptive emotion regulation strategies.

Developmental changes in emotion regulation, and affective experience, may be explained by Carstensen's socioemotional selectivity theory, which states that enhanced emotion regulation in older adults occurs due to a sense of foreshortened future (Carstensen, Isaacowitz, & Charles, 1999). Socioemotional selectivity theory posits that ageing is associated with a shift in goals (from knowledge gain to emotion-focused) and a shift of attention (to present-focused and emotionally meaningful goals), which may explain the reduced negative, and increased positive, affect (Carstensen, Fung, & Charles, 2003). This is

further supported by the strength and vulnerability integration theory (Charles, 2010) which proposes a number of factors, including a sense of foreshortened future and enhanced emotion regulation abilities, as key variables related to enhanced wellbeing in older age. One key feature of both of the aforementioned developmental theories is the shift to present-focused attention with age due to a foreshortened future. As present-focused attention is also a primary feature of mindfulness, it could be suggested that these developmental theories may be identifying the affective changes associated with an increase in mindfulness over the lifespan. This is in line with current findings suggesting that mindfulness appears to increase with age (Bränström et al., 2011). However, the role of dispositional mindfulness in ageing requires further investigation.

A number of physiological changes have also been identified to occur with age. Some physiological changes occur during the ageing process due to reduced biological functioning; for example, heart rate and heart rate variability have been found to be slightly lower in older age (Antelmi et al., 2004; Takahashi et al., 2012). Indeed, Levenson, Carstensen and Gottman (1994) identified lower physiological reactivity during a marital conflict task in older adults, compared to middle-aged adults. These differences were maintained even after controlling for the increased positive affect identified in their older adult sample. However, not all physiological measures show reductions with age. For example, Wrzus and colleagues identified greater cardiovascular reactivity in older adults when responding to a complex, resource-intensive stressor compared to a less resource intensive stressor that affects only one facet of life (Wrzus, Müller, Wagner, Lindenberger, & Riediger, 2013). In addition, while older adults show similar overall levels of salivary cortisol, they appear to experience greater diurnal variation than younger adults (Heaney, Phillips, & Carroll, 2012). A small amount of research has also identified the role of mindfulness in reducing physiological reactivity. For example, Daubenmier, Hayden, Chang, and Epel (2014) found in a sample of adult women that a low level of acceptance (based on the *accept* subscale of a dispositional mindfulness

measure) was associated with increased levels of salivary cortisol. Therefore, age appears to be related to physiological development throughout adulthood and recent research is starting to identify the role of dispositional mindfulness in physiological reactivity.

While developmental changes in emotion regulation and reactivity, including a decrease in negative affect and increase in positive affect, have been shown to occur in older adults (Kunzman, Little & Smith, 2000; Larcom & Isaacowitz, 2009). Physiological reactivity, such as heart rate variability, also appears to show reductions in older adults. Furthermore, affective and physiological changes have both been associated with dispositional mindfulness. However, it is not clear how dispositional mindfulness, which appears to increase with age, relates to changes in physiological or affective changes. Thus, a thorough investigation regarding mindfulness, and affective and physiological reactivity across adulthood is required. This review therefore aims to assess the literature to date regarding dispositional mindfulness in adults, and its association to affective and physiological reactivity and regulation.

Method

Search Strategy and Selection Criteria

The protocol for the systematic review was based upon the Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009). Using selected search terms, a systematic search of the literature was conducted in PsycINFO, identifying articles up to and including October 2015.

Initial search terms were selected to comprehensively identify literature focusing on adult development or lifespan research, affect reactivity or physiological data, coping or emotion regulation, and dispositional mindfulness. However, the final search combining each

of these criteria returned no results and so the search terms were broadened. The final search terms for this systematic review included combined keyword searches for emotional or physiological reactivity or regulation (affect or "emotion regulation" or physio$ or "heart rate" or react$), and dispositional or trait mindfulness ("trait mindfulness" or "dispositional mindfulness").

Eligibility and exclusion criteria

Eligibility criteria included any papers that were published in peer-reviewed journals and needed to include measurement of affective or physiological reactivity. Limiters were applied such that studies were excluded from the systematic review if they were not peer-reviewed articles, did not provide any data, or did not provide data from adults (18 years or over). Studies were also excluded if they were not published in English, as the exclusion of non-English papers has been identified to not disadvantage the findings of systematic reviews (Moher et al., 2000). Articles were reviewed by one author (JF) to assess eligibility for the current study. Studies were screened by title and abstract, and finally by full-text, against the inclusion criteria.

Data management and outcomes

Results were imported to and managed with a reference manager (Endnote, Version X7.3.1). Results were sorted into groups based on eligibility for the review, and sub-folders created to reflect these groups.

The primary outcome of interest was the impact of dispositional mindfulness on affective and/or physiological measures. Psychological and physiological measures were identified for the review. It was expected that outcome data would report level of mindfulness

(for example, low versus high), and potentially also age group (for example, younger versus older adults). A systematic narrative synthesis was produced, with a focus on the relationship between dispositional mindfulness, age, and affective and physiological reactivity.

Results

Study Selection

From the 99 studies that were identified during the search, 29 were found to be eligible for inclusion in the review. As can be seen in Figure 1, 66 articles were excluded based on review of their title and abstract. A further four articles were deemed ineligible after review of the full article; whereby two articles did not meet the age criteria, and two articles did not investigate the relationship between mindfulness and affective reactivity.

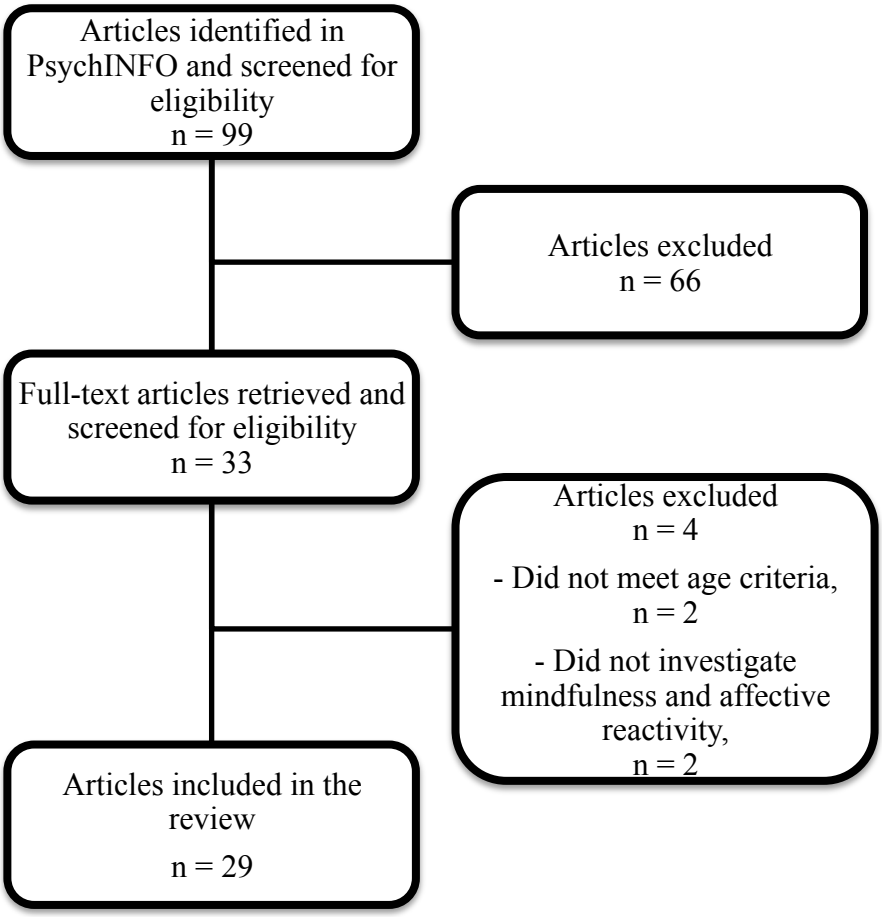

Figure 1. Flow chart of the eligibility of identified articles.

Study Characteristics

Data were extracted for the eligible 29 studies, which can be found in Table 1 (see Appendix A). The information of interest for this review included data regarding the sample size, sample demographic information, research design and data analysis methodology, as well as measures of dispositional mindfulness, psychological variables and physiological variables.

Affect and physiology measures. Psychological variables were included in all but one of the eligible studies (Laurent, Laurent, Nelson, Wright, & De Arujo Sanchez, 2015). Twenty-one of the 29 studies included measures of general subjective wellbeing (for example, measures of subjective distress or overall wellbeing), while 19 studies contained specific measures for anxiety or depression. Aside from assessment of affective reactivity using general psychological measures, eleven studies included measures of positive and/or negative reactivity (for example, with the Positive and Negative Affect Schedule; PANAS) and eight assessed physiological reactivity (using measures of heart rate or heart rate variability, blood pressure, immune protein, salivary alpha amylase or salivary cortisol).

Sample age. The majority of the studies used samples with a mean age of 19 to 25 years of age; though three studies (Bränström et al., 2011; Daubenmier et al., 2014; Fogarty et al., 2015) did not report a mean age for their overall sample. Six studies included samples with a mean age between 30 and 55 years of age. Furthermore, the eligible studies included limited investigation into age differences, with only two studies (Bränström et al., 2011; Raes et al., 2013) using a sample that included younger, middle-aged and older adults (age range 18 to 60 and 85 years of age, respectively), and only one study (Prakash, Hussain, & Schirda,

2015) that specifically compared younger and older adults. Therefore, further analysis of the studies was unable to discuss in depth the variability of results by age group.

Quality Assessment and Thematic Analysis of Studies

The Cochrane Handbook for Systematic Reviews of Interventions is recommended for assessment of bias (Higgins, Altman & Stern, 2011), however this protocol is only appropriate for randomized control trials. Therefore, a quality assessment of each study was undertaken using the MERGE criteria (Liddle, Williamson, & Irwig, 1996), which was adapted to enhance applicability for the current study. The MERGE criteria were considered the most appropriate assessment tool as they address key areas of bias (such as quality of the sample description, or measures), and could be adapted to the requirements of the literature. Furthermore, the MERGE criteria provide an overall grade of quality for each study, rather than providing a summary score, which has been suggested to be a questionable and arbitrary measure of quality (Colle, Rannou, Revel, Fermanian, & Poiraudeau, 2002). Overall quality assessment of the eligible studies ranged from A to B2, though just over 75% achieved the highest rating of A, indicating a low risk of bias; results are shown in Table 2 (see Appendix B).

Thematic analysis was used to classify articles according to their core findings. Six key themes were identified: (1) Dispositional mindfulness increases with age, (2) Increased dispositional mindfulness relates to enhanced wellbeing, (3) Dispositional mindfulness results in reduced negative affect, (4) Dispositional mindfulness is associated with reduced physiological reactivity, (5) Mindfulness-based treatment influences both negative and positive affect, and (6) Mindfulness and mechanisms of change.

Dispositional Mindfulness Increases with Age

Only three studies included participants from a broad range of ages, or compared multiple age groups within the study. From these three studies (Bränström et al., 2011; Prakash et al., 2015; Raes et al., 2013), it appears that dispositional mindfulness varies as a function of age. That is, all three studies found a positive correlation between dispositional mindfulness and age. For the two studies that assessed dispositional mindfulness over adulthood (Bränström et al.; 2011; Raes et al., 2013), mindfulness was found to consistently increase from younger through to older adulthood.

Increased Dispositional Mindfulness Relates to Enhanced Wellbeing

A large number of studies have been conducted to investigate the relationship between dispositional mindfulness and wellbeing. For this review sixteen studies were identified, which investigated the relationship between trait mindfulness and variables related to subjective wellbeing, particularly positive and negative affect. Physiological variables were also investigated, as well as potential mechanisms of change such as emotion regulation and positive reappraisal.

Decreased psychological distress. A number of studies have focussed on the relationship between negative affect and psychological distress, and dispositional mindfulness. Three studies found a significant negative correlation between mindfulness and measures of psychopathology (namely, anxiety and depression), further supporting the link between mindfulness and reduced psychological distress. Furthermore, Bränström and colleagues found that the *nonjudging of experience* facet of mindfulness was particularly related to anxiety. Lyvers et al. (2014) also identified a significant correlation between lower

levels of mindfulness and alexithymia (which is limited or absent emotional experience and cognition associated with emotions; Larson, Brand, Bermond, & Hijman, 2003). The authors suggest that as mindfulness is believed to encompass the acts of identifying, describing and labelling emotions, this finding is not surprising but gives further support to the idea that mindfulness shows significant positive correlation to indices of psychological dysfunction. Finally, Raes et al. (2013) identified a negative correlation between mindfulness and negative affect, and also found that mindfulness partially mediated the relationship between age and negative affect.

Negative cognitions are an important aspect of psychological distress, and have been found to specifically relate to dispositional mindfulness. For example, one study (Kiken & Shook, 2012) found that a negative association between dispositional mindfulness and negative cognitions. In addition, perceived stress can have a significant impact on subjective wellbeing and cognitive state. Prakash et al. (2015) identified a significant inverse relationship between mindfulness and perceived stress. Furthermore, this relationship between dispositional mindfulness and perceived stress was found in both younger and older adults.

Increased subjective wellbeing. The relationship between dispositional mindfulness and subjective wellbeing was investigated in a small number of eligible studies. For example, Keune and Forintos (2010) found support for the positive relationship between mindfulness and subjective wellbeing, by identifying significant positive correlations between dispositional mindfulness and a number of measures of subjective wellbeing (including positive affect, position emotion, and vitality). The authors also identified that regular meditation experiences, or meditation practice sessions of longer durations, provided greater benefits for subjective wellbeing. This is similar to the findings of Jislin-Goldberg, Tanay and Bernstein (2012) who identified a stronger correlation between dispositional mindfulness and

trait-like positive affect in people who mediate, compared to a non-meditation sample. Furthermore, one study (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007) investigated the role of dispositional mindfulness within romantic relationships. Barnes and colleagues found that baseline levels of dispositional mindfulness predicted the level of self-control and accommodating behaviours both at baseline and follow-up time points. The authors suggest that trait mindfulness may be related to more adaptive relating and coping behaviours within a romantic relationship.

Bränström et al. (2011) found support for the positive association between mindfulness and subjective wellbeing, identifying a relationship between trait mindfulness and positive states of mind, and perceived health. In particular, the mindfulness facets of *acting with awareness* and *nonreactivity to inner experience* were consistently related to positive aspects of subjective wellbeing. In addition, *describe* (the act of identifying and describing thoughts and feelings) was significantly related to positive states of mind.

Another study (Jimenez, Niles, & Park, 2010) also identified a significant relationship between dispositional mindfulness and positive emotion, self-acceptance and mood regulation expectancies. They identified that the relationship between mindfulness and depression was mediated by the three previously mentioned variables (positive emotion, self-acceptance and mood regulation expectancies). In addition, it was identified that the relationships between mindfulness and depressive symptoms, mood regulation expectancies and self-acceptance, were mediated by positive emotion. The authors suggest that the relationship between mindfulness and positive affect is unexpected as the core concepts of mindfulness, as promoting conscious awareness and attention and non-judgement, would be expected to reduce negative affect but not necessarily increase positive affect.

Dispositional Mindfulness is Related to Reduced Negative Affect Reactivity

A considerable number of mood-induction studies have focussed on the relationship between dispositional mindfulness and affect. Of the eleven mood-induction studies that were identified, nine included assessment of affective reactivity. Overall, there appears to be a reduction of negative affect reactivity due to dispositional mindfulness. For example, Brown et al. (2012) found that in response to a psychosocial stressor task, more mindful individuals showed a similar, but consistently lower, negative affective reactivity profile to the low mindfulness group. Similarly, they showed a stable profile of negative affectivity to a neutral task, whereas less mindful participants showed more variability in negative and anxious affect. The reduced negative affect reactivity and quicker recovery profiles of more mindful participants were observed even when controlling for other factors which correlated with affective reactivity; namely perceived stress, anxiety and negative affect. Contrary to Brown et al.'s finding of enhanced recovery, Diaz et al. (2014) did not find a difference in short-term recovery based on dispositional mindfulness levels. However, it was found that enhanced long-term recovery, measured by fewer intrusive thoughts over the recovery period, was identified in participants with higher levels of mindfulness. The authors suggest that these results are in line with previous research identifying a relationship between mindfulness and reduced rumination.

Arch and Craske (2010) also identified that more mindful participants experienced less negative affective reactivity after a hyperventilation stressor task. However, this effect was found only amongst those participants with higher anxiety sensitivity. The finding was not evident for participants with low anxiety sensitivity. Furthermore, Arch and Craske did not find evidence of an association of dispositional mindfulness with negative affective reactivity after a relaxation task, though there was an association with self-reported psychological distress. Creswell, Pacilio, Lindsay and Brown (2014) also identified some

variation of reactivity based on dispositional mindfulness. While Creswell and colleagues found that brief mindfulness meditation training reduced self-reported stress during a stressor task, which did not significantly differ based on the level of trait mindfulness. They identified that participants with low levels of mindfulness showed the largest affective reactivity during a stressor task. This research suggests that dispositional mindfulness may reduce negative affect reactivity, but not to a significantly lower level; or it may interact with individual factors, such as anxiety sensitivity.

One study (Barnes et al., 2007) examined the association between mindfulness and styles of relating and coping within a romantic relationship. They identified that more mindful participants reported less affective reactivity to the relationship conflict task. In addition, the more mindful participants showed lower levels of affective reactivity at pre-task as well as post-task. The authors suggest that these findings support the previous research, which highlights an inverse relationship between trait mindfulness and psychological distress.

