EMOTION REGULATION CAPACITY IN OLDER ADULTS:

EFFECTS ON FACIAL EXPRESSION AND MEMORY

Submitted by

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Declaration

This thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma.

No parts of this thesis have been submitted towards the award of any other degree or diploma in any other tertiary institution.

No other person's work has been used without due acknowledgement in the main text of the thesis.

All research procedures reported in the thesis received the approval of the Australian Catholic University's policy document on Human Research and Experimentation.

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Acknowledgements

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List of Abbreviations

Autonomic Nervous System………………………………………………...	ANS
Electromyography………...………………………….………………..	EMG
Parasympathetic Nervous System…..……………………………………….	PSNS
Prefrontal Cortex…………………..………………………………………..	PFC
Selection, Optimisation, and Compensation – Emotion Regulation……..…	SOC-ER
Skin Conductance Level…………………………………………………….	SCL
Socioemotional Selectivity Theory…….……………………….………..	SST
Strength and Vulnerability Integration Model………………………………	SAVI
Sympathetic Nervous System……………………………………………….	SNS

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Abstract

This thesis primarily investigated the extent to which the capacity for emotion regulation is preserved in older adults. In doing this, the current research explored possible contributors that might help explain how older adults regulate their emotions as well as young adults, and the limitations to emotion regulation ability in ageing. Subtle changes in muscle activity associated with positive and negative facial expressions were measured with *zygomaticus* and *corrugator* facial electromyography (EMG) as a novel technique to determine age differences in specific emotion regulation use, as well as age differences in emotional reactivity.

In Study 1, young and older adults were similarly effective in using expressive suppression and cognitive ‘detached’ reappraisal strategies to regulate their facial expressions to positive and negative pictures, without impacting memory performance. EMG revealed that older adults’ facial muscle activity during the watch condition was significantly lower relative to young adults, suggesting age differences in emotional reactivity may reduce the demands on cognitive resources needed for successful emotion regulation. No evidence was found to support the suggestion that older adults’ regulation ability could partly be explained through more effective use of different strategies.

In Study 2, emotion-eliciting films of varying emotional intensities were developed and piloted with young and older adults for use in subsequent studies. Specifically, amusing, happy, sad, and neutral films were empirically tested as evoking discrete levels of the target emotion with minimal levels of unrelated emotions. The battery of films was established as suitable dynamic stimuli for both age groups.

In Study 3, using expressive suppression, older adults were able to reduce their facial muscle activity to amusing and happy films, but not to sad films, whereas young adults were able to regulate all emotion types, although not to baseline levels of a neutral expression. Findings demonstrated limitations to older adults’ emotion regulation capacity, such as

impairments in regulating heightened negative emotional responses that may place greater cognitive demands on emotion regulation efforts (contrasting with lower emotional responses to static pictures in Study 1). Study 3 further contributed to understanding the effect of emotional reactivity on emotion regulation success.

In Study 4, older adults were able to regulate their facial reactivity to high-intensity sad films using a focused-breathing strategy, but experienced difficulty when using expressive suppression and detached reappraisal. Young adults were effective at using all strategies, but most successful when using detached reappraisal. EMG demonstrated that older adults are more effective at using different strategies when regulating responses to dynamic negative stimuli. Study 4 provided support for the use of mindful emotion regulation as an alternative approach to regulating emotions across the life span.

Taken together, these studies provide evidence that in some conditions, older adults can regulate their emotional responses similar to young adults. However, there are specific limitations to this capacity, such as the type of strategy utilised, the type of emotion-eliciting stimuli, and the valence and intensity of the experienced and expressed emotion. Findings also demonstrate that successful emotion regulation efforts in older adults may be partly due to having less facial reactivity to regulate and resulting in fewer demands on cognitive resources during regulation. Thus, the current research highlights that emotion regulation is not completely spared in later life, and that there are a number of complexities involved when considering the relationship between emotion regulation and ageing.