The relationship between specific facets of mindfulness and negative affect reactivity has also received significant attention in the literature. For example, Ostafin, Brooks and Laitem (2014) found that more mindful participants showed less negative affective reactivity after a stressor task. In addition, the *nonjudging of experience*, *acting with awareness* and *nonreactivity to inner experience* facets of mindfulness significantly and negatively correlated with post mood-induction negative affect. They also found partial mediation between two specific factors of mindfulness (*nonjudging of experience*, and *acting with awareness*) and anxiety. These findings were confirmed in a second study and support the relationship between mindfulness and reduced affective reactivity. Furthermore, their mediation analyses suggest that reduced affective reactivity mediates the relationship between mindfulness and anxiety. Bullis et al. (2014) also investigated specific facets of mindfulness. They suggest that higher levels on the *acting with awareness* facet of mindfulness predicted less anxiety during

a stressor task. Further, Bullis et al. found that higher levels on the *observing* factor of their mindfulness measure, suggesting greater awareness and attendance to bodily sensations, was associated with more symptoms of panic, and symptoms of greater severity.

Increased negative affect identification. Fogarty et al. (2015) identified an increased ability to differentiate negative emotion in the more mindful group, when they completed an emotional task first. Differentiating emotions refers to the ability to identify between emotions of similar valence. Rather than all good emotions, or all bad, there would be different emotions of each valence identified. Based on previous research, it was predicted that more mindful participants would exhibit greater emotion differentiation, though the authors cannot conclusively explain why the neutral task first participants showed non-significant differences based on mindfulness levels.

Reduced cognition reactivity. Raes et al. (2009) identified a negative relationship between dispositional mindfulness and cognitive reactivity, suggesting that people higher in dispositional mindfulness display lower levels of cognitive reactivity, and potentially therefore also lower levels of depressive symptoms. In addition, Kiken and Shook (2014) found that more mindful participants reported less negative rumination. The authors also identified that brief mindfulness meditation training resulted in fewer negatively-valenced cognitions and an increase in the number of non-valenced cognitions. Though, brief mindfulness training did not increase the number of positively-valenced cognitions. Similarly, Fogarty et al. (2015) did not find a significant difference in differentiation of positive affect due to level of mindfulness in their mood-induction task.

Dispositional Mindfulness is Related to Reduced Physiological Reactivity

Six experimental studies and three questionnaire studies included measures of physiological reactivity. Physiological variables measured in the studies included salivary cortisol, salivary alpha amylase and heart rate variability. A number of studies found decreased salivary cortisol reactivity in participants with higher levels of dispositional mindfulness. For example, in one study the reactivity profile was similar between low and high mindful participants; however, more mindful participants showed overall lower levels of cortisol and slower reactivity during a stressor task (Brown et al., 2012). Moreover, during a control task more mindful participants showed quicker reactivity and reduction in cortisol.

Another study also found that participants with higher levels of mindfulness, and who had also completed brief mindfulness training, displayed reduced cortisol reactivity compared to participants with lower levels of mindfulness (Creswell et al., 2014). However, Creswell and colleagues did not identify a difference in blood pressure readings during the stressor task between low and high mindful participants. Laurent et al. (2015) also found an interaction between mindfulness training and trait mindfulness levels; whereby, the use of mindfulness training during a stressor task did not show a significant effect regarding cortisol or saliva alpha amylase reactivity unless dispositional mindfulness was included as a moderating factor. This suggests that the application of mindfulness training during a negative mood-induction task only shows benefit for those participants with higher levels of dispositional mindfulness.

Heart rate variability and blood pressure research have shown similar benefits of dispositional mindfulness regarding physiological wellbeing. Mankus, Aldao, Kerns, Mayville and Mennin (2013) identified a correlation between level of dispositional mindfulness and heart rate variability; however, this association was only evident in individuals with high levels of generalised anxiety symptoms. There was no significant

association between mindfulness and heart rate variability for individuals with low levels of generalised anxiety symptoms. Another study (Tomfohr, Pung, Mills, & Edwards, 2015) identified lower levels of blood pressure and interleukin-6 (an inflammatory marker) in more mindful participants.

Interestingly, there may be gender effects regarding the effect of dispositional mindfulness on physiological reactivity. Fogarty et al. (2015) found that higher levels of mindfulness were associated with lower heart rate during a neutral task, and greater heart rate variability during a stressor task. This finding was only identified for men, not women. In fact, in their sample women with lower mindfulness showed greater heart rate variability. Furthermore, the significant results for men only occurred when the participants completed the stressor task first.

Specific facets of dispositional mindfulness have been identified in the research as showing greater association to physiological reactivity. For example, Daubenmier et al. (2014) identified a negative correlation between the cortisol awakening response (CAR) and the *describe* and *accept* facets dispositional mindfulness in women. Bullis et al. (2014) also found that participants with higher levels of the *describing* facet of mindfulness showed lower heart rate during recovery from their stressors task. Furthermore, Laurent, Laurent, Hertz, Egan-Wright and Granger (2013) identified gender differences regarding the particular mindfulness facets related to physiological reactivity in their study. For example, greater cortisol reactivity during a couple conflict task was found in women with higher levels of the *nonreactivity to inner experience* dimension of mindfulness. The same conflict task resulted in reduced cortisol reactivity in men who had higher levels of the *describing* facet of mindfulness. The authors suggest that these findings are in line with typical gender differences regarding differential coping with emotive situations; whereby women have

difficulty disengaging from post-conflict rumination and men typically show difficulty identifying and discussing emotions.

Improved physiological recovery. Two studies also identified differences in the physiological recovery profiles depending upon level of dispositional mindfulness. For example, Brown et al. (2012) found quicker physiological recovery, identified as quicker reduction of salivary cortisol, in more mindful participants during a control task. This effect was still observed when controlling for other factors such as perceived stress, anxiety and negative affect. Fogarty et al. (2015) also identified quicker recovery for participants with higher dispositional mindfulness on a measure of heart rate variability. However, this effect was only found for men, not women.

Mindfulness-Based Treatment Influences Both Negative and Positive Affect

Five studies specifically investigated mindfulness-based treatment, dispositional mindfulness, and changes in positive or negative emotion. While the specific focus of these five studies varied, each investigated the effects of mindfulness-based treatment on subjective wellbeing. The majority of treatment-based studies focussed on reducing negative factors, particularly related to depression or anxiety symptoms; though two of the studies also investigated positive factors.

Reduced negative affect was a key finding for three of the articles. For example, Orzech, Shapiro, Brown and McKay (2009) implemented an intensive, four-week mindfulness training program for adults. They identified a reduction in negative affect (reported as a decrease in anxiety and depressive symptoms), as well as an increase in mindfulness and decentering, and acceptance from pre-treatment to follow-up. Though the

reduction in depression scores was not significant, the authors suggest this may had been due to low level of depressive symptoms at pre-treatment. However, change in mindfulness was associated with better treatment outcome, including reduced depressive symptoms and increased wellbeing. Greeson et al. (2015) also provided an eight-week mindfulness-based stress reduction program to members of the community. At post-treatment, they found a significant reduction in negative affect (reported as a decrease in depressive symptoms); a result which was significant even after controlling for baseline depression, as well as age and gender which are known to correlate with depressive symptoms. They also identified a greater reduction in depression for individuals with higher pre-treatment depression scores. However, the reduction in depression scores was not related to baseline dispositional mindfulness levels, suggesting that mindfulness level did not influence treatment efficacy. Nevertheless, Greeson and colleagues did find changes in mindfulness, and experiences of spirituality, explained the changes in depressive symptoms. Raes et al. (2009) also compared an eight-week mindfulness-based cognitive-therapy program to a control group and found significant reductions in negative affect (reported as a reduction of depressive symptoms) from pre- to post-treatment. They also identified a significant decrease in cognitive reactivity, a variable that the authors found to be negatively correlated with dispositional mindfulness, following mindfulness-based treatment. Similar to Greeson and colleagues, Raes et al. found that the relationship between group (mindfulness versus control) and cognitive reactivity was mediated by change in mindfulness.

As previously discussed, mindfulness-based treatments have been associated with a decrease in negative affect. Yet, the effect of mindfulness-based treatment on positive factors has been the focus of few studies. Orzech et al. (2009) identified a significant increase in wellbeing and resilience following mindfulness-based treatment. However, the increase occurred for both the mindfulness and control groups. Post-hoc analyses identified that an increase in mindfulness or acceptance was associated with an increase in wellbeing. As

mindfulness significantly increased in the mindfulness-training group, compared to the control, this suggests that mindfulness-based training results in increased wellbeing. This is considerably different to the findings of Jislin-Goldberg et al. (2012) who found a decrease in trait-like positive affect for their mindfulness and control groups, from pre- to post-treatment. Furthermore, trait-like positive affect only correlated with mindfulness at the post-treatment time point. This suggests the need for further research into dispositional mindfulness and positive affect, and perhaps also a revision of positive affect measures (or longer measurement time points).

The effect of increases in dispositional mindfulness after treatment has been specifically investigated regarding positive reappraisal. Garland, Gaylord and Fredrickson (2011) found that dispositional mindfulness was positively correlated with positive reappraisal at pre-treatment, and change in positive reappraisal predicted change in dispositional mindfulness. The authors found this relationship to be bidirectional, with changes in mindfulness also predicting change in positive appraisal. Garland and colleagues suggest this to be an upward spiral effect between mindfulness and positive reappraisal, whereby they equally enhance one another. These results suggest that mindfulness may improve positive processes involved in coping.

Mindfulness and Mechanisms of Change

A number of mechanisms of change regarding dispositional mindfulness have been investigated in the literature, including rumination, cognitive reactivity and emotion regulation. Five studies specifically investigated the mechanisms through which mindfulness may enhance subjective wellbeing. For example, two studies (Coffey & Hartman, 2008; Kiken & Shook, 2014) investigated the relationship between dispositional mindfulness and rumination. Kiken and Shook (2014) identified significant positive correlations between

mindfulness and positive rumination. Furthermore, mindfulness was a significant predictor of negative rumination, after controlling for state negative affect. The authors suggest that mindfulness level may play an important role in the presence or regulation of negative rumination patterns. The authors also suggest that mindfulness may reduce negatively biased cognitions, but not impact positively biased cognitions.

Coffey and Hartman (2008) also investigated the relationship between dispositional mindfulness and rumination, along with two other potential mechanisms of change: emotion regulation and nonattachment. Coffey and Hartman found that emotion regulation was positively associated with mindfulness, with higher mindfulness levels resulting in a better ability to regulate negative emotions. They also found that mindfulness was associated with ruminations and nonattachment.

Two studies (Pepping, O'Donovan, Zimmer-Gembeck, & Hanisch, 2014; Prakash et al., 2015) specifically investigated the importance of emotion regulation regarding the relationship between dispositional mindfulness and psychological distress. Prakash and colleagues (2015) found that emotion regulation skills provided full mediation of the relationship between dispositional mindfulness and perceived stress. This research suggests that the ability to effectively regulate emotion mediates the relationship between mindfulness and perceived stress regardless of age group. Furthermore, Pepping et al. (2014) found indirect relationships between mindfulness and symptoms of psychological distress, such as anxiety and depression, through two facets of emotion regulation, *non-acceptance of emotions* and *lack of access to strategies* in an undergraduate sample, and *lack of access to strategies* only in a clinical sample; as well as a main effect of mindfulness on symptoms of distress in the clinical sample. However, the lack of access to emotion regulation strategies can explain a significant proportion of psychological distress within a clinical sample, and only if they reported low levels of mindfulness. The authors suggest that difficulty accepting emotions,

judgement for experiencing emotion, and a maladaptive response to emotion are they key factors at play within the undergraduate sample.

The role of cognitive factors were examined in one study (Hanley, Garland, & Black, 2014). Hanley and colleagues (2014) investigated mindful reappraisal within a sample of meditators and found a significant relationship between the level of self-reported mindfulness and use of mindful reappraisal. Furthermore, they found that those participants who reported more mindfulness meditation practice also reported higher prevalence of the use of mindful reappraisal. The authors suggest that greater use of mindful reappraisal correlates to positive subjective wellbeing; therefore aligning with the current literature suggesting a positive relationship between trait mindfulness levels and subjective wellbeing. However, the authors note that almost half of their sample did not report using mindful reappraisal techniques. Therefore, there are other mechanisms through which mindfulness may play a role in reducing psychological distress.

Discussion

Research on dispositional mindfulness has grown over the past decade. However, there is limited research that has investigated the role of dispositional mindfulness in different age groups across the adult lifespan, with only three studies (Bränström et al., 2011; Prakash et al., 2015; Raes et al., 2013) specifically examining dispositional mindfulness across a range of adult age groups. These three studies identified a positive correlation between dispositional mindfulness and age; further, Raes and colleagues found that mindfulness partially mediates the relationship between age and negative affect. Findings from these few studies suggest that there may be changes in dispositional mindfulness and the relationship with affect as people age, and further investigation is required. This is particularly interesting given that research suggests that negative affect decreases and positive affect increases with age (Mroczek &

Kolarz, 1998). In this review, however, due to the limited number of studies focussing on multiple age groups within the spectrum of adulthood, conclusions about the relationship with age and changes that might occur with age could not be made. Further research regarding dispositional mindfulness and ageing is needed.

The research consistently demonstrated that the higher levels of dispositional mindfulness were related to lower levels of psychological distress. Specifically, dispositional mindfulness was found to be negatively correlated with anxiety, depression, perceived stress and negative cognitions. Furthermore, dispositional mindfulness was positively correlated with measures of subjective wellbeing including, state and trait positive affect, vitality, perceived health and self-acceptance, among other variables. Dispositional mindfulness was also found to relate to reduced physiological reactivity, including reduced cortisol levels and slower cortisol reactivity; lower heart rate variability in individuals with high generalised anxiety; and lower blood pressure and interleukin-6 levels.

Increased dispositional mindfulness was related to lower negative affect reactivity after stressor tasks, better coping during romantic conflict situations, reduced cognitive reactivity, and sometimes enhanced negative affect identification. Furthermore, mindfulness-based treatments typically resulted in reduced negative affect (reported as decreased anxiety and depression symptoms) and increased positive affect (reported as increased wellbeing or positive reappraisal skills). Creswell et al. (2015) suggested that dispositional mindfulness and mindfulness training might equally foster resilience to stress. However, the studies investigating mindfulness-based training included in this review have highlighted that the amount of change in mindfulness is an important factor (Raes et al., 2009), and affects treatment outcome (e.g. Garland et al., 2011). Therefore, the baseline levels of dispositional mindfulness may be important for mindfulness-based treatment outcome. While there is promising research that dispositional mindfulness impacts on positive and negative affect, and

the importance of dispositional mindfulness regarding mindfulness-based treatment outcome; a full review of the impact of mindfulness on psychopathology, psychological distress, or treatment outcome is outside the scope of this review. Furthermore, it is important to note that the treatment studies included in this review consisted of only research on mindfulness, which also assessed affective and physiological reactivity.

It was found that mindfulness enhanced subjective wellbeing, and reduced psychological distress, through a number of mechanisms, including: emotion regulation, ruination, and mindful reappraisal. A potential direct effect of dispositional mindfulness on psychological distress was also found. No studies involving mindfulness-based treatment investigated the relationship between treatment and physiological reactivity; therefore, only affective reactivity was discussed.

Finally, dispositional mindfulness was found to be related to enhanced subjective wellbeing; however, being a practitioner of mindful meditation provided greater psychological benefits. Replicating previous findings, Keune and Forintos (2010) found differences in levels of dispositional mindfulness between meditators and non-meditator samples. Differences in dispositional mindfulness were also identified between other groups; for example, Arch and Craske (2010) also identified a difference in mean level of dispositional mindfulness between anxious and non-anxious individuals. While the non-anxious group reported higher levels of mindfulness, both groups displayed a normal distribution of scores.

Strengths and Limitations

This review was conducted to assess to the role of dispositional mindfulness in physiological and psychological reactivity across the lifespan. A significant limitation of the

literature is the lack of research investigating dispositional mindfulness across multiple age groups. The current findings are helpful to establish the general relationship between dispositional mindfulness and ageing. However, comparisons across adult age groups cannot be made from these general results and findings related to ageing need to be interpreted with caution.

The current study limited the search terms to include only dispositional or trait mindfulness, as a means of capturing studies that specifically investigated this variable. An overwhelming amount of literature is available that uses the term mindfulness; however, as the aim of the current study was to investigate the impact of trait mindfulness on affective and physiological reactivity throughout adulthood, these limitations were considered feasible. In addition, search terms were not designed to include a complete review of the impact of mindfulness and other factors of distress; therefore conclusions need to be interpreted with this in mind.

Furthermore, the majority of studies included in this review utilised either the Mindfulness Attention Awareness Scale (MAAS; Brown and Ryan, 2003) or the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). A number of studies highlighted the importance of awareness components of mindfulness in their results. For example, Bränström et al. (2011) only found a significant difference between the age groups for the *acting with awareness* facet of mindfulness. In addition, Kiken and Shook's (2014) found significant results when using the MAAS; however, these results did not hold when using the FFMQ. Therefore a scale such as the MAAS, which focuses on the core concept of mindfulness of conscious awareness of, and attention to, the present moment (Brown & Ryan, 2003), may be valuable for future research to use. Therefore, utilisation of a measure of dispositional mindfulness that is supported by the literature in future research is pertinent.

Recommendations for future research

Although trait mindfulness has consistently shown to positively correlate with decreased psychological distress (e.g., Keune & Forintos, 2010), further research investigating the role of dispositional mindfulness and subjective wellbeing is required using multiple adult samples to allow for comparison of results across the lifespan. Furthermore, as dispositional mindfulness has also been found to positively correlate with enhanced subjective wellbeing and positive traits (e.g., Jislin-Goldberg et al., 2012), further investigation into the potential role of dispositional mindfulness and the reduced psychopathology and increased rates of positive affect across the adult lifespan is required. In sum, a study investigating the role of dispositional mindfulness in affective and physiological reactivity and recovery across adulthood is needed.