CHAPTER 1: General Introduction

"There's nothing more daring than showing up, putting ourselves out there and letting ourselves be seen."

– Brené Brown (2012)

1.1. General Overview

Emotions provide brief responses to interpersonal and intrapersonal situations to inform us of what is important, assist us in achieving personal goals, and allow us to efficiently communicate with others (Greenberg & Paivio, 2003; Gross & Thompson, 2007; Urry & Gross, 2010). As such, they are central to everyday life and wellbeing throughout the life span. Our understanding of the emotional functioning of healthy older adults (aged 65 years or older), however, remains limited, with most studies in the ageing literature concentrating on the reduced functions associated with the ageing process. While there are undoubtedly well established age-related cognitive, social, and physical declines, there is, however, growing evidence suggesting that older adults maintain some aspects of emotional functioning, such as emotion regulation (Isaacowitz & Blanchard-Fields, 2012; Kryla-Lighthall & Mather, 2008; Scheibe & Carstensen, 2010; Suri & Gross, 2012). Emotion regulation is the process of managing our emotional systems by reducing, enhancing, or maintaining our emotional responses at a desired time and is an essential and adaptive skill for day-to-day functioning. Therefore, understanding how young and older adults regulate their experience and expressions of emotions provides valuable information about age-related changes in emotion regulation (Mather, 2012).

1.2. The Current Research Project

The core focus of this research thesis was to investigate the extent to which emotion regulation capacity is preserved in older adults. The first overall aim was to investigate and further understand the possible contributors that might help explain *how* older adults are able to regulate their emotions in comparison with young adults, such as through age differences in emotional reactivity that may reduce demands on cognitive resources to regulate, or through more effective use of different types of strategies. The second overall aim was to investigate the *limitations* to older adults' emotion regulation ability, such as emotion regulation difficulties associated with heightened emotional arousal and discrete emotional states (e.g., amusement vs. sadness), coupled with different strategies.

Young and older adults were instructed to implement a range of emotion regulation strategies to reduce their emotional responses, which included expressive suppression, cognitive 'detached' reappraisal, and focused-breathing. Facial electromyography (EMG) was used as a novel technique to assess the effectiveness of emotion regulation on subtle changes in facial expressions, along with self-report to assess subjective experience, and the autonomic measure of skin conductance (SCL) to assess physiological arousal. Additionally, to index the cognitive demands associated with emotion regulation processes, memory performance (i.e., stimulus recall following regulation) was compared between strategies in young and older adults.

This research project consists of three experimental studies addressing specific aims and hypotheses relating to emotion regulation in young and older adults (plus an additional study piloting dynamic film stimuli). Each study is connected by a primary focus on examining the effects of regulatory strategies on facial reactivity, and the possible consequences the engagement in these regulatory efforts may have on subsequent memory recall. Figure 1.1 illustrates the relationship between each study, in sharing the common dependent variables (emotional responses, memory performance), and the progressive changes to the independent variables and stimuli. As shown in Figure 1.1, the first study examined emotion regulation of positive and negative pictures using cognitive reappraisal and expressive suppression. A large selection of films were piloted in the second study to determine sets of dynamic stimuli that were of higher emotional intensity, and requiring increased effort when engaging in emotion regulation. The third study required participants to regulate their emotional responses using expressive suppression to amusing, happy, and sad films of varying emotional intensities. The fourth study included the addition of a focused-breathing strategy, alongside expressive suppression and cognitive reappraisal, to regulate feelings of sadness. Data from the third and fourth study were collected during the same testing session using the same participants and background measures.