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Appendix A

Table 1

Studies Included in the Review, Listed by Study Design

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Arch & Craske, 2010	Anxiety disorders group: USA, n = 46, Mean age = 33.7 (SD = 11.0), 39% male Control group: USA, n = 44, Mean age = 36.2 (SD = 12.8), 36% male	Experimental design; Hierarchical multiple regression model	Mindfulness Attention Awareness Scale (MAAS)	Anxiety (ASI, MASQ, RRAQ), Psychological distress (SUDS), positive and negative affect (PANAS)
Brown et al., 2012	USA, n = 44, Mean age = 19.68 (SD = 1.36), 18% male	Experimental design; Restricted maximum likelihood mixed models	Mindfulness Attention Awareness Scale (MAAS)	Psychological distress (PSS, POMS), positive and negative affect (PANAS), anxiety (TMAS, FNE), physiological reactivity (salivary cortisol)
Bullis et al., 2014	USA, n = 48, Mean age = 29.10 (SD = 8.32), 100% male	Experimental design; Hierarchical regression model	Kentucky Inventory of Mindfulness (KIMS)	Anxiety (ASI, STAI-T, STAI-B, DSQ), psychological distress (SUDS), physiological reactivity (heart rate)
Creswell et al., 2014	USA, n = 66, Mean age = 21.70 (SD = 2.91), 59% male	Experimental design; Mixed effect linear models and *t*-tests	Mindfulness Attention Awareness Scale (MAAS)	Perceived stress (VAS)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Diaz et al., 2014	Spain, n = 76, Mean age = 23.1 (SD = 3.7), 0% male	Experimental design; Multivariate analysis of variance and multiple regression analyses	Five Facet Mindfulness Questionnaire (FFMQ)	Subjective wellbeing (MH5, single-item measure of subjective distress, IES), positive and negative affect (PANAS)
Fogarty et al., 2015	New Zealand, n = 80, Mean age (and SD) not reported, 50% male	Experimental design; Mixed model analysis of covariance, univariate analysis of variance	Five Facet Mindfulness Questionnaire (FFMQ)	Positive and negative affect (PANAS), physiological reactivity (heart rate, heart rate variability)
Laurent et al., 2013	USA, n = 100 heterosexual couples, Mean age = 21.31 (SD = 6.12), 50% male	Experimental design; dyadic growth curve modelling in HLM	Five Facet Mindfulness Questionnaire (FFMQ)	Depression (CES-D), anxiety (BAI), subjective wellbeing (WHO-WB), physiological reactivity (salivary cortisol)
Laurent et al., 2015	USA, n = 101 heterosexual couples, Mean age = 21.31 (SD = 6.12), 50% male	Experimental design; growth curve modelling in HLM	Five Facet Mindfulness Questionnaire (FFMQ)	Physiological reactivity (salivary cortisol, salivary alpha amylase)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Ostafin et al., 2014	Study 1: Country not specified, n = 80, Mean age = 20.05 (SD = 2.43), 53% male Study 2: Country not specified, n = 71, Mean age = 19.68 (SD = 3.32), 59% male	Experimental design; Correlation, repeated measures and mediation analyses	Five Facet Mindfulness Questionnaire (FFMQ)	Negative affect (VAS), anxiety (BSI)
Garland et al., 2011	USA, n = 339, Mean age = 45.7 (SD = 13.4), 25% male	Treatment design; correlation and meditational analysis	Five Facet Mindfulness Questionnaire (FFMQ)	Psychological distress (PSS), emotion regulation (CERQ)
Greeson et al., 2015	USA, n = 322, Mean age = 45 (SD = 12.2), 26% male	Treatment design; *t*-tests, and hierarchical multiple regression analyses	Cognitive and Affective Mindfulness Scale-Revised (CAMS-R)	Anxiety and depression (HADS), spirituality (DSES)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Orzech et al., 2009	USA, n = 69, Mean age = 53.3 (SD not reported), 29% male	Treatment design; *t*-test, correlation and multilevel modelling analysis	Mindful Attention Awareness Scale (MAAS)	Subjective wellbeing (POMS, SCS, EQ, AAQ-II, SWLS), positive and negative affect (PANAS)
Jislin-Goldberg et al., 2012	Study 1: Israel, n = 174, Mean age = 24 (SD = 2.7), 24% male Study 2: Israel, n = 51, Mean age = 25 (SD = 4.3), 35% male	Questionnaire and treatment design; Correlation and analysis of variance	Mindful Attention Awareness Scale (MAAS)	Subjective wellbeing (MEQ, SMS), positive affect (PANAS)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Raes et al., 2009	Study 1: Country not specified, n = 164, Mean age = 19.21 (SD = .91), 21% male Study 2: Control group - Belgium, n = 21, Mean age = 40.43 (SD = 8.59), 10% male; Mindfulness group – Belgium, n = 18, Mean age = 43.06 (SD = 11.61), 22% male	Questionnaire and treatment design; Correlation, analysis of variance and meditational analyses	Kentucky Inventory of Mindfulness Skills extended version (KIMS-E)	Depression (LEIDS-R, BDI, MDQ)
Barnes et al., 2007	Study 1: USA, n = 89, Mean age = 19.3 (SD not reported), 27% male Study 2: USA, n = 60 heterosexual couples, Mean age = 20.05 (SD not reported)	Questionnaire and experimental design; Correlation and multiple regressions	Mindful Attention Awareness Scale (MAAS)	Subjective wellbeing (SCS-b, POMS)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Kiken and Shook, 2014	Study 1: Country not specified, n = 159, Mean age = 20.26 (SD = 4), 41% male Study 2: Country not specified, n = 102, Mean age = 21 (SD = 3.73), 35% male	Questionnaire and experimental design; Correlation, *t*-test and analysis of variance	Mindful Attention Awareness Scale (MAAS) and Five Facet Mindfulness Questionnaire (FFMQ)	Psychological distress (RRS), subjective wellbeing (RPA), positive and negative affect (PANAS)
Bränström et al., 2011	Sweden, n = 382, Age range = 18-60 (Mean and SD not reported), 41% male	Questionnaire design; Correlation and regression analyses	Five Facet Mindfulness Questionnaire (FFMQ)	Anxiety and depression (HADS), subjective wellbeing (PSOMS, PSS, two-item measure of perceived health and quality of life)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Coffey and Hartman, 2008	Sample 1: Country not specified, n = 197, Mean age = 18.9 (SD = 0.94), 36% male; Sample 2: Country not specified, n = 249, Mean age = 18.75 (SD = 1.2), 34% male	Questionnaire design; Correlation and structural equation modelling	Mindful Attention Awareness Scale (MAAS)	Subjective wellbeing (TMMS, LI, RRQ), Depression and anxiety (BSI)
Daubenmier et al., 2014	USA, n = 43, Mean age (and SD) not reported, 0% male	Questionnaire design; Regression analyses	Kentucky Inventory of Mindfulness Skills (KIMS)	Anxiety (STAI-T), psychological distress (PSS, RRQ), negative affect (PANAS), physiological reactivity (salivary cortisol)
Hanley et al., 2014	Country not specified, n = 118, Mean age = 27.38 (SD = 12.78), 34% male	Questionnaire design; Analysis of variance, correlation, and multiple regression analyses	Mindful Attention Awareness Scale (MAAS)	Subjective wellbeing (WHO-5, three-item measure of mindful reappraising coping; WHO-5), anxiety and depression (DASS-21)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Jimenez et al., 2010	USA, n = 514, Mean age = 18.8 (SD not reported), 38% male	Questionnaire design; Correlation and structural equation modelling	Freiburg Mindfulness Inventory (FMI) *	Depression (CES-D), subjective wellbeing (NMR-15, mDES, PWS)
Keune and Forintos, 2010	Meditators group: Hungary, n = 30, Mean age = 24.6 (SD = 3.7), 50% male Non-meditators group: Hungary, n = 30, Mean age = 25.8 (SD = 4.8) 50% male	Questionnaire design; Correlation and *t*-tests	Mindful Attention Awareness Scale (MAAS)	Positive and negative affect (PANAS-X), anxiety (BAI), subjective wellbeing (SVS)
Kiken and Shook, 2012	Country not reported, n = 181, Mean age = 19.4 (SD = 3.4), 59% male	Questionnaire design; Correlation and structural equation modelling	Mindful Attention Awareness Scale (MAAS)	Psychological distress (DAS, LMSQ, FES), anxiety (BAI), depression (BDI-II), negative affect (PANAS)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Lyvers et al., 2014	Australia, n = 153, Mean age = 21.29 (SD = 3.11), 43% male	Questionnaire design; Correlation, hierarchical regression and multivariate analysis of covariance	Mindful Attention Awareness Scale (MAAS)	Anxiety and depression (DASS-21), subjective-wellbeing (NMRS, FSBS, BIS-11, TAS-20, AUDIT)
Mankus et al., 2013	USA, n = 67, Mean age = 20.17 (SD = 1.35), 49% male	Questionnaire design; Regression analysis	Mindfulness Attention Awareness Scale (MAAS)	Anxiety (GADQ-IV), physiological reactivity (heart rate variability)
Pepping et al., 2014	Study 1: Country not specified, n = 639, Mean age = 21.06 (SD = 6.24), 24% male Study 2: Country not specified, n = 55, Mean age = 39 (SD = 12.66), 0% male	Questionnaire design; Correlation and mediation analyses	Five Facet Mindfulness Questionnaire (FFMQ)	Psychological distress (DERS), anxiety and depression DASS-21), subjective wellbeing (OQ-45.2)

Table 1 continued

Author, year	Sample (country, size, age, gender)	Study design, Method of analysis	Dispositional mindfulness measure	Relevant psychological and physiological measures
Prakash et al., 2015	Young adults: USA, n = 50, Mean age = 23.6 (SD = 3.27), 36% male Older adults: USA, n = 48, Mean age = 65.4 (SD = 4.83), 35% male	Questionnaire design; Correlation and mediation analyses	Mindful Attention Awareness Scale (MAAS)	Psychological distress (PSS, DERS), subjective wellbeing (WBSI)
Raes et al. 2013	Multiple European countries, n = 07, Mean age = 43.5 (SD = 17.49), 35% male	Questionnaire design; Correlation and mediation analysis	Mindful Attention Awareness Scale (MAAS) and Kentucky Inventory of Mindfulness Skills (KIMS)	Personality traits (NEO-FFI), quality of life (WHOWOLD-BREF), negative affect (PANAS), anxiety (STAI), depression (BDI-II), psychological distress (RRS)
Tomfohr et al., 2015	USA, n = 130, Mean age = 21.7 (SD = 2.7), 44% male	Questionnaire design; Correlation and hierarchical regression analyses	Five Facet Mindfulness Questionnaire (FFMQ)	Psychological distress (PSS), depression (CES-D), physiological reactivity (blood pressure, interleukin-6)

Note: * only 7 items of the 14-item scale were used.

AAQ-II = Acceptance and Avoidance Questionnaire; ASI = Sensitivity Index; AUDIT = Alcohol Use Disorders Identification Test; BAI = Beck Anxiety Inventory; BDI/-II = Beck Depression Inventory; BIS-11 = Barratt Impulsiveness Scale; BSI = Brief Symptom Inventory; CERQ = Cognitive Emotion Regulation Questionnaire; CES-D = Center for Epidemiologic Studies Depression Scale; DAS = Dysfunctional Attitudes Scale; DASS-21 = Depression Anxiety Stress Scale, 21-item version; DERS = Difficulties in Emotion Regulation Scale; DSES = Daily Spiritual Experience Scale; DSQ = Diagnostic Symptoms Questionnaire; EQ = Experiences Questionnaire; FES = Future Events Scale; FNE = Fear of Negative Evaluation, brief version; FSBS = Frontal Systems Behaviour Scale; GADQ-IV = Generalised Anxiety Disorder Questionnaire; HADS = Hospital Anxiety and Depression Scale; IES = Impact of Events Scale; LEIDS-R = Leiden Index of Depression Sensitivity; LI = Linking Inventory; LMSQ = Looming Maladaptive Style Questionnaire; MASQ = Mini-Mood and Anxiety Symptom Questionnaire; mDES = Modified Differential Emotions Scale; MDQ = Major Depression Questionnaire; MEQ = Meditation Experience Questionnaire; MH5 = Short Form Health Survey; NMR-15 = Negative Mood Regulation Expectancies; NMRS = Negative Mood Regulation Scale; OQ-45.2 = Outcome Questionnaire; PANAS/-X = Positive and Negative Affect Schedule/extended version; POMS = Profile of Mood States; PSOM = Positive States of Mind Scale; PSS = Perceived Stress Scale; PWS = Psychological Wellbeing Scale; RPA = Responses to Positive Affect Questionnaire; RRAQ = Reactions to Relaxation and Arousal Questionnaire; RRQ = Rumination-Reflection Questionnaire; RRS = Ruminative Responses Scale short form; SCS = Self-Compassion Scale; SCS-b = Self-Control Scale; SMS = State Mindfulness Scale; STAI-B = Spielberger State-Trait Anxiety Inventory, state version; STAI-T = Spielberger State-Trait Anxiety Inventory, trait version; SUDS = Subjective Units of Distress; SVS = Subjective Vitality Scale; SWLS = Satisfaction with Life Scale; TAS-20 = Toronto Alexithymia Scale; TMAS = Taylor Manifest Anxiety Scale; TMMS = Trait Meta-Mood Scale, repair subscale; VAS = Visual Analogue Scale; WBSI = White Bear Suppression Inventory; WHO-5 = World Health Organisation Wellbeing Index; WHO-WB = World Health Organisation.; WHOQOL-BREF = World Health Organisation Quality of Life Assessment.

Appendix B

Table 2

Quality Assessment of Studies

Study	Participants well-defined*	% of individuals that refused to participate, excluded*	Outcomes measured in standard, reliable way*	Included other variables in the study	% of individuals lost to follow-up, dropped out*	Overall quality of study**
Experimental studies						
Arch and Craske (2010)	a	?	a	Yes	?	A
Barnes et al. (2007) (study 2)	b1	5%	b1	Yes	?	B1
Brown et al. (2012)	a	?	a	Yes	?	A
Bullis et al. (2014)	a	4%	a	Yes	?	A
Creswell et al. (2014)	a	1.37% (excluded)	a	Yes	4.11%	A
Diaz et a. (2014)	a	?	a	Yes	?	A
Fogarty et al. (2015)	b2	?	a	Yes	?	B2
Kiken and Shook (2014)	a	?	a	n/a	?	B1
Laurent et al. (2013	a	?	a	Yes	12.28%	A
Laurent et al. (2015)	a	?	a	n/a	11.40%	B1
Ostafin et al. (2014)	b1	?	a	Yes	?	A

Table 2 continued

Study	Participants well-defined*	% of individuals that refused to participate, excluded*	Outcomes measured in standard, reliable way*	Included other variables in the study	% of individuals lost to follow-up, dropped out*	Overall quality of study**
Treatment studies						
Garland et al. (2011)	a	?	a	Yes	?	A
Greeson et al. (2015)	a	?	a	Yes	44%	A
Jislin-Goldberg et al. (2012)	a	46.46%	b1	Yes	3.77% mindfulness group, 0% control group	A
Orzech et al. (2009)	b1	?	a	Yes	8% Group A, 24% Group B	A
Raes et al. (2009)	a	?	a	Yes	25% MBCT-group, n/a control group	A
Questionnaire studies						
Barnes et al. (2007) (study 1)	b1	?	a	Yes	7.87%	A
Bränström et al. (2011)	a	62%	b1	Yes	?	B1
Coffey and Hartman (2008)	a	?	a	Yes	?	A
Daubenmier et al. (2014)	b2	8.51%	a	Yes	?	B2

Table 2 continued

Study	Participants well-defined*	% of individuals that refused to participate, excluded*	Outcomes measured in standard, reliable way*	Included other variables in the study	% of individuals lost to follow-up, dropped out*	Overall quality of study**
Hanley et al. (2014)	b1	?	b1	Yes	?	B1
Jimenez et al. (2010)	b1	?	b1	Yes	?	B1
Jislin-Goldberg et al. (2012)	a	?	b1	Yes	?	A
Keune and Forintos (2010)	a	?	a	Yes	?	A
Kiken and Shook (2012)	a	?	a	Yes	?	A
Kiken and Shook (2014)	a	?	a	Yes	?	A
Lyvers et al. (2014)	a	?	a	Yes	?	A
Mankus et al. (2013)	a	?	a	Yes	?	A
Pepping et al. (2014)	a	?	a	Yes	?	A
Prakash et al. (2015)	a	?	a	Yes	?	A
Raes et al. (2009)	b1	?	a	Yes	?	A
Raes et al. (2013)	a	?	a	Yes	?	A
Tomfohr et al. (2015)	a	?	a	Yes	?	A

Note: Where multiple studies of differing design within the one paper were eligible for inclusion in the review, two ratings were given (e.g. questionnaire and treatment studies included in the same article are graded and reported separately under each respective heading).

* a = Criterion entirely fulfilled. b1 = Criterion mostly fulfilled. b2 = Criterion mostly unfulfilled. c = Criterion not at all fulfilled. ? = Criterion not described adequately to allow for classification. n/a = Not applicable.

** A = Low risk of bias. All or most of evaluation criteria from the checklist are fulfilled, conclusions of the study are though very unlikely to alter. B1 = Low-moderate risk of bias. Some evaluation criteria from the checklist are fulfilled, conclusions of the study are thought unlikely to alter. B2 = Moderate-high risk of bias. Some evaluation criteria from the checklist are fulfilled, conclusions of the study are thought likely to alter. C = High risk of bias. Few or no criteria fulfilled, conclusions of the study are thought very likely to alter.

Chapter Three

Study Two

Affective and physiological reactivity across adulthood: The role of dispositional mindfulness.

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Author contribution:

Ms Jacqueline Frei was responsible for the design of this study, collection, data entry, analysis and write-up of this paper. Dr Viviana Wuthrich, Dr Kerry-Ann Grant and Professor Ron Rapee provided research and statistical supervision and were involved in reviewing the manuscript.

Abstract

The ways in which individuals regulate their emotions and cope with adversity and hassles have been found to change over the course of the lifespan, whereby older adults may display more adaptive, proactive coping styles (Amirkhan & Auyeung, 2007) as well as enhanced emotion regulation skills (Mroczek & Kolarz, 1998). One concept that may explain the age-related affective change is dispositional mindfulness. The current study assessed the relationship between dispositional mindfulness and ageing, and whether mindfulness would predict affective and physiological reactivity to two mood-induction tasks. Ninety-nine participants (age range 18 to 90 years of age, $M = 45.78$, $SD = 19.93$) completed two mood-induction tasks, one positive- and one negative-mood task. Participants completed self-report measures of anxiety, depression, neuroticism, coping styles and dispositional mindfulness. Participants rated their state positive and negative affect, perceived stress, and also had heart rate variability measured, pre- and immediately post-task, and also 15-, 30- and 45-minutes post-task. Age was found to correlate with dispositional mindfulness and positive affect. Further, age was correlated with decreased negative affect and perceived stress. There were no age differences for physiological reactivity to the tasks. Dispositional mindfulness was found to be related to positive affect reactivity to both mood-induction tasks. While most research into dispositional mindfulness and affect has focussed on negative emotions, this study suggests that further investigation into positive affective reactivity and the ways in which it may be enhanced by trait mindfulness is warranted.

Emotion regulation is an important process, which is developed over an individual's lifespan. Emotion regulation specifically refers to a process used to reduce, increase or sustain particular facets (e.g. thoughts, feelings, behaviours or physiological responses) that constitute an emotion (Gross & Thompson, 2007). While individuals can employ different strategies to regulate their emotions, these strategies can vary in appropriateness and efficacy (Gross, 2001). Emotion dysregulation has been defined as the implementation of existing, inappropriate emotion regulation processes, such as techniques utilised in childhood but which are no longer helpful in adulthood (Werner & Gross, 2010). Further, emotion dysregulation and instability has been linked to psychopathology (Cicchetti, Ackerman, & Izard, 1995; Gruber, Kogan, Quoidbach, & Mauss, 2013; Marwaha, Parsons, & Broome, 2013; Mennin, Holaway, Fresco, Moore, & Heimberg, 2007; Skirrow. McLoughlin, Kuntsi, & Asherson 2009).

In fact appropriate regulation of both positive and negative affect may be equally important, as positive and negative affect have been found to be discrete constructs (Garland et al., 2010), and therefore differentially affect subjective wellbeing. For example, Watson, Clark and Tellegen (1988) identified deficits in regulating positive affect related to psychological disorders such as mania; whereas, deficits in regulating negative affect corresponds to disorders such as depression. Furthermore, Folkman and Moskowitz (2000), while reviewing current findings, suggest that positive emotions are experienced alongside negative situations in a myriad of situations, even during illness or bereavement. As positive and negative affect are two independent systems, rather than two opposite ends of a spectrum, it is pertinent to include both in studies of affectivity in ageing rather than inferring one from the absence of the other.

Research has suggested that emotion regulation processes evolve over the lifespan, including throughout adulthood (Gross et al., 1997; Levenson, 1999). For example, Gross and

colleagues found evidence for enhanced emotion regulation in older adults, particularly in regards to controlling emotion and (purposely) maintaining neutral affective states (Gross et al., 1997). Contrary to older literature regarding emotion regulation, which proposed diminished affective intensity with ageing (e.g. Labouvie-Vief & DeVoe, 1991), recent studies have identified that older adults do not experience blunted reactivity to stimuli, compared to younger adults. For example, Kisley, Wood, and Burrows (2007) found that older adults experienced the same levels of neuroaffective reactivity as younger adults. Moreover, research into affective reactivity in adulthood has shown differences in self-reported affect, which not only refute claims of diminished affective intensity in older age (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000); but also lends support for enhanced affect regulation with age. For example, a number of studies have identified higher levels of positive affect in older adults (Kessler & Staudinger, 2009; Mroczek & Kolarz, 1998). In addition, older adults also report lower levels of psychological distress and negative affect (Lawton, Kleban, & Dean, 1993; Mahoney, Segal, & Coolidge, 2015; Mroczek & Kolarz, 1998), and have reduced rates of anxiety and depression (Slade, Johnston, Oakley Browne, Andrews, & Whiteford, 2009), than younger adults. While some researchers suggest that reduced anxiety and depression levels are due to methodological errors (e.g., Bryant, Jackson, & Ames, 2008), others maintain it might be a product of the *positivity effect*, whereby older adults attend to and remember positive stimuli, rather than negative stimuli (Kennedy, Mather, & Carstensen, 2004; Reed & Carstensen, 2012). These developmental differences between younger and older adults provide further support that emotion reactivity and regulation continues to evolve throughout the adult lifespan.

Mindfulness is associated with a reduction in negative affect reactivity and negative rumination (Arch & Craske, 2006; Arch & Craske, 2010; Kiken & Shook, 2014; Ostafin, Brooks, & Laitem, 2014), enhancement of positive factors (Garland, Gaylord, & Fredrickson, 2011) and greater long-term recovery after stressors (Diaz, Jiménez, & Lopes, 2014).

Dispositional mindfulness has been defined as the trait of conscious attention to and awareness of the present moment (Brown & Ryan, 2003; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008). As emotion regulation involves four key components, "(1) pausing, (2) noticing, (3) deciding how controllable the emotion and situation are, and (4) acting in line with long-term goals" (Werner & Gross, 2010, p. 20), there is considerable conceptual overlap between the early (attention and cognition-based) steps of emotion regulation, and mindfulness. Furthermore, dispositional mindfulness has been associated with increased wellbeing and insight (Bränström, Duncan, & Moskowitz, 2011; Harrington, Loffredo, & Perz, 2014), negative emotion differentiation (Fogarty et al., 2015), and shows evidence of buffering physiological and affective reactivity to a stressor task (Brown, Weinstein & Creswell, 2012; Bullis, Bøe, Asnaani, & Hofmann, 2014; Feltman, Robinson, & Ode, 2009; Fogarty et al., 2015). De Frias and Whyne (2015) also found that increased mindfulness might be an important protective factor, shielding individuals from the effects of stress. Therefore, while mindfulness has been associated with an increase in positive factors and a decrease in negative factors associated with mental health and wellbeing, more research into its relationship with ageing is needed.

The paradox of ageing, whereby one's brain and body degenerate but enhanced emotion regulation and subjective wellbeing are also experienced, is a notable phenomenon (Mather, 2012). One theory that addresses this paradox is socioemotional selectivity theory (SST). This theory suggests that the increase in positive affect during ageing occurs due to a sense of foreshortened future (Carstensen, Isaacowitz, & Charles, 1999). According to Carstensen and Mikels (2005), older adults are aware of a foreshortened future and thus implement shorter-term goals. In addition, these goals will be emotionally meaningful, thereby enhancing emotion regulation at this stage of life (Carstensen & Mikels, 2005). SST also hypothesises that younger adults experience greater negative affect and lower positive affect than older adults, as their attention encompasses more negative stimuli and their goals

are focussed on gaining information or knowledge (Carstensen, 1995). This is further supported by strength and vulnerability integration theory which posits that a number of factors, including the awareness of a foreshortened future and enhanced emotion regulation skills, contribute to the increased subjective wellbeing in older adults (Charles, 2010).

A number of studies have identified differences in dispositional mindfulness by age (Baer et al., 2008; Mahoney et al., 2015). To date there, have only been two studies investigating the relationship between ageing, affect and trait mindfulness (Bränström et al., 2011; Raes, Bruyneel, Loeys, Moerkerke, & De Raedt, 2013). Raes and colleagues identified that the decrease in negative affect seen across adulthood was mediated by trait mindfulness. Bränström and colleagues identified an increase in mindfulness with age, particularly on the *acting with awareness* subscale, which showed significant differences between groups. However, both of these studies used a questionnaire design and therefore did not include active measures of affective reactivity.

The coping strategies used by individuals have also been a focus of investigation to explain the change in emotion regulation strategies over the lifespan. Coping strategies have been defined as disparate from emotion regulation due to their focus on negative affect, which occurs over longer periods of time (Gross & Thompson, 2007). While previous research suggested low levels of change in coping styles across the lifespan (McCrae, 1989), the current literature suggests that ageing results in decreased use of maladaptive coping strategies and increased use of adaptive coping strategies (Amirkhan & Auyeung, 2007). For example, Tadic, Wuthrich, Kangas and Rapee (2014) found higher levels of self-reported avoidant coping style in the younger adults. Additionally, increased use problem solving in older, compared to younger, adults has also been identified (Armstrong, Wuthrich, Knight, & Joiner, 2014). It has been proposed that some coping styles, such as emotion-focussed coping, may rely on the presence of other factors, such as the self-confidence to implement certain

coping style (Trouillet, Doan-Van-Hay, Launay, & Martin, 2011). Aldwin, Sutton, Chiara and Spiro (1996) also suggest that changes in coping may simply reflect the change in social position that occurs with ageing. Interestingly, increased mindfulness has been linked to reduced use of maladaptive coping strategies, such as avoidance (Weinstein, Brown, & Ryan, 2009). Therefore, coping styles may be an important factor to control for when investigating the relationship mindfulness, age and affect.

Neuroticism is a personality trait related to the experience of negative affect. It is assessed by a number of facets of negative affect, including worry, anxiety and frustration, and is associated with a number of psychopathology (Ormel et al., 2013). Neuroticism is associated with emotional instability and particular psychological disorders, such as anxiety and depression (Bowen, Balbuena, Leuschen, & Baetz, 2012). The decrease in neuroticism over adulthood, which parallels the decrease in anxiety and depression, has been found in a number of studies including cross-cultural investigations (Bleidorn et al., 2013); however, it has not been consistently identified. For example, Cobb-Clark and Schurer (2012) identified that emotional stability (the opposite of neuroticism), as assessed by a measure of personality traits, was stable over a four-year period in adults. Further, Allemand, Zimprich and Hendriks (2008) identified inconsistent changes in emotional stability, with no specific trajectory towards increasing or decreasing over the lifespan. Allemand and colleagues concur that this result is similar to the current literature on the topic. This suggests that neuroticism, which has considerable conceptual overlap with psychological distress, does not appear to change as a function of age and therefore may not be related to the decrease in anxiety and depression that is evidenced in older adults. Therefore, neuroticism may be another important factor to control for when investigating the relationship between mindfulness, age and affect.

Physiological reactivity to emotional cues has been shown to vary as a function of age. For example, older adults demonstrate a reduction in measures of heart rate and heart rate

variability (Antelmi et al., 2004; Takahashi et al., 2012). Though some research has identified cardiovascular reactivity may be linked to the type of stressful event, whereby negative experiences impacting multiple facets of life may result in greater cardiovascular reactivity in older adults (Wrzus, Müller, Wagner, Lindenberger, & Riediger, 2013). Research has also identified variation in salivary cortisol with ageing, whereby older adults show greater diurnal variation, but not increased cortisol overall (Heaney, Phillips, & Carroll, 2012). Research into the relationship between physiological markers and other facets of emotion has resulted in mixed results, often finding differential relationships between various emotions and physiological measures (e.g., Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). However, other factors may also account for some variation of physiological functioning by age group. For example, Steptoe and Wardle (2005) found that positive affect was related to increased health status. Also, Brown et al. (2012) found that cortisol levels during a psychosocial stressor task (the Trier Social Stress Task) were moderated by dispositional mindfulness. In addition, Fogarty et al. (2015) found partial support for more mindful participants exhibited greater heart rate variability, and superior recovery, to a mood-induction task. These findings provide support for a potential relationship between mindfulness and affective physiological reactivity to stress. Therefore further investigation of the role of mindfulness in physiological reactivity and recovery is required.

Mindfulness research has significantly increased in popularity over the past decade. However, the field is lacking research that adequately investigates the relationship between affective reactivity, physiological reactivity and mindfulness across the adult lifespan. As noted earlier, the current literature provides evidence that positive affect increases, whilst negative affect decreases, with age (Mroczek & Kolarz, 1998). In addition, the incidence of psychopathology such as anxiety and depression decreases over the lifespan (Slade et al., 2009). Similarly, mindfulness has been related to increased subjective wellbeing and reduced negative affect (see Keng, Smoski, & Robins, 2011). A small portion of affective research has

been conducted on a comprehensive range of adults encompassing younger, middle-aged and older adults (e.g., Windsor & Antsey, 2010). Only two studies to date (Bränström et al., 2011; Raes et al., 2013) have attempted to investigate the relationship between mindfulness, ageing and affect. However, some important variables that may affect affective reactivity were omitted in this study (for example, a measure of coping style was not included). For example, Raes and colleagues did not include positive affect or physiological reactivity in their investigation. In previous studies investigating differences in coping and emotion regulation across the lifespan, comparisons have been made between younger and older adults. Problematically, this leads to assumptions of the changes that occur in middle age. Therefore, a notable gap in the literature exists regarding an investigation into mindfulness and other important factors related to affective and physiological reactivity and regulation, across the complete adult lifespan.

The current study aims to investigate the interaction between dispositional mindfulness, and affective and physiological reactivity and recovery, across the adult lifespan. Firstly, it was hypothesised that mindfulness would increase with age. Secondly, in line with previous findings, it was expected that negative affective reactivity would decrease with age, and positive affect reactivity would increase with age. Finally, it was proposed that level of mindfulness would predict affective and physiological reactivity and recovery. As other factors, such as neuroticism, coping strategies, anxiety and depression have been shown to also change over the lifespan, these variables were also included in the present study to examine their relationship with mindfulness and age.

The specific aims for the study were:

1. To investigate the relationship between age and dispositional mindfulness.
   Specifically, it is hypothesised that there would be a significant positive correlation between age and dispositional mindfulness.

2. To investigate the relationship between age and affective and physiological reactivity and recovery. It was hypothesised that there would be decreased negative affect, perceived stress and heart rate variability, and increased positive affect, as age increased.
3. To identify the role of mindfulness alongside other predictors of affective and physiological reactivity and recovery. It was hypothesised that dispositional mindfulness would explain affective and physiological reactivity in both negative and positive mood-induction tasks over and above neuroticism, psychopathology and coping strategies.

Method

Participants

One hundred and one participants, ranging from 18 years to 90 years of age, were included in the study. The final sample consisted of 99 participants: 33 younger adults (M_{age} = 23.09, *SD* = 5.17, range = 18-34 years of age; 61% female), 33 middle-aged adults (M_{age} = 44.82, *SD* = 6.47, range = 35 – 58 years of age; 61% female) and 33 older adults (M_{age} = 69.42, *SD* = 6.29, range = 60-90 years of age; 61% female). Age groups were categorised similar to the ranges from previous research (e.g. Lawton, Kleban, Rajagopal, & Dean 1992). Participants were recruited through local newspapers and community noticeboards in Sydney, Australia; online advertisements on classified and social media websites; a Centre for Emotional Health community research participation register and the Macquarie University first year psychology research participation pool. Participants who were first year psychology students received course credit, and community members received $35 in cash in exchange for participation in the study. In the final sample, the younger adult group included the most students (n=21), compared to the middle-aged (n=6) and older adults (n=1) groups.

Participants were excluded from this study if they had a pre-existing heart condition, or high blood pressure (which was not managed by blood pressure medication). Macquarie University Human Research Ethics Committee approved this research.

Measures

Demographic measures. Demographic information, such as age, gender, education, occupation, income and ethnic identity was obtained using single-response and open-ended items.

Affective state measures. Affective state was measured using two self-report scales, The Positive and Negative Affect Schedule and a Visual Analogue Scale.

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was used to assess state levels of positive and negative affect. Participants were asked to rate how they felt at each time point by selecting a response for each of the twenty descriptor words (ten were positive mood descriptors and ten were negative mood descriptors) on a five-point Likert scale ranging from 0 (*very slightly or not at all*) to 4 (*very much*). Adequate internal consistency for the moment version of the PANAS has been reported with α= .98 for the Positive scale, and α= .85 for the Negative scale (Watson et al., 1988). In the current study similar values were shown: α= .91 and α=.86 for the Positive and Negative scales, respectively.

A Visual Analogue Scale (VAS) was created for this study and was administered at each time point. A horizontal line was produced with two anchor points, *Not at all stressed* on the left and *Extremely stressed* on the right end of the line. Participants were asked to mark an 'x' along the line to represent how stressed they were feeling *right now*. VAS scores for each time point were produced by measuring the distance from the left end of the line to the centre

of the 'x' marked by the participant. The distance, in millimetres, became the VAS score; where the greater the score, the higher the level of perceived stress as reported by the participant. The Visual Analogue Scale (VAS) was 123 millimetres in length however, scores were adapted from the original range of 0 to 123 millimetres in length to 0 to 100 millimetres, for ease of analysis; this was done by dividing each VAS score by 123 and multiplying by 100.

Psychological symptom measures. Anxiety and depression were assessed using the Depression, Anxiety and Stress Scale, Geriatric Anxiety Inventory and the Geriatric Depression Scale.

Depression, Anxiety and Stress Scale (DASS-42; Lovibond & Lovibond, 1995) is a 42-item scale that was used to measure depression, anxiety and stress in the younger and middle adult sample. The DASS-42 consists of 42 items that load on three factors: a depression scale, an anxiety scale and a stress scale. Each item is rated on a 4-point Likert scale ranging from 0 (*Did not apply to me at all*) to 4 (*Applied to me very much, or most of the time*). The DASS-42 has been shown to have good psychometric validity, with alpha coefficient reported as α=.91 for the depression subscale and α=.81 for the anxiety subscale (Lovibond & Lovibond, 1995). Very good internal consistency was also obtained in the current study with the depression scale obtaining α=.96 and the anxiety scale obtaining α=.89. For the purposes of this study, only the Depression and Anxiety subscales were analysed.