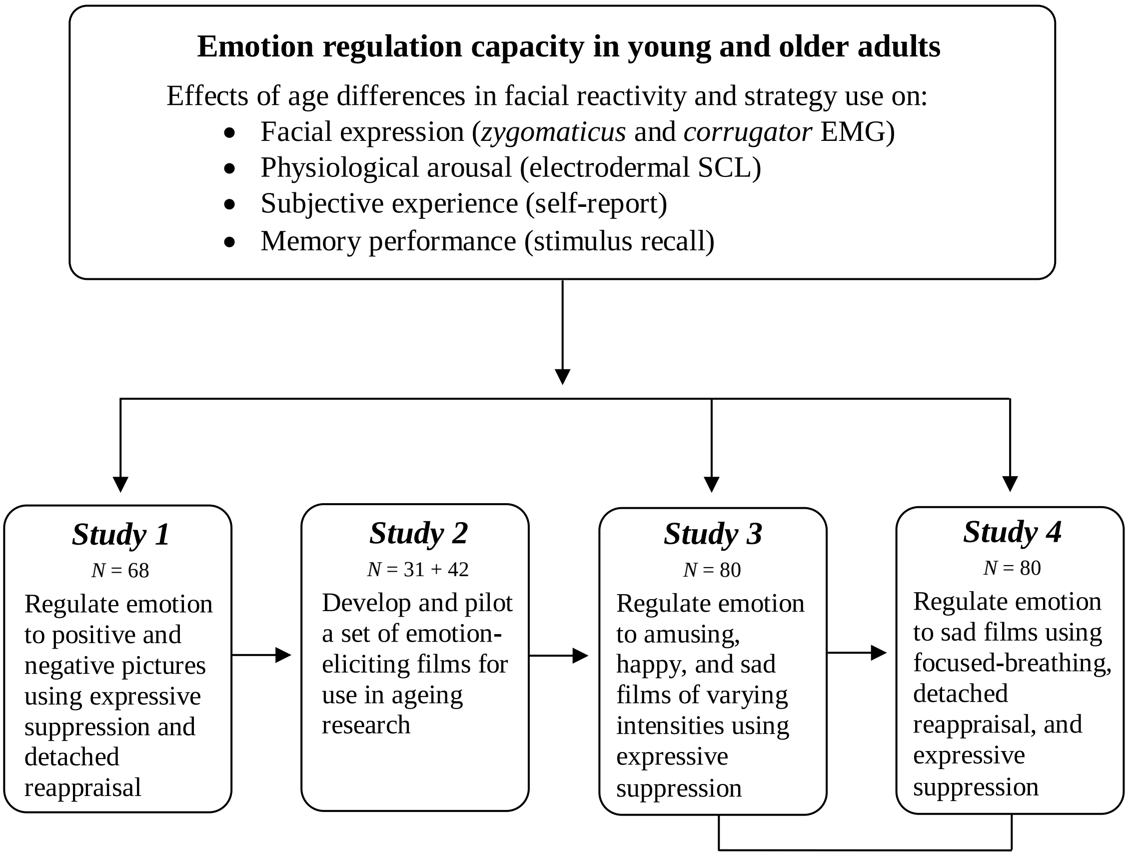

Figure 1.1. Research structure and the relationship between experimental studies.

1.2.1 Research Questions Specific to Each Study

Study 1 (Chapter 3), accepted for publication in *Psychology and Aging* (Pedder et al., 2016), investigated whether the type of strategy utilised, or age differences in facial reactivity, might contribute to understanding how older adults can regulate their emotion as well as young adults. Participants were instructed to regulate their emotional responses to positive and negative pictures using expressive suppression and detached reappraisal strategies. Z*ygomaticus* and *corrugator* EMG recordings were used to objectively measure subtle changes in muscle responses involved in smiling and frowning. The specific objectives of Study 1 were to:

1. Determine the extent young and older adults can regulate their facial expression of positive and negative emotion, as measured with EMG.
2. Determine whether age differences in facial reactivity, or differential use of emotion regulation strategies (expressive suppression and detached reappraisal), might explain how older adults effectively engage in emotion regulation.
3. Determine the impact expressive suppression and detached reappraisal strategies have on memory performance.