Geriatric Anxiety Inventory (GAI; Pachana et al., 2007) is a 20-item scale for measuring anxiety symptoms in older adults. Participants choose their responses using the dichotomous rating scale (*agree* or *disagree*) to identify whether they had experienced each

statement in the past week. The GAI has been reported to have a Cronbach's alpha of .91 (Pachana et al., 2007); the current study also obtained good internal consistency with α=.92.

Geriatric Depression Scale (GDS; Yeasavage et al., 1983) is a 30-item scale that identifies depressive thoughts and feelings and participants choose a response (*yes* or *no*) as to whether they identify with experiencing each statement in the past week. The GDS has been reported to have a Cronbach's alpha of .94 (Yeasavage et al., 1983). The current study also obtained very good internal consistency, with α= .94.

Coping measure. Coping strategies were assessed using the COPE Inventory.

COPE Inventory (COPE; Carver, Scheier & Weintraub, 1989) is a 60-item scale for assessing coping strategies. Participants rate how often they employ different coping strategies when experiencing stressful situations, using a 4-point Likert scale ranging from 1 (*I usually don't do this at all*) to 4 (*I usually do this a lot*). Items are summed into fifteen subscales, though only the following three subscales were used in this study: positive reinterpretation and growth, and active coping – to represent problem-focussed coping; and, behavioural disengagement – to represent avoidant-focussed coping. Previous research has shown adequate psychometric properties for these scales: active coping α= .62, positive reinterpretation and growth α= .68, behavioural disengagement α= .63 (Carver et al., 1989). The current study identified similar, though higher, results for internal consistency: active coping α= .80, positive reinterpretation and growth α= .77, behavioural disengagement α= .70.

Personality trait measures. Mindfulness and neuroticism were assessed using the Mindfulness Attention Awareness Scale and the Adult Temperament Questionnaire.

Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is a 15-item scale used to assess dispositional mindfulness and awareness, primarily the presence or absence of attention to and awareness of the present moment. Participants rated how frequently or infrequently they experience each statement on a 6-point Likert scale, ranging from 1 (*Almost Always*) to 6 (*Almost Never*). The MAAS has shown similar psychometric properties in multiple cultures (Christopher, Charoensuk, Gilbert, Neary, & Pearce, 2009). Further, in a community-based adult sample, ranging from 18 to 77 years of age, the reported alpha coefficient was α= .87 (Brown & Ryan, 2003). In the current study, internal consistency was also found to be α = .87.

Neuroticism was assessed using the Negative Affect subscale of the Adult Temperament Questionnaire (ATQ-NA; Evans & Rothbart, 2007), which consists of 26 items tapping negative affect regarding fear, sadness, discomfort and frustration, including reverse scored items. Each item was rated on an 8-point Likert scale ranging from 1 (*Extremely untrue of you*) to 7 (*Extremely true of you*), and an option of 8 (*Not Applicable*). Previous research has identified adequate internal consistency of α= .81. The current study found similar internal consistency, α= .87.

Physiological measure. Heart rate variability was included as a measure of physiological reactivity.

The standard deviation of peak-to-peak intervals of the arterial pulse waveform was used to represent heart rate variability (HRV). The standard deviation of the peak-to-peak intervals was chosen, as it is the simplest measure of overall heart rate variability that can be derived from heart rate data (Task Force of the European Society of Cardiology, 1996). Under stress, heart rate and blood pulse increase and the interbeat intervals, or distance between

waveform peaks, becomes smaller. As such, a smaller standard deviation is expected from stressful situations compared to non-stressful situations.

HRV was included as a biological measure of reactivity and measured using a piezo-electric pulse transducer (MP100, ADInstruments, Australia) and was recorded using LabChart software (version 7.0, 2004) via a 4-channel data acquisition system (PowerLab 4/30, ADInstruments, Australia). The sampling rate and recording range were set to 1000Hz and 500mV, respectively. Signals were checked for adequate clarity, with adjustments made to the placing and tightness of the transducer, where necessary, to obtain strong signal recordings. Recordings were standardised in length, taken at each time point for 3-minutes duration.

Mood-induction tasks. Two mood-induction tasks were conducted, one designed to elicit an increase in positive affect and one designed to elicit an increase in negative affect.

Positive task. The positive mood-induction task consisted of a 10-minute collection of video clips, similar to previous positive mood-induction research, which successfully induced amusement through the use of clips (Davidson, Ekamn, Saron, Senulis, & Friesen, 1990; Gross & Levenson, 1995; Mauss et al., 2005). A range of video clips were piloted by independent raters of varying ages and the clips that were rated the highest on amusement value across the sample were included in the final experiment. There were a total of 3 clips included: 1) Mr Bean (a comedian) visiting the dentist, 2) the Umbilical Brothers (comedians) conducting a mime show, and 3) laughing babies interacting with household pets. All clips provided positive mood-induction entertainment without using language; furthermore, all clips had a laughter track native to the video clips that was kept for the mood-induction task. The effects of one clip being perceived as more favourable than the other was counterbalanced by randomly presenting either the comedian block of clips first and then the

laughing baby videos block, or vice versa. The random allocation of video block order was counterbalanced separately for each of the three age groups. The clips were shown on a 21-inch computer monitor with the experimenter out of view behind a partition.

As a manipulation check, each participant provided a rating for how amusing they found the video clips altogether. Overall, the videos received a mean 'humorousness' rating of 6.82 (*SD* = 1.98) on a 10-point Likert-type scale from 1 (*Not funny at all*) to 10 (*Extremely* funny), with a middle-point of 5 (*Moderately funny*).

Negative task. The negative mood-induction task was a modified version of the Trier Social Stress Task (TSST; Kirschbaum, Pirke, & Hellhammer, 1993), which took 15 minutes for participants to complete. Participants were instructed to present a speech detailing why they were the best candidate for a job of their choice which could be voluntary or paid, and could be a position they've currently have, previously held or would like to obtain. Unlike the original TSST which gave participants 10 minutes to prepare their speech and then required participants to present their speech at a microphone in front of a panel of three confederates, participants in the current study were given five minutes to prepare for their speech and were told that their speech would be video recorded and a performance analysis would be conducted to assess how well they performed. Participants were notified that they could write notes to prepare but that they could not use the notes during their presentation. During the speech task, the participant stood in front of the experimenter who was seated. If a participant was silent for more than 10 seconds, or if participants finished their speech before the five minutes were up, standard prompts were used to encourage them to talk for the remaining time. After the preparation and presentation of the speech, participants were then asked to complete a mental arithmetic task whereby they were to serially subtract 13 from 1,022 as fast and accurately as possible. If the participant provided an incorrect response the experimenter

notified the participant that the answer was incorrect and to start again from the beginning (1,022). During both of the TSST tasks the experimenter displayed a neutral disposition, which provided limited to no social or emotional feedback to the participant, thereby increasing the difficulty of the tasks. At the end of the experiment, participants were debriefed and advised that no recording had actually been taken and therefore no performance analysis would be conducted.

Procedure

The experimental session for the current study consisted of two baseline readings, followed by the first task and subsequent post-task readings. Then the second task and subsequent post-task readings were conducted (see Figure 1). Participants completed the VAS and PANAS measures and had heart rate measurements taken at each time point. Additional questionnaires were administered between the two baseline time points, or after post-task readings.

Upon arrival to the laboratory, participants first provided written and informed consent. Baseline heart rate was then taken manually at the radial artery by the researcher (JF). Participants were confirmed to have a healthy resting heart rate of between 60 and 100 beats per minute prior to inclusion in the study (American Heart Association, 2015). The transducer was attached to the distal phalanx of the middle finger before the distal interphalangeal joint, on the participants' non-dominant hand. During recording of heart rate recording, participants were advised to sit upright with their weight centred, with their non-dominant hand relaxed and still, resting comfortably on their leg. Participants were advised to sit in the same position each time an HRV measurement was taken to avoid creating artefacts in the data (e.g. due to change in posture).

Participants then completed the pre-task questionnaire pack, which consisted of the demographic and medication questions, and anxiety and depression measures. Participants took approximately thirty minutes to complete the questionnaires; if participants could not answer all of the questionnaires within the thirty minutes they were able to complete the remaining measures between the recovery time points of the first task. Participants then had another baseline measure of their heart rate conducted, before being randomly allocated to either complete the positive or negative mood-induction task first. For the positive-mood induction task, participants were advised to watch the videos that came up on the screen in front of them. Participants were not given details about the task except instructions that they would not be tested on this task and they simply had to watch some video clips.

Immediately after each of the tasks, the participant completed the PANAS and VAS to assess levels of positive and negative affect, and current stress levels. The PANAS and VAS were also completed at 15, 30 and 45 minutes intervals post-tasks. At these same time points, additional post-task measures of heart rate were obtained after the participant had completed the self-report measures. Between the post-task and 15-minute post-task time points of the first task, participants were asked to complete the mindful awareness scale and the coping questionnaire. Participants were given magazines to read between the 15-, 30- and 45-minute post-task time points. The magazines used were deemed to be neutral stimuli (for example, they contained articles on interior design, gardening or cooking), ensuring participants did not experience affective or physiological reactivity outside of the mood-induction tasks.

After the PANAS and VAS were completed 45 minutes after the first task, participants were then asked to complete the alternate task (e.g., if a participant was allocated to complete the negative mood-induction task first, they would then complete the positive mood-induction task 45 minutes after the negative mood-induction post-task time point). When participants had completed the required questionnaires at each time point, they were given magazines with

neutral content (e.g. home and gardening magazines) to read until the next time point. Once both tasks were completed, as well as the four post-task time point measures for each task, participants were debriefed and the experiment concluded.

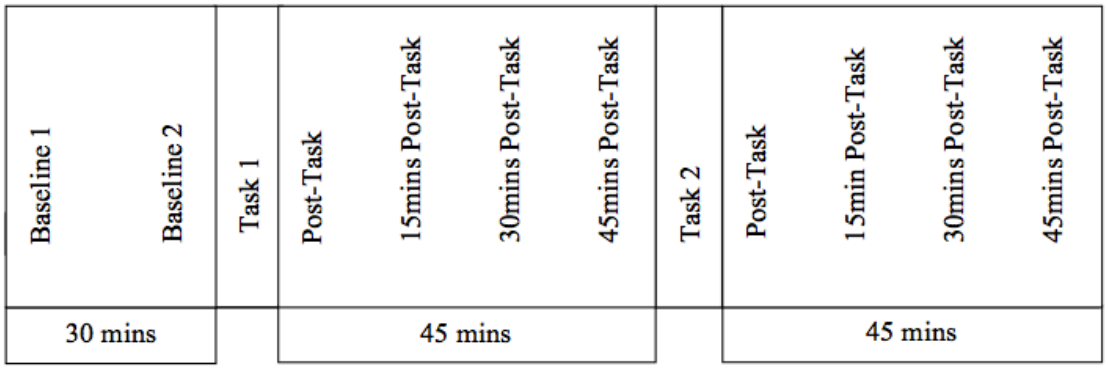

Figure 1. Timeline of the experimental session time points.

Data Scoring and Analysis

Two participants, both from the younger adult group, dropped out before the end of the experiment. Their data was excluded from analysis so that the resulting data analyses were based on the 99 participants who completed the experimental session.

Missing self-report questionnaire data was imputed by mean imputation using the subject's mean, where there was at least 80% valid data. Where a subscale consisted of four items, mean imputation was applied if three items had valid data.

The heart rate data from each participant was visually checked before cyclic measurements were computed offline using Kubios HRV (Version 2.2, University of Eastern Finland, Kuopio/Finland). Identification of the peaks of pulse waves has been previously used to identify and measure interbeat intervals (Wong et al., 2012). Using the systolic peak, raw data were used to compute the standard deviation of the interbeat intervals (HRV). As the

sample times were short (3 minutes' duration) no detrending method was required prior to computation of HRV. To normalise distribution, log transformation of the heart rate variability data was conducted (Simpson & Wicks, 1988). Heart rate data from four participants (one younger adult, one middle-aged adult and two older adults) were excluded due to identification of significant artefacts. This left a total of 95 participants with physiological data: 32 younger, 32 middle-aged, and 31 older adults.

Linear mixed model analyses were utilised to assess the data, as each of the outcome variables were continuous and therefore the correlation between the repeated measurements on the outcome variables could be accounted for. Furthermore, mixed models can accommodate missing data without requiring exclusion of cases with incomplete data (Bagiella, Sloan, & Heitjan, 2000). Finally, mixed models allow for the inclusion of multiple variables (in this case, dispositional mindfulness along with the other key variables of interest) within the same model. Mixed models were conducted to investigate hypothesis three, utilising an exploratory top-down strategy (based on the procedures outlined by West, Welch, & Galecki, 2007). Assumptions of normality were assessed for all variables prior to fitting of the models. Univariate outliers were dealt with by changing their score to the next highest score plus one unit (or, next lowest score minus one unit). The COPE behavioural disengagement subscale did not display significant linearity by age group (r= -.019). However, it was kept in the models as the literature suggests that avoidant coping skills typically differ by age group. Anxiety and depression composite scores were calculated, after identifying univariate outliers, by computing z-scores on log transformations of each variable. There were no multivariate outliers identified. Furthermore, for each model the Mahalanobis distance did not exceed the critical χ^2, collinearity statistics showed that the tolerance values were moderate to high and the variance inflation factors (VIF) were adequate (less than 4.0) suggesting that multicollinearity would not interfere with interpretation of the models.

Data were centred on the post-task time point prior to analyses. After fitting a full fixed-effect model, the random effects were refined and a random intercept model was identified as the best fit. Non-significant fixed effects were then removed in a step-wise fashion from the model. The model fit was compared using likelihood ratio tests. Assumptions of normality were not completely satisfied with the final models. Sensitivity analyses were conducted and identified limited change when outliers were transformed. Original models were kept for all outcome measures, with the exception of the VAS positive mood-induction model, for which the model with transformed outliers is reported. All analyses were conducted using SPSS (Version 21, IBM Corporation).

Results

Preliminary Analysis

Preliminary analyses of the demographic variables are provided in Table 1. A total of 99 participants were included in the full analyses, 33 participants from each age group. As can be seen in Table 1, there was no significant difference between groups according to the number of males. There was a significant difference for country of birth, with significantly more older adults born in Australia than the middle-aged and younger adults. The middle-aged and younger adults showed a similar proportion of participants born in Australia and overseas. There was a significant difference of marital status by age group with a higher incidence of marriage, de facto relationships, divorce and widow/widower as age increases. Similarly, there was a significant difference of income and education by age group, with higher levels of income and qualifications found in the middle-aged and older age groups. The differences between the younger, and middle-aged and older adults, on marital status, education and income are expected due to differences in stage of life. There was no significant difference between the age groups on current level of stress.

Analysis of variance was conducted to assess the effect of gender on the covariate and predictor variables. No significant difference was found by gender for each of the variables of interest (the four COPE subscales, mindfulness, neuroticism, depression z-scores, and anxiety z-scores), all *p's* > .05.

Table 1

Demographic and Current Stress Level Values for Each Age Group

	Younger Adults *n* (%)	Middle-Aged Adults *n* (%)	Older Adults *n* (%)	χ^2	*p*
Gender				.000	1.00
Male	13 (39)	13 (39)	13 (39)		
Female	20 (61)	20 (61)	20 (61)		
Total	33 (100)	33 (100)	33 (100)		
Marital status				53.056	<.001
Never married	29 (87.9)	8 (24.2)	2 (6.1)		
Married/De Facto	4 (12.1)	20 (60.6)	21 (63.6)		
Separated/Divorced/ Widowed	0 (0)	5 (15.2)	10 (30.3)		
Country born				7.692	<.05
Australia	18 (54.55)	14 (42.42)	25 (75.76)		
Other	15 (45.45)	19 (57.58)	8 (24.24)		
Highest qualification				31.051	<.000
High school or below	21 (63.64)	6 (18.18)	3 (9.09)		
Certificate, Diploma or Trade qualification	3 (9.09)	4 (12.12)	11 (33.33)		
Bachelors or Postgraduate degree	9 (27.27)	23 (69.70)	19 (57.58)		
Current stress levels				8.630	>.05
Less stressed than usual	5 (15.15)	8 (24.24)	3 (9.09)		
Same level of stress as usual	20 (60.61)	22 (66.67)	28 (84.85)		
More stresses than usual	8 (24.24)	3 (9.09)	2 (6.06)		

Table 2 shows the mean and standard deviations of anxiety and depression scores for each age group. The younger and middle-aged adults showed low mean scores on the DASS-42, with mean scores falling within the range for normal to mild severity (Lovibond & Lovibond, 1995). Higher scores for anxiety and depression in the younger, compared to the middle-aged, adults are consistent with normative data from the Australian population (Crawford, Cayley, Lovibond, Wilson, & Hartley, 2011). The older adults showed low mean scores on the GAI and GDS, falling below clinical cut-off scores (Johnco, Knight, Tadic, & Wuthrich, 2014; Yeasavage et al., 1983).

Table 2

Mean and Standard Deviations for Anxiety and Depression by Age Group

	Younger Adults	Middle-Aged Adults	Older Adults
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Anxiety	8.73 (7.23)	4.88 (5.34)	3.09 (4.58)
Depression	9.30 (8.97)	7.15 (8.81)	4.39 (6.15)

Note. Younger and middle-aged adults used the DASS-42 Anxiety and Depression subscales; Older adults used the Geriatric Anxiety Inventory and the Geriatric Depression Scale.

Significant differences by age group on some of the key variables of interest were identified; Table 3 shows the means and standard deviations of these variables. Post hoc comparisons, using Bonferroni correction, identified a significant difference between the younger and older adults for two of the key variables. Active coping showed a mean difference of 2.455, $p < .001$, with higher levels of active coping reported with increasing age. Further, behavioural disengagement showed a mean difference of -2.061, $p < .01$, with

younger adults showing the highest levels of behavioural disengagement, followed by older and then middle-aged adults.

Table 3

Means and Standard Deviations of the Coping and Neuroticism Scales

Scale	Younger adults *M* (*SD*)	Middle-aged adults *M* (*SD*)	Older adults *M* (*SD*)	*F*	*p*
Positive reinterpretation and growth	11.79 (2.56)	12.76 (2.41)	12.21 (2.70)	1.190	n.s.
Active coping	10.39 (2.69)	11.82 (2.57)	12.85 (2.36)	7.749	.001
Behavioural disengagement	6.33 (2.30)	5.85 (2.20)	5.98 (2.07)	6.504	.002
Neuroticism	4.04 (.85)	3.88 (.81)	3.87 (.63)	0.502	n.s.

Note. n.s. = non-significant p-value

Bivariate correlations were conducted to assess the relationships between the key variables. Associations between mindfulness and the other key variables were as expected, with positive correlations identified between mindfulness and positive reinterpretation and growth (r = .278, p = .005), and active coping (r = .451, p = .000). Mindfulness showed negative correlations with anxiety (r = -.419, p = .000), depression (r = -.364, p = .000), neuroticism (r = -.423, p =.000) and behavioural disengagement (r = -.365, p = .000).

Mindfulness by Age

To examine the relationship between mindfulness and age (hypothesis 1), bivariate correlations were conducted. Mindfulness scores were normally distributed across each age group (younger, middle-aged and older adults; all $p > .05$). Pearson's correlation identified a moderate, significant positive relationship between MAAS and age group, $r = .340$, $p < .001$.

The mean value of mindfulness for each age group was identified, see Figure 2. Younger adults had the lowest mindfulness score ($M = 3.79$, $SD = 0.76$), followed by the middle-aged adults ($M = 4.17$, $SD = 0.76$), and the older adults ($M = 4.46$, $SD = 0.77$). Post hoc comparisons, using Bonferroni correction, identified a significant difference between the younger and older adult mindfulness scores ($F = 6.331$, $p < .01$). The differences between the younger and middle-aged adults, and middle-aged to older adults, were non-significant.

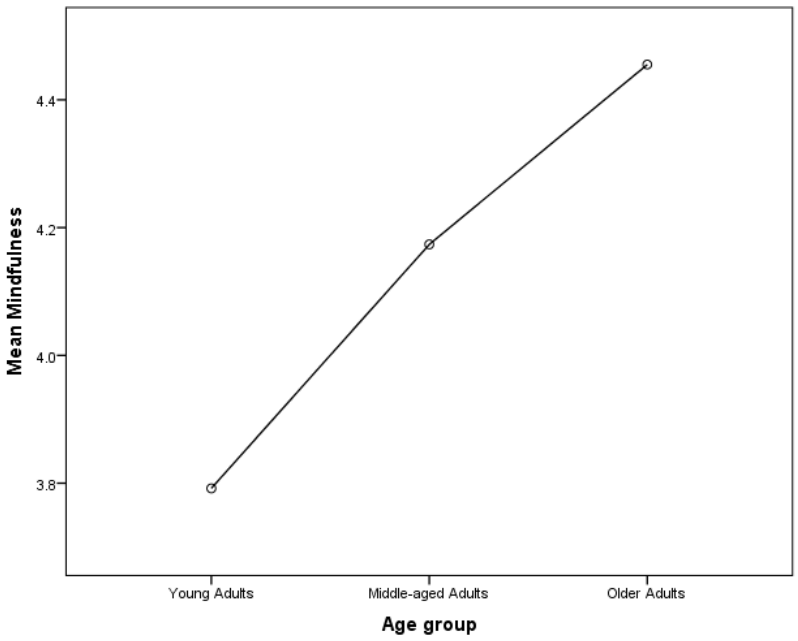

Figure 2. Self-Reported Mean Level of Dispositional Mindfulness by Age Group.

Video and Task Order Effect

Analyses were conducted to identify whether there were any immediate differences in perceived stress (VAS), positive affect (PA), negative affect (NA) or heart rate variability (HRV) reactivity due to video block order in the positive mood-induction task. Firstly, no significant differences for the VAS, PA, NA and HRV scores were found (all *p's* > .05) regardless of the order of video blocks. In addition, no significant differences were found for any of these outcome variables when assessing the order of video blocks by mood-induction task order (negative task first, or positive task first; all *p's* > .05)

Furthermore, there was no significant difference of 'humourousness' rating for the video blocks by task allocation order ($F = .884$, $p = .35$). However, analysis of variance of the 'humorousness' ratings by age group indicated that there was a significant difference in ratings by age group ($F = 5.212$, $p < .01$), with older adults and middle-aged adults rating higher levels of humorousness of the videos ($M = 7.37$, $SD = 1.73$, and $M = 6.97$, $SD = 1.83$, respectively) than the younger adults ($M = 5.56$, $SD = 1.95$).

A one-way analysis of variance was conducted to assess whether there was a difference in reported affect at each time point, on the VAS, PA and NA measures, depending on task order allocation (positive task first then negative task second, or vice versa). Regardless of task order, similar affect reactivity was identified for PA and NA (all time points, $p < .05$). Similarly, no significant differences were identified due to task order allocation on the VAS for the condition with the negative task first (all time points, $p > .05$). However, there were significantly lower VAS scores at the 15 minutes, 30 minutes and 45 minutes post-task positive mood-induction time points, for the negative task first task order allocation: $F(1, 95) = 5.440$, $p < .05$, $F(1, 95) = 10.298$, $p < .01$, $F(1, 94) = 9.819$, $p < .01$, respectively. This suggests that there may be an effect of reduced stress identification in the positive-mood induction task when it is presented after the negative-mood induction task.

A one-way analysis of variance was also conducted to assess whether there were differences at each time point for heart rate variability depending on task order allocation. No significant differences were identified by task order allocation (positive task first then negative task second, or vice versa) for the heart rate variability measures with the exception of one significant difference at post-task time point for the positive mood-induction task (F = 5.265, p = .024), whereby the participants who participated in the positive task second had a slight increase in HRV, whereas the positive task first group had a slightly decreased HRV, at this time point.

Pre- to Post-Task Reactivity

Changes from pre- to post-task were assessed to investigate immediate reactivity for each mood-induction task. Immediate reactivity was assessed for each outcome measure to investigate the relationship between affective and physiological reactivity, and age (hypothesis two).

Affect reactivity. Paired t-tests confirmed changes from pre- to post-task in the expected directions for most of the self-report measures (see Table 4). All measures of perceived stress identified a significant change in the expected direction (all p's < .05). Positive affect showed almost no change, with the exception of the older adults who experienced a significant decrease after the negative mood-induction task (p < .05). Negative affect showed a highly significant increase for all age groups after the negative mood-induction task (all p < .001). In addition, the younger adults also showed a significant decrease in negative affect after the positive mood-induction task (p <.01).

Due to the mixed results regarding positive affect reactivity after the mood-induction tasks, further investigation of the reactivity profiles was undertaken. It was identified that positive affect showed more reactivity over a longer period of time, however this was only found for the negative mood-induction task. Paired t-tests identified that younger and older adults experienced a significant decrease in positive affect between pre- and 15-minute post-task for the negative mood-induction task (t = -2.508, p = .017, and t = -2.746, p = .010, respectively). The middle-aged adults also showed greater reduction in positive affect over the pre- to 15-minute post-task time point, however the change was still non-significant (t = -0.519, p > .05). A longer reactivity profile did not identify greater positive affect reactivity for the positive mood-induction task, or for the negative affect and perceived stress measures.

Heart rate variability. Paired *t*-tests were conducted on heart rate variability scores (see Table 4). While the younger and older adults experienced a significant increase after the negative task (both *p's* < .05), suggesting the younger and older adults experienced reduced heart rate variability after the negative mood-induction task as was expected; the middle-aged adults did not experience the same decrease in heart rate variability. Only the older adults experienced the expected increase in heart rate variability from pre- to post-task for the positive mood-induction task; however, this result was not significant (p > .05). The younger and middle-aged adults both experienced a slight decrease in heart rate variability (p > .05 and p < .05, respectively), suggesting the positive mood-induction task was not associated with a more relaxed state for these participants.

Table 4

Values for Pre- to Post-Task Change on Each Outcome Variable (t-test values)

Outcome Variable	Young Adults	Middle-aged Adults	Older Adults
Perceived stress pre-post change (negative task)	5.272***	4.576***	5.942***
Perceived stress pre-post change (positive task)	-3.830**	-3.204**	-2.837**
Positive affect pre-post change (negative task)	.327	.040	-2.352*
Positive affect pre-post change (positive task)	.880	-.762	.082
Negative affect pre-post change (negative task)	4.361***	5.416 ***	4.805***
Negative affect pre-post change (positive task)	-3.086**	1.435	-1.660
Heart rate variability pre-post change (negative task)	2.316*	-.271	2.240*
Heart rate variability pre-post change (positive task)	1.090	2.132*	-1.065

* significant at p < .05; ** significant at p < .01; *** significant at p < .001

Note. A positive value suggests an increase in that measure after the mood-induction task. Perceived stress = Visual Analogue Scale (VAS); Positive affect = PA, measured by the PANAS; Negative affect = NA, measured by the PANAS; Heart rate variability = HRV, measured by the standard deviation of normal-to-normal R-R intervals.

Outcome Measures by Age Group

The trajectory for each outcome measure by age group was plotted for visual inspection of age group patterns. As can be seen in Figures 3 and 4, reactivity was similar for each age group on each measure, with older adults generally exhibiting higher levels of positive affect, and lower levels of perceived stress and negative affect. The younger adults exhibited generally lower levels of positive affect, and higher levels of perceived stress and negative affect. The middle-aged adults typically showed moderate responses to each measure, with their scores falling between the younger and older adults. The only exception to

this pattern can be found in the heart rate variability data, which shows the younger adults with higher scores. This is an expected finding, as older adults were expected to show overall lower levels of heart rate variability due to the decline of cardiovascular functioning with age. The similarity between the heart rate variability scores for middle-aged and older adults is unexpected.

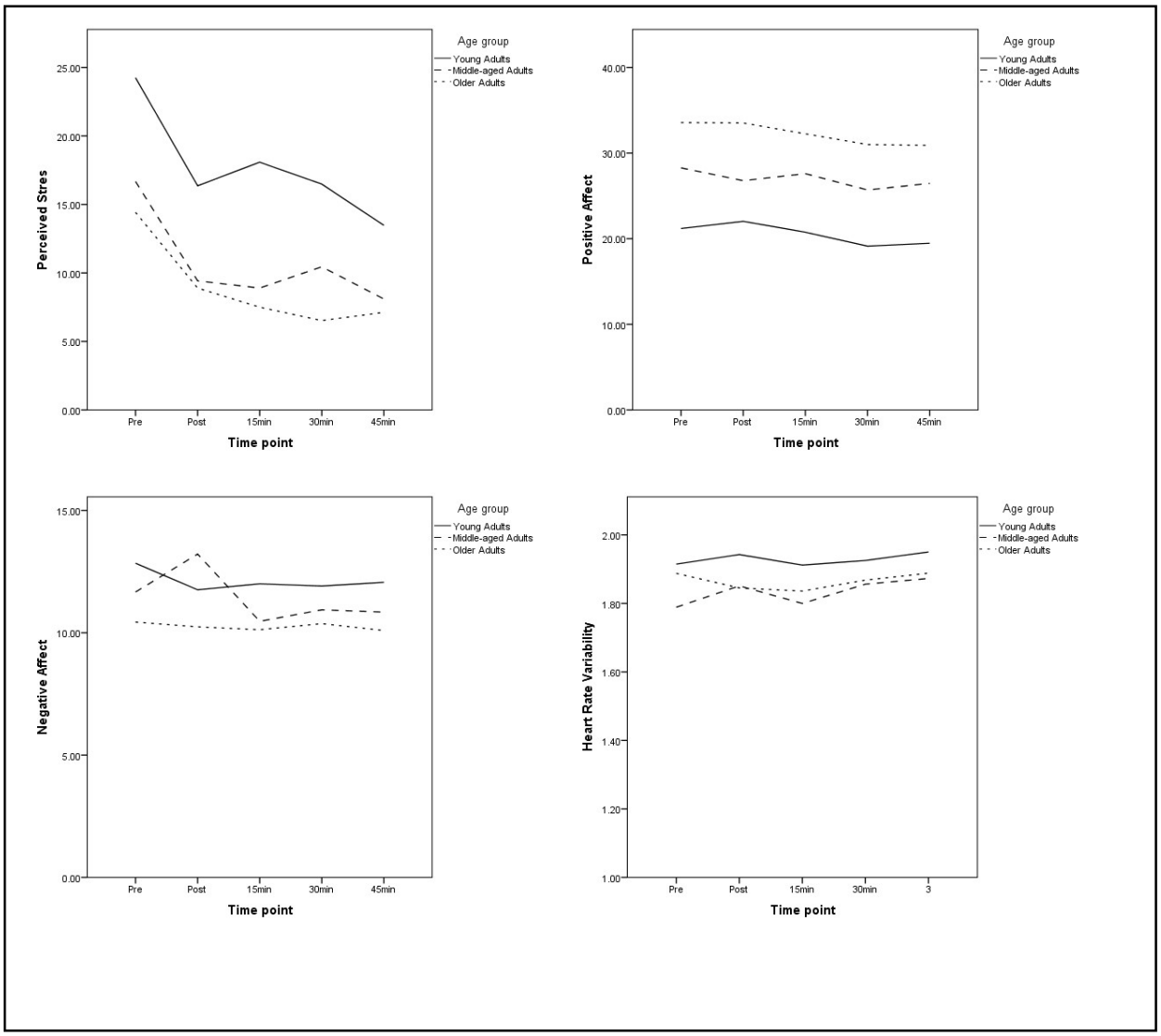

Figure 3. Mean reported perceived stress, positive affect, negative affect, and heart rate variability by age group for the positive mood-induction task.

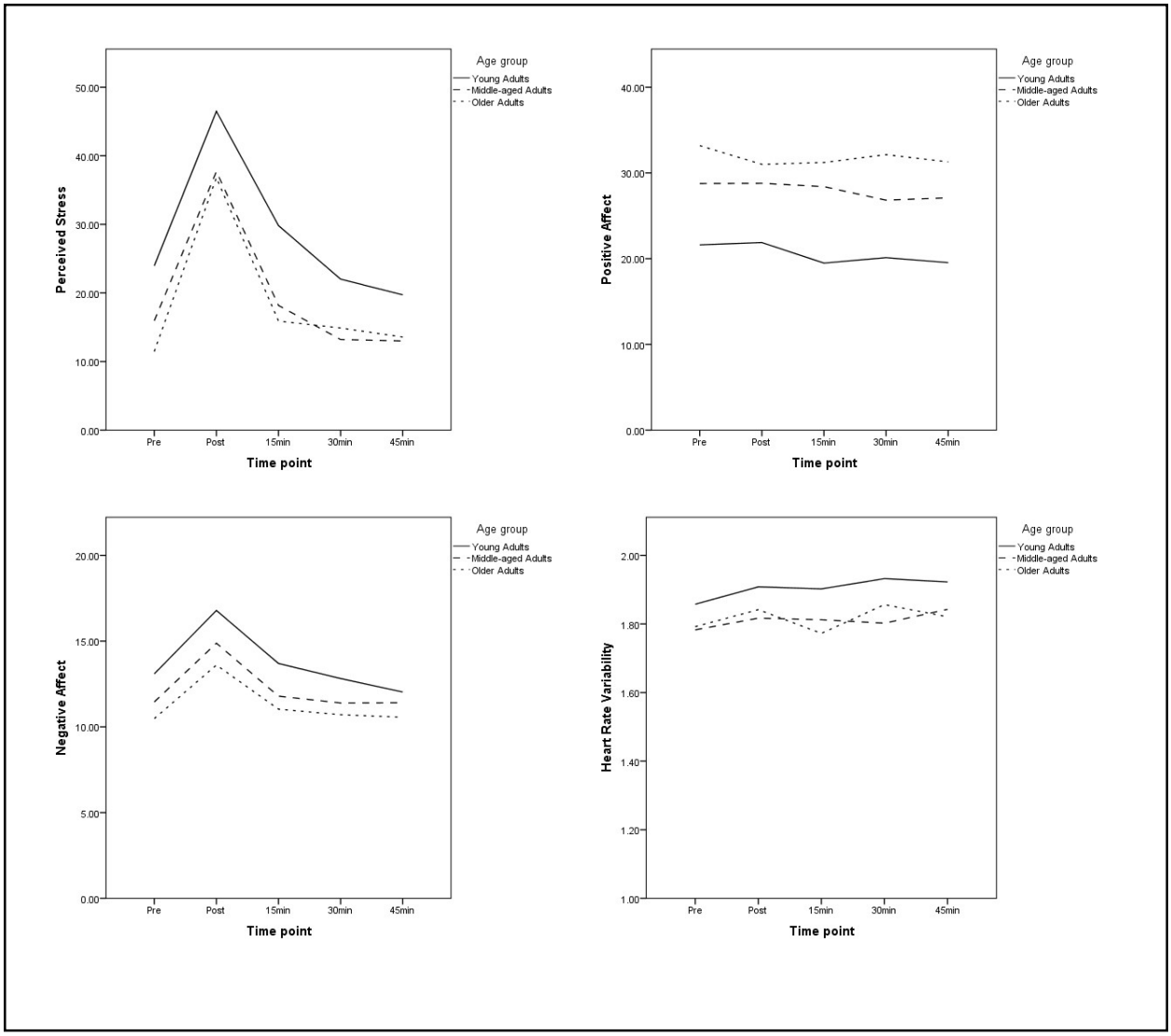

Figure 4. Mean reported perceived stress, positive affect, negative affect, and heart rate variability by age group for the negative mood-induction task.