Study 2 (Chapter 4) was designed as a pilot study for Studies 3 and 4. The purpose of Study 2 was to select and empirically test a set of dynamic emotional stimuli that were more challenging than the static pictures used in Study 1 and also differed in their levels of emotional intensity. Specifically, Study 2 piloted a large range of emotion-eliciting films that were suitable for young *and* older adults. The stimuli were intended to evoke heightened levels of emotion reactivity and arousal that would place greater demands on emotion regulation efforts in the subsequent studies. Participants were instructed to self-rate their subjective emotional experience to amusing, happy, sad, and neutral films. The specific objectives of the Study 2 were to:

1. Develop and pilot amusing and sad films that elicit the intended discrete emotional states in young and older adults, ensuring the content is relevant for both age groups.
2. Norm sets of amusing and sad films that differ in low and high levels of emotional self-reported intensity.
3. Norm a set of pleasant (happy) films that elicit feelings of happiness, which is more emotionally arousing than the pleasant static pictures used in Study 1, but less emotionally arousing than dynamic amusing films to use in Study 3.

Study 3 (Chapter 5) was based on the findings from Study 1 that older adults may be effective at regulating emotion due to having less facial reactivity than young adults, and therefore potentially require less cognitive effort for emotion regulation. Thus, Study 3 further investigated age differences in facial reactivity as a contributor to older adults' emotion regulation ability, and also considered the limitations to successful regulation. Specifically, Study 3 investigated older adults' capacity to regulate their facial expressions when viewing dynamic films designed to elicit greater emotional arousal than the static pictures used in Study 1. Participants viewed amusing, happy, and sad emotion-eliciting films of varying intensities, piloted in Study 2, and were instructed to regulate overt facial expressions using expressive suppression. Facial expression (EMG), physiological arousal (SCL), and self-reported emotional experience were assessed. The specific objectives of Study 3 were to:

1. Determine whether older adults maintain emotion regulation success when regulating facial expressions in response to dynamic stimuli of amusing and sad films.
2. Manipulate the emotional intensity of stimuli to produce low and high levels of facial reactivity in the watch condition for young and older adults, and determine the effects on emotion regulation efforts.

3. Determine the relative impact on memory performance when participants are instructed to regulate their expressions to stimuli of varying emotional intensities.

Study 4 (Chapter 6) extended Study 3 by investigating alternative strategies that may assist older adults to more effectively regulate their emotional responses to negatively arousing films. Specifically, this study aimed to enhance the understanding and evidence for breathing-based techniques as a regulation strategy in later life. Focused-breathing was compared and contrasted with expressive suppression and detached reappraisal strategies. Focused-breathing was also assessed in whether it could be a more efficient and less effortful strategy for older adults due to relying on different mechanisms and skills than traditional cognitive- and behavioural-based strategies. Participants were instructed to watch naturally or use each of the three emotion regulation strategies whilst viewing sad films. The specific objectives of the Study 4 were to:

1. Determine the effectiveness of focused-breathing for regulating facial responses, physiological arousal, and subjective feelings of sadness in young and older adults.
2. Determine the effects of focused-breathing on memory performance, in order to index recruitment of possible attentional resources with this strategy use.

1.2.2 Thesis Structure

Following the current introductory chapter, this thesis includes one literature review, four separate chapters describing the experimental studies, and one general discussion. The complete reference list and appendices are included at the end of this document.

The introductory chapter is designed to provide the reader to a general overview of the research project, including key contextual information, the focus of investigation, and an outline of the experimental studies. Chapter 2 reviews the research literature that currently exists for emotion regulation in young and older adults, providing the fundamental theoretical and empirical basis for the later chapters. Chapter 2 also provides an evaluation of the relevant literature on cognition and emotion regulation, and examines the rationale for the core research questions of the subsequent studies.

Chapters 3, 4, 5, and 6 include individual experimental studies, each with their own Introduction, Method, Results, and Discussion sections.

Chapter 7 is the final chapter, and provides an overall summary of the thesis and reviews the primary research questions associated with each empirical study. This chapter contains the overall discussion, including implications of the findings, limitations, and directions for future research. A conclusion is provided at the end.