Affect Reactivity and Recovery

To examine the role of dispositional mindfulness and other key variables on affective and physiological reactivity and recovery profiles (hypothesis three), linear mixed models were conducted for each mood-induction task, by comparing the pre and 15 to 45 minute post task time points to the post task time point. This analysis was conducted for each outcome variable by age group (younger, middle-aged or older adults) with dispositional mindfulness and covariates. The covariates were gender, anxiety, depression, the three COPE subscales (positive reinterpretation and growth, active coping, and behavioural disengagement) and neuroticism. The models also included interaction terms investigating the relationship between age group, time point and mindfulness, and a random intercept for each participant. As this was considered an exploratory study, a top-down strategy utilising continuous model fit and reduction was used (West et al., 2007).

Positive task. Regarding the positive mood-induction task, final models for the self-reported perceived stress (VAS) model identified a significant main effect for time ($F(4, 146.09) = 4.03$, $p = .004$), as well as significant main effects for active coping ($F(1, 87.52) = 4.93$, $p = .029$), positive reinterpretation and growth ($F(1, 88.08) = 4.55$, $p = .036$), neuroticism ($F(1, 87.99) = 6.48$, $p = .013$) and depression ($F(1, 87.74) = 6.21$, $p = .015$). Estimates of fixed effects are reported in Table 5. Follow-up contrasts identified a significant difference between pre-task and 45min post-task perceived stress scores ($t(90.86) = 2.75$, $p = .007$, $CI = 12.06, 74.54$) suggesting that the participants continued to experience a reduction in perceived stress over the 45 minute period, resulting in a lower level of perceived stress than before the task. The two-way and three-way interactions for time, age group and mindfulness were all non-significant.

Table 5

Final Fixed Effects Model of Predictors of Perceived Stress Reactivity for the Positive Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	-32.00	15.69	96.10	-2.04	.04*
Pre time point[a]	43.30	15.73	90.86	2.75	.01*
Post time point[a]	10.49	10.39	108.53	10.01	.32
15min post time point[a]	5.68	8.33	92.62	.68	.50
30min post time point[a]	3.18	6.57	110.76	.484	.629
Younger adults[b]	20.33	15.78	95.16	1.29	.20
Middle-aged adults[b]	-9.39	16.31	95.76	-.58	.57
Mindfulness	4.29	2.83	96.19	1.52	.13
Active coping	1.24	.56	87.52	2.22	.03*
Positive reinterpretation and growth	-1.13	.53	88.08	-2.13	.04*
Neuroticism	4.65	1.83	87.99	2.55	.01*
Depression	3.43	1.38	87.74	2.49	.02*

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

The positive affect (PA) model identified significant main effects for mindfulness ($F(1, 91.08) = 11.31$, $p = .001$), and a trend was identified for depression ($F(1, 89.96) = 3.22$, $p = .076$). Estimates of fixed effects are reported in Table 6. The two-way and three-way interactions between age group, time and mindfulness were non-significant. However, contrasts identified a trend between the younger and older adults for the age group by mindfulness by pre-task time interaction, suggesting that positive affective reactivity varied depending upon level of mindfulness and age group at the pre-task time point ($t(118.38) = 1.80$, $p = .075$, $CI = -0.33, 6.87$).

Table 6

Final Fixed Effects Model of Predictors of Positive Affect Reactivity for the Positive Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	11.72	10.42	103.04	1.12	.26
Pre time point[a]	1.38	5.87	121.43	.24	.81
Post time point[a]	2.12	6.16	114.13	.35	.73
15min post time point[a]	-.97	4.46	85.76	-.22	.83
30min post time point[a]	-3.38	4.08	103.07	-.83	.41
Younger adults[b]	4.58	13.13	103.14	.35	.73
Middle-aged adults[b]	-10.95	13.80	103.22	-.79	.43
Mindfulness	4.28	2.30	102.66	1.86	.07

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

The negative affect (NA) model identified a significant main effect for Behavioural Disengagement ($F(1, 89.59) = 7.96$, $p = .006$) and neuroticism ($F(1, 89.59) = 4.06$, $p = .047$). Estimates of fixed effects are reported in Table 7. The two-way and three-way interactions for time, age group and mindfulness were all non-significant.

Table 7

Final Fixed Effects Model of Predictors of Negative Affect Reactivity for the Positive Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	3.14	3.38	93.86	.93	.36
Pre time point[a]	1.88	1.87	104.59	1.00	.32
Post time point[a]	-.34	3.41	94.00	-.10	.92
15min post time point[a]	.57	.70	83.37	.81	.42
30min post time point[a]	.49	1.29	83.96	.39	.70
Younger adults[b]	4.39	3.39	96.21	1.30	.20
Middle-aged adults[b]	5.87	3.49	96.55	1.68	.10
Mindfulness	.49	.59	96.15	.83	.41
Behavioral disengagement	.34	.12	89.59	2.82	.01*
Neuroticism	.71	.35	89.59	2.02	.05*

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

There were no significant main or interaction effects identified in the heart rate variability model. Estimates of fixed effects are reported in Table 8. The two and three-way interactions between time, age group and mindfulness were non-significant. However, the final model did not show adequate goodness of fit, suggesting it was not better than the intercept-only model. Therefore, the current variables were not considered a good fit for the HRV model.

Table 8

Final Fixed Effects Model of Predictors of Heart Rate Variability for the Positive Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	1.76	.23	134.08	7.79	.00*
Pre time point[a]	-.03	.17	98.16	-.17	.87
Post time point[a]	-.11	.19	117.05	-.57	.57
15min post time point[a]	-.18	.17	126.05	-1.09	.28
30min post time point[a]	-.26	.16	105.60	-1.69	.10
Younger adults[b]	.22	.30	131.99	.75	.46
Middle-aged adults[b]	.09	.31	132.18	.31	.76
Mindfulness	.03	.05	133.38	.57	.57

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

Negative task. Regarding the negative mood-induction task, final models for self-reported perceived stress (VAS) identified a significant main effect for anxiety ($F(1, 90.02) = 6.02$, $p = .016$), and a trend for depression ($F(1, 89.37) = 3.76$, $p = .056$). Estimates of fixed effects are reported in Table 9. The two-way and three-way interactions for time, age group and mindfulness were all non-significant.

Table 9

Final Fixed Effects Model of Predictors of Perceived Stress Reactivity for the Negative Task

Variable	Estimate	*SE*	*df*	*F*	*p*
Intercept	6.48	17.50	111.83	.37	.71
Pre time point[a]	-4.57	17.43	115.39	-.26	.79
Post time point[a]	48.14	27.78	106.84	1.73	.09
15min post time point[a]	11.54	15.79	148.34	.73	.47
30min post time point[a]	14.56	11.84	105.31	1.23	.22
Younger adults[b]	.90	22.33	110.50	.04	.97
Middle-aged adults[b]	-15.99	23.36	110.81	-.68	.50
Mindfulness	1.58	3.87	112.21	.41	.69
Anxiety	5.04	2.06	90.02	2.45	.02*

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

The positive affect (PA) model identified significant main effects for mindfulness ($F(1, 89.89) = 10.43$, $p = .002$), Positive Reinterpretation and Growth ($F(1, 89.69) = 6.78$, $p = .011$) and depression ($F(1, 89.68) = 4.37$, $p = .039$). Estimates of fixed effects are reported in Table 10. The two-way and three-way interactions for time, age group and mindfulness were all non-significant.

Table 10

Final Fixed Effects Model of Predictors of Positive Affect Reactivity for the Negative Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	6.52	10.55	105.28	.62	.54
Pre time point[a]	-3.67	5.50	134.96	-.67	.51
Post time point[a]	-1.62	4.90	106.19	-.33	.74
15min post time point[a]	-2.05	4.56	107.49	-.45	.65
30min post time point[a]	-2.32	4.60	79.13	-.51	.62
Younger adults[b]	-13.66	12.57	108.41	-1.09	.28
Middle-aged adults[b]	-11.95	13.20	108.26	-.91	.37
Mindfulness	2.98	2.21	107.21	1.35	.18
Positive reinterpretation and growth	.95	.37	89.69	2.61	.01*
Depression	2.04	.97	89.68	2.09	.04*

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

The negative affect (NA) model identified significant a main effect for behavioural disengagement ($F(1, 90.61) = 14.24$, $p = .000$) and a trend for time ($F(4, 132.67) = 2.41$, $p = .052$). Estimates of fixed effects are reported in Table 11. Follow-up contrasts of age group variance identified a significant difference between the middle-aged and older adults ($t(107.46) = 2.09$, $p = .039$, $CI = 0.46, 17.29$), suggesting that the middle-aged adults showed greater negative affect reactivity than the older adults. There was a significant difference for time, with contrasts identifying a significant difference between the post-task and 45min post-task scores ($t(104.11) = 2.24$, $p = .027$, $CI = 1.00, 16.57$). This suggests that participants experienced increased negative affect at post-task, which then decreased over the 45 minute period. Contrasts also highlighted a trend for the age group by mindfulness interaction, showing a difference between the middle-aged and older adults ($t(107.54) = -1.95$, $p = .053$, $CI = -3.81, 0.03$). This suggests that negative affect reactivity varied based on both age group and level of mindfulness.

Table 11

Final Fixed Effects Model of Predictors of Negative Affect Reactivity for the Negative Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	5.02	3.49	104.49	1.44	.15
Pre time point[a]	.11	2.06	96.91	.06	.96
Post time point[a]	8.79	3.92	104.11	2.24	.03*
15min post time point[a]	2.19	2.22	121.66	.99	.33
30min post time point[a]	.28	1.55	87.92	.18	.86
Younger adults[b]	5.86	4.11	107.11	1.43	.16
Middle-aged adults[b]	8.88	4.25	107.46	2.09	.04*
Mindfulness	.54	.70	107.09	.76	.45

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

The heart rate variability (HRV) model did not identify any main or interaction effects. Estimates of fixed effects are reported in Table 12. However, the final model did not show adequate goodness of fit, suggesting it was not better than the intercept-only model. Therefore, the current variables were not considered a good fit for the HRV model.

Table 12

Final Fixed Effects Model of Predictors of Heart Rate Variability for the Negative Task

Variable	Estimate	*SE*	*df*	*t*	*p*
Intercept	1.46	.29	126.74	4.99	.00*
Pre time point[a]	.17	.19	120.65	.87	.39
Post time point[a]	.08	.197	123.03	.41	.69
15min post time point[a]	-.13	.20	119.12	-.64	.52
30min post time point[a]	.15	.21	118.74	.71	.48
Younger adults[b]	.16	.34	131.61	.46	.64
Middle-aged adults[b]	-.29	.36	131.91	-.81	.42
Mindfulness	.06	.06	131.43	1.03	.31

Note. * significant result.

[a] -1=Pre time point, 0=Post time point, 1=15minute post time point, 2=30minute post time point, 3=45minute post time point (reference category).

[b] 1=Younger adults, 2=Middle-aged adults, 3=Older adults (reference category).

Discussion

The current study showed a significant positive correlation between age and mindfulness. This provides additional support for the supposition that mindfulness may naturally increase over the adult lifespan. While previous research has identified a difference between mindfulness levels of younger and older adults (e.g. Mahoney et al., 2015), this has only shown that there are mean trait mindfulness differences between these two age groups.

By including the mean mindfulness level for middle-aged adults in the current study, it is provided evidence that middle-aged adults reported a mean level of dispositional mindfulness between the younger and older adults. This is line with research conducted by Bränström et al. (2011) and Raes et al. (2013), who found a positive relationship between dispositional mindfulness and age, further supporting the idea that mindfulness may indeed increase over adulthood. This finding also suggests that an age-related increase in dispositional mindfulness could be a driving factor of the positivity bias that is identified in older adults.

Secondly, the current study identified higher levels of negative affect and perceived stress in the younger adults, compared to the middle-aged and older adults. Furthermore, there was evidence of the positivity effect. That is, the older adults consistently reported lower levels of negative affect and perceived stress, and higher levels of positive affect, than younger adults. One important factor of the present study was to identify the trajectory of affective and physiological reactivity and recovery in three age groups (young, middle-aged and older adults). As such, the present study identified that the middle-aged adults report levels of affective reactivity and recovery that were between the levels of the younger and older adults. This provides additional support for a consistent pattern of change of affect across adulthood.

It was also hypothesised that there would be a reduction of heart rate variability with age, with younger adults showing the highest level of heart rate variability followed by middle-aged and then older adults. However, we did not find evidence for a reduction of physiological reactivity by age. Furthermore, the expected changes in heart rate variability (that is, increased heart rate variability after the positive mood-induction task, and decreased heart rate variability after the negative mood-induction task) were not consistently identified in the current study. It is possible that the pulse transducer was not sensitive enough, the recording periods too short, or pulse wave measurement not appropriate to measure and identify changes in heart rate variability. As one study has identified that pulse wave

measurement may not translate appropriately as a measurement of heart rate variability (Wong et al., 2012), future research utilising a well-validated measure of heart rate variability, such as electrocardiogram, would be beneficial.

Finally, we found mixed results for the role of mindfulness amongst other predictors of physiological and affective reactivity and recovery. Though overall, dispositional mindfulness was related to the level of positive affect that an individual experiences, regardless of their age and whether they are experiencing a positive or negative event. In addition, it supports the idea that mindfulness may be related to enhancing positive growth, not just decreasing negative factors (Garland, Gaylord, & Fredrickson, 2011). This is an important finding as typically research has identified only that a reduction of negative affect is associated with increased mindfulness; however, the present study suggests that mindfulness may play a part in enhancing positive affect and responding to events (even stressful ones) with increased positive affect.

As mindfulness is associated with a reduction in negative affect reactivity (Arch & Craske, 2006; Ostafin et al., 2014), it was hypothesised that investigating the relationship between age and mindfulness could provide valuable results. Furthermore, past research has shown mindfulness to reduce negative emotions, and to not affect positive emotion levels (Arch & Craske, 2006), potentially suggesting that dispositional mindfulness could play a part in the negativity bias found to occur over the adult lifespan. It was expected that dispositional mindfulness would be a predictor of negative affect and perceived stress reactivity and recovery profiles. However, behavioural disengagement and neuroticism were the only significant predictors for negative affect. For the perceived stress model, active coping, positive reinterpretation and growth, neuroticism, anxiety and depression were identified as significant predictors. These findings suggest that other factors, besides mindfulness were significant predictors of negative affect and perceived stress.

There were differences in reactivity after the negative mood-induction task, compared to the positive mood-induction task. The Trier Social Stress Task (TSST), the negative mood-induction task used in the current study, is a well-validated psychosocial task. Therefore, the substantial reactivity identified from pre- to post-task on the perceived stress and negative affect measures, for all three age groups, is in line with the previous literature. However, only the older adults showed a significant decrease in positive affect after the TSST. Overall, the TSST generated affective reactivity for negative affect and perceived stress in the expected direction.

The positive mood-induction task used in the current study was designed to be similar to previous studies that have used video clips to induce emotion (e.g. Davidson et al., 1990). In addition, the use of films to successfully induce emotion using a standardised method has previously been reported (Gross & Levenson, 1995). However, the video clips in the current study were designed to show footage, including comedy clips, which did not rely on language (as humour can vary greatly by cohort and cultural background) and were accompanied by their original laughter tracks to enhance the humorousness of the clips. Nonetheless, the positive mood-induction task showed a significant reduction in perceived stress for all three age groups. There was also a significant reduction of negative affect for the younger adults, and an increase in heart rate variability for the middle-aged adults, after the positive mood-induction task. However, the positive mood-induction did not result in an increase in positive affect for any age group. A significant increase in positive affect after the positive mood-induction task would be required to draw stronger conclusions from the results of this study. This is a limitation of the present study as it may be that the positive mood-induction task was not sufficiently potent to induce the increase in positive affect that was desired. Future research may benefit from using a new design for a positive mood-induction task that provides greater affective and physiological reactivity.

The variability in affective change scores could be a function of the measures used. While the VAS found significant changes in perceived stress for every age group, and across both mood-induction tasks; the scales of the PANAS identified mixed results. The negative affect subscale of the PANAS did show a significant increase after the negative mood-induction task; however, there was limited support for a reduction of negative affect after the positive mood-induction task. In addition, the positive affect scale of the PANAS showed little variability in each age group on both tasks, with the exception of the reduction in positive affect after the negative mood-induction task in the older adults. Furthermore, the positive affect subscale showed a considerable floor effect, particularly among the younger adults. There has also been suggestion of difficulty with terminology used for affect identification in different age group (Lawton et al., 1993). Therefore, the PANAS may not be sufficiently sensitive or appropriate to measure positive and negative affect in non-anxious adults (Arch & Craske, 2010); or across the different age groups.

Future research may also benefit from assessing change over a longer period of time. For example, positive affect reactivity was identified to be greater when measuring from pre- to 15 minutes post-task for the negative mood-induction task, rather than pre- to post-task. However, pre- to post-task reactivity was adequate to identify changes in negative affect and perceived stress. This suggests that negative affect may change quicker than positive affect; therefore, measurement of positive and negative affect may need to be taken at different time points after a mood-induction task. These results are similar to those found by Diaz et al. (2014).

While the current study utilised a structured research design, there may not had been sufficient power to identify the relationships of interest between age, dispositional mindfulness and reactivity due to the moderate sample size for each age group. This is particularly important when considering the linear mixed models which, when all variables were entered into the model, contained seven key variables as well as fixed factors (such as

age and time point), and covariates to control for (such as gender). However, the linear mixed models provided a good preliminary, exploratory analysis of the key variables related to coping and reactivity.

Attention must also be paid to the categorisation of age groups in the current study. Research into ageing has provided mixed definitions of older adults, with some studies assessing age as continuous and not defining the cut-off for their older adult group (e.g. Aldwin, 1991). While other research (e.g. Lawton et al., 1992) clearly defines age limits for younger, middle-aged and older adults. The current study took into account the sociological factors related to the ageing population, as well as current trends in the literature, when defining each age group. Older adults were defined as 60 years of age or more, to capture the young-old as well as older adults and the elderly. A starting limit of 60 years of age is consistent with other categorisations of older adults in both experimental and review papers (Armstrong et al., 2014; Bryant et al., 2008). In addition, the inclusion of a smaller student sample in the younger adult group, or relatively consistent student samples in each age group, may affect the results of the study. Therefore, this may be beneficial for future research to address.

Prudence must be used when inferring the trajectory of mindfulness, and any possible changes, over the lifespan. As we used a cross-sectional design it is possible that the differences in mindfulness were due to cohort effects. However, as there is a moderate and significant linear correlation between mindfulness and age, it can be suggested that there may indeed be a natural increase in mindfulness as measured by the MAAS (that is, conscious awareness of the present moment). This is in line with qualitative feedback provided by participants of this study, who frequently commented on the high number of tasks younger adults' juggle, and their busy schedules, coupled with their difficulty to manage and cope with the tasks and events in their lives. The theme of wisdom or life experience occurring with age is a long-held belief that suggests that with age we gain insight and patience. This research

sought to assess mindfulness as the core concept that could be fuelling this frequently observed and socially documented phenomenon.

There may also be limitations attributed to the mindfulness measure used in the current study. While the MAAS has been shown to have stronger relations to measures of wellness compared to an alternate, direct measure of the MAAS (Brown & Ryan, 2003), and has also shown similar psychometric properties in Eastern and Western cultures (Christopher et al., 2009); it is an indirect measure of mindfulness (Brown & Ryan, 2003). There may have also been floor effects for positive affect on the PANAS, whereby the younger adults in this study frequently reported very low ratings across all time points, as well as after the positive mood-induction task.

Finally, studies such as Fogarty et al. (2015) suggest that increased dispositional mindfulness may not reduce affective reactivity as previously hypothesised. Rather, they suggest that increased mindfulness may aid in superior affective recovery. Future research should include assessment of recovery profiles, as was done in the current study, to gain an overall picture of the full affective process after a mood-induction task.

The present study aimed to investigate the relationship between age and dispositional mindfulness; as well as the role of mindfulness in affective and physiological reactivity and recovery in adults, using two mood-induction tasks. Mindfulness was identified to have a significant, positive relationship with age. Furthermore, mindfulness was found to be related to positive affect reactivity in both positive and negative mood-induction tasks. Although not a focus of the current study, the authors suggest that dispositional mindfulness may increase as a result of maturation or life experience. While a substantial portion of research has identified the role of dispositional mindfulness in reducing negative affect and negatively-based rumination (Arch & Craske, 2006; Kiken & Shook, 2014), this study supports the limited research that shows dispositional mindfulness may also be important in maintaining or

enhancing positive affect. Furthermore, it is possible that dispositional mindfulness may be related to the positivity effect seen in older adults.

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Chapter 4

General Discussion

This thesis was concerned with investigating the role of dispositional mindfulness in affective and physiological reactivity, as well as its' relationship with ageing. Dispositional mindfulness had previously been shown to be associated with reduced negative affect and physiological reactivity (Arch & Craske, 2006; Arch & Craske, 2010) and enhanced wellbeing (Bränström, Duncan, & Moskowitz, 2011). Further, mindfulness has been associated with adaptive coping styles (Weinstein, Brown, & Ryan, 2009), and lower levels of neuroticism (Giluk, 2009). However, the relationships between these variables and how they relate to age was not known. In order to investigate the relationship between dispositional mindfulness, ageing, and affective and physiological reactivity, two studies were conducted. Firstly, a thorough review of the literature regarding dispositional mindfulness, and affective and physiological reactivity was conducted (Study One) to assess the status of the research and identify whether this topic had been investigated across the adult lifespan. Results from the review identified a lack of research utilising samples of adults from across adulthood, and measures of affective and physiological reactivity. Therefore, the final study (Study Two) sought to investigate ageing, dispositional mindfulness, and affective and physiological reactivity in a representative adult community sample. The findings from these studies are reviewed below.

Overview of Study One

Study One (reported in Chapter Two) used a systematic review protocol to examine the literature within the field of dispositional mindfulness, ageing, and affective and physiological reactivity. A review of the twenty-nine eligible studies provided evidence for the association of dispositional mindfulness with enhanced subjective wellbeing, and reduced psychological distress, in adults. A limited number of studies were identified that investigated the role of mindfulness regarding affective and physiological reactivity across adulthood. In fact, only three studies included a multiple adult age group in their sample (Bränström et al.,

2011; Prakash, Hussain, & Schirda, 2015; Raes, Bruyneel, Loeys, Moerkerke, & De Raedt, 2013). However, these three studies did not include mood-induction tasks and therefore did not assess affective and physiological reactivity, but rather assessed state levels of affect and mood. For these reasons, limited extrapolation can be made regarding the role of mindfulness in affective and physiological reactivity across adulthood. Overall, the studies included in the review were assessed with regards to the general relationship between dispositional mindfulness, affect and physiological measures, and affective and physiological reactivity (where data was available).

Thematic analysis identified six main themes, which indicated that dispositional mindfulness was related to enhanced wellbeing, reduced physiological reactivity and reduced negative affect; mindfulness-based treatment influences both positive and negative affect; and a number of factors may mediate the relationship between mindfulness and enhanced wellbeing/reduced psychological distress. It was identified that dispositional mindfulness increases with age (Bränström et al., 2011; Prakash et al., 2015; Raes et al., 2013), and was positively correlated with subjective wellbeing, both state and trait positive affect, perceived health and self-acceptance (Jimenez, Niles & Park, 2010; Jislin-Goldberg, Tanay, & Bernstein, 2012; Keune & Forintos, 2010). Dispositional mindfulness was also negatively correlated with anxiety, depression, perceived stress and negation cognitions (Bränström et al., 2011; Keune & Forintos, 2010; Lyvers, Makin, Toms, Thorberg, & Samios, 2014). In addition, increased dispositional mindfulness was associated with reduced negative affective and cognitive reactivity (Arch & Craske, 2010; Brown, Weinstein, & Creswell, 2012; Creswell, Pacilio, Lindsay & Brown, 2014). Finally, dispositional mindfulness was related to reduced physiological measures such as salivary cortisol, heart rate variability, and blood pressure (Brown et al., 2012; Creswell et al., 2014; Tomfohr, Pung, Mills, & Edwards, 2015).

The eligible studies investigating mindfulness-based treatment suggested that treatment may enhance wellbeing for individuals of varying levels of pre-treatment

dispositional mindfulness (Greeson et al., 2015; Orzech, Shapiro, Brown, & McKay, 2009). Overall it appears that better treatment outcome coincides with a greater increase in dispositional mindfulness from pre- to post-treatment (Garland, Gaylord, & Fredrickson, 2011). Further, as the majority of eligible studies utilised community or undergraduate samples of varying mindfulness experience, and treatment programs typically resulted in improvement of psychological measures, it could be suggested that good treatment outcome may be possible for meditators and non-meditators alike. The review of the literature highlighted the paucity of research investigating ageing, dispositional mindfulness, and affective and physiological reactivity. Moreover, a number of the studies did not include covariates that have also been identified to experience changes due to ageing, such as neuroticism and coping skills, which may be important to include in further research. Therefore, it was established that a study investigating ageing, dispositional mindfulness, and affective and physiological reactivity, with the addition of important covariates such as neuroticism and coping styles, was required.

Overview of Study Two

Study Two (reported in Chapter Three) aimed to investigate the relationship between dispositional mindfulness, affective and physiological reactivity, and ageing using an experimental design. Furthermore, it explored the relationship of dispositional mindfulness and other key variables that have been identified in the literature to be associated with affective and physiological reactivity and age-related changes. Using an experimental design, physiological and psychological reactivity data were collected from participants across a broad age range (18 to 90 years of age), before and after two mood-induction tasks. The relationship between ageing and dispositional mindfulness was initially investigated. Thereafter, dispositional mindfulness and the other key variables were investigated to assess their role in physiological and affective reactivity to mood-induction tasks.

Firstly, the study found that there is a significant, positive correlation between age and dispositional mindfulness. This suggests that an individual may become more consciously aware of and attentive to the present moment with age. This study also found that there were differences between the age groups on three of the four outcome measures (perceived stress, positive affect, and negative affect). Older adults reported the lowest levels of negative affect and perceived stress and higher levels of positive affect. Further, younger adults reported the lowest level of positive affect, and highest levels of negative affect and perceived stress; and the middle-aged adults reporting moderate levels of positive affect, negative affect and perceived stress, with their scores falling between the older and younger adult. The results identified variance in the mean levels of affect, but a similar reactivity and recovery profile for each age group. The results from this study are in line with research that suggests higher levels of positive affect and lower levels of negative affect and psychological distress, in older adults.

Finally, the study provided an exploratory investigation of the role of dispositional mindfulness, affective and physiological reactivity, and ageing along with a number of other key variables associated with age-related changes in affect and physiology. Dispositional mindfulness was found to be related to positive affect reactivity for both of the mood-induction tasks. This suggests that regardless of whether an event is positive or negative, the level of dispositional mindfulness appears to impact on the degree of positive affect that will be experienced. Though, this finding was not related to age group. Further, mindfulness was not found to be a significant predictor for our other three outcome measures. However, we can tentatively suggest that dispositional mindfulness may play a role in the experience or maintenance of positive affect.

Theoretical Implications

The results from Study One showed support for age-related changes in affective and physiological reactivity. Furthermore, Study One identified that dispositional mindfulness is related to ageing, as well as affective and physiological reactivity. This suggests that research regarding age-related changes in affective and physiological reactivity may benefit from inclusion of dispositional mindfulness. In Study Two, older adults reported lower levels of perceived stress and negative affect, and higher levels of positive affect, than younger adults. This is in line with previous research, which has identified that older adults tend to experience and maintain higher levels of positive affect, and lower levels of negative affect, than younger adults (e .g. Carstensen, Pasupathi, Mayr, & Nesselroade, 2000).

The results from Study Two also supported the age-related changes in affective reactivity, as well as an age-related increase in dispositional mindfulness with age. Therefore, providing support for socioemotional selectivity theory and strength and vulnerability integration theory, whereby older adults become more present-focused and experience enhanced emotion regulation (Carstensen, Isaacowitz, & Charles, 1999; Charles, 2010).

Strengths of Research

The two studies presented for the current thesis have a number of strengths that should be highlighted. For instance, both studies investigated a number of factors (dispositional mindfulness, affective and physiological reactivity, and related factors) along with ageing. These factors have often been examined separately but have not, to date, been included within the one study.

In addition, Study Two utilised a robust experimental design and statistical analyses to investigate the relationship between dispositional mindfulness, and state affective and physiological reactivity. Further, the study utilised a primarily community-based sample whose age encompassed a large range of the adult lifespan. Therefore, results may be

generalisable to communities with similar ethnic and demographic makeup, and the results may provide important findings for a large range of adult age groups. Lastly, the majority of the self-report measures used in Study Two were validated measures and frequently used in research in this field as well as clinical studies (for example, the Depression Anxiety Stress Scale is commonly used in research and clinical practice). This provides additional support regarding validity of the findings.

Limitations of the Research and Directions for Future Research

Despite the strengths of the studies, there are limitations that must be considered. Firstly, Study One could have utilised broader search terms to identify a greater selection of the literature. For example, future reviews of the literature could include a search for all studies that discuss or assess mindfulness, or include additional search terms related to emotion regulation, such as coping. While this was beyond the scope of the current thesis, including additional terms or expanding the search terms may yield additional search results and is something that should be considered for future reviews.

Secondly, the unexpected findings for the heart rate variability data in Study Two suggest that a more rigorous measurement of heart rate variability may be required for future studies. For example, electrocardiogram (ECG) recording of heart rate variability allows for measurement of the parasympathetic nervous system, which is mediated by the vagus nerve, on heart rate (Task Force for the European Society of Cardiology, 1996). Vagal activity is a key contributor to the high frequency component of heart rate variability, and ECG recordings include measurement of high and low components. Further, ECG recordings can be analysed using more advanced techniques, such as spectral analysis, that investigate both high and low components (Task Force for the European Society of Cardiology, 1996). Therefore, ECG may be a more suitable measurement technique for future research. In addition, sampling duration

of heart rate variability could be extended to a minimum of five minutes per sample to increase validity of the data (Task Force for the European Society of Cardiology, 1996).

Finally, although Study Two utilised a sample that spanned younger, middle-aged and older adulthood, both the overall and subgroup sample sizes were small. A larger sample size would had allowed for more rigorous statistical analysis. While significant predictors were identified within the study, these results should be interpreted with caution and further studies should include a larger sample. Furthermore, increasing the power in future studies may results in additional results, which could not be identified in the present studies. As Study Two used a cross-sectional design, the relationship between dispositional mindfulness and age could be a result of cohort or age group effects. Therefore, a longitudinal study, to assess the change in mindfulness over the course of a lifespan, would be beneficial for future research. So too could the inclusion of age as a continuous variable, rather than categorising younger, middle-aged and older adults, as the cut-offs for each age group can vary in the research.

Conclusion

Older adults consistently reported higher levels of positive affect and reduced negative affect, as well as less physiological reactivity to stressor tasks, than younger adults. Furthermore, older adults have been found to have overall enhanced emotion regulation, and higher levels of dispositional mindfulness, compared to other adult age groups. However, the relationship between ageing, dispositional mindfulness, and affective and physiological reactivity was not clear. By reviewing the literature on the topic (Study One), and examining dispositional mindfulness and affective and physiological reactivity in a sample of adults encompassing the spectrum of adulthood (Study Two), this thesis provides some significant contributions to the understanding of ageing, dispositional mindfulness, and affective and physiological reactivity. Firstly, the literature regarding dispositional mindfulness and affective and physiological reactivity tends to focus on specific age groups (particularly,

younger adults). This is important to note, as it presents significant limitations when attempting to apply the findings from the literature to middle-aged and older adults. The previously reported positive association between ageing and dispositional mindfulness was replicated in this study, providing further support for the relationship between ageing and increased mindfulness. In addition, it was found that dispositional mindfulness is related to positive affect across all age groups. This is a significant finding as it suggests that dispositional mindfulness may be related to the experience or maintenance of positive affect. Furthermore, it supports the general association between dispositional mindfulness and enhanced wellbeing. Future research could look at replicating the present research, utilising a longitudinal design and a larger sample size, to thoroughly investigate the relationship between dispositional mindfulness, and affective and physiological reactivity. This will aid our understanding of the mechanisms involved in emotion regulation across adulthood.

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Appendix

Final Macquarie University Human Ethics Committee

Approval Letter for Study Two (reported in Chapter Three)

MACQUARIE UNIVERSITY

Jacqueline Frei <jacqueline.frei@mq.edu.au>

Approved- Ethics application- Wuthrich (Ref No: 5201200726)

1 message

Ethics Secretariat <ethics.secretariat@mq.edu.au> Mon, Dec 3, 2012 at 11:30 AM
To: Dr Viviana Wuthrich <viviana.wuthrich@mq.edu.au>
Cc: Prof Ron Rapee <ron.rapee@mq.edu.au>, Dr Kerry-Ann Grant <kerryann.grant@mq.edu.au>, Miss Jacqueline Frei <jacqueline.frei@mq.edu.au>

Dear Dr Wuthrich

Re: "Why does anxiety and depression decrease with age? An examination of emotional and physiological reactivity across the lifespan" (Ethics Ref: 5201200726)

Thank you for your recent correspondence. Your response has addressed the issues raised by the Human Research Ethics Committee and you may now commence your research.

This research meets the requirements of the National Statement on Ethical Conduct in Human Research (2007). The National Statement is available at the following web site:

http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/e72.pdf.

The following personnel are authorised to conduct this research:

Dr Kerry-Ann Grant
Dr Viviana Wuthrich
Miss Jacqueline Michelle Frei
Prof Ron Rapee

NB. STUDENTS: IT IS YOUR RESPONSIBILITY TO KEEP A COPY OF THIS APPROVAL EMAIL TO SUBMIT WITH YOUR THESIS.

Please note the following standard requirements of approval:

1. The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Human Research (2007).

2. Approval will be for a period of five (5) years subject to the provision of annual reports.

Progress Report 1 Due: 03 December 2013
Progress Report 2 Due: 03 December 2014
Progress Report 3 Due: 03 December 2015
Progress Report 4 Due: 03 December 2016
Final Report Due: 03 December 2017

NB. If you complete the work earlier than you had planned you must submit a Final Report as soon as the work is completed. If the project has been discontinued or not commenced for any reason, you are also required to submit a Final Report for the project.

Progress reports and Final Reports are available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

3. If the project has run for more than five (5) years you cannot renew approval for the project. You will need to complete and submit a Final Report and submit a new application for the project. (The five year limit on renewal of approvals allows the Committee to fully re-review research in an environment where legislation, guidelines and requirements are continually changing, for example, new child protection and privacy laws).

4. All amendments to the project must be reviewed and approved by the Committee before implementation. Please complete and submit a Request for Amendment Form available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

5. Please notify the Committee immediately in the event of any adverse effects on participants or of any unforeseen events that affect the continued ethical acceptability of the project.

6. At all times you are responsible for the ethical conduct of your research in accordance with the guidelines established by the University. This information is available at the following websites:

http://www.mq.edu.au/policy/

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/policy

If you will be applying for or have applied for internal or external funding for the above project it is your responsibility to provide the Macquarie University's Research Grants Management Assistant with a copy of this email as soon as possible. Internal and External funding agencies will not be informed that you have final approval for your project and funds will not be released until the Research Grants Management Assistant has received a copy of this email.

Please retain a copy of this email as this is your official notification of final ethics approval.

Yours sincerely
Dr Karolyn White
Director of Research Ethics
Chair, Human Research Ethics Committee