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CHAPTER 2: Literature Review of Emotion Regulation in Old Age

> *"With age, things are appraised against a much deeper store of pertinent experiences, which can lend different perspectives on emotionally relevant matters involving such considerations as losses and gains. Also as we age, our inclinations to exert control over our emotional response tendencies may change in significant ways, as may our abilities to impose these controls effectively."*
>
> *– Robert W. Levenson (2000)*

Overview of Chapter

The current chapter provides a detailed review of the literature on emotion regulation capacity in healthy older adults. The first section of the chapter provides a general overview of emotion and emotion regulation, with a definition of both constructs is provided. The functional role of emotions in our daily lives is also explored, and a distinction is made between when emotions are adaptive and maladaptive. The important role of emotion regulation is highlighted and frameworks for conceptualising and organising emotion regulation strategies are reviewed, with a focus on Gross' (1998b) process model of emotion regulation.

The second section reviews research on emotion regulation capacity in old age. Emotion regulation is examined in the context of recent evidence and theoretical perspectives regarding successful ageing and maintained wellbeing in later life. Older adults' capacity to regulate subjective experience, facial expressions, and physiological reactions to positive and negative emotions is reviewed, and the effects of healthy ageing on specific strategies outlined in Gross’ (1998b) process model are examined. The relationship between emotion regulation and cognition is also explored, with an emphasis on the cognitive and neurological processes involved in regulating emotions in later life.

The third section reviews theory and evidence for two proposed areas that may contribute to preserved emotion regulation in older adults (Morgan & Scheibe, 2014). First, age-related biological changes may lower emotional reactivity in older adults and thereby reduces the degree of effort and resources required to achieve emotion regulation goals compared with young adults. Second, focused-breathing, as a type of mindful emotion regulation (Chambers, Gullone, & Allen, 2009), is introduced as an alternative approach to regulating emotion and that may particularly benefit older adults.

The final section of this literature review provides a brief summary of the chapter, with an emphasis on the key areas of research investigated in the current thesis.

2.1. Understanding Emotion and Emotion Regulation

In understanding emotion regulation, it is important to first consider what emotions are, and the role they play in guiding and influencing our daily lives.

2.1.1 What is Emotion?

Defining emotion. Emotions are short-term experiential states that arise to prepare the body for action and to provide personal meanings to experiences evoked by the self or a situation (Greenberg & Paivio, 2003; Opitz, Gross, & Urry, 2012). Emotions involve conscious feelings of awareness and reflection, as well as unconscious automatic biological responses that stimulate physiological and neurological processes (Greenberg & Paivio, 2003). In particular, emotions surface when we attend to situations where something is important to us, and which is relevant to our goals and needs (Urry & Gross, 2010). Emotions involve the integration of multiple components, such as changes in internal thoughts and experience (e.g., feelings of happiness or sadness), facial expressions (e.g., smile or frown), behavioural responses (e.g., fight or flight), physiological drives (e.g., heart rate or sweating), and changes in neural activity (Gross, 2002; Urry & Gross, 2010).

Historically, emotions have been regarded as irrational and separate from cognition, however, recent research has begun to understand the interplay between these two constructs (Ardelt & Ferrari, 2014; LeDoux & Phelps, 2011; Oatley, Parrott, Smith, & Watts, 2011). In comparison to cognition, emotions are part of a biologically older system that contributes to rapid decision-making and actions in response to immediate environmental stimuli and events (Chambers et al., 2009; Greenberg & Paivio, 2003). Emotions lead to physiological and neurological changes, which alert our consciousness, direct our action tendencies, and orientate our thoughts. Cognition, however, provides us with the ability to make sense of our emotional experiences through knowledge, analysing the situation, and establishing the most appropriate means of achieving our goals (Greenberg & Paivio, 2003). By working hand in hand, our emotion and cognitive systems allow us to make adaptive responses by bringing to attention what is most important, establishing our goals, making sense of our experiences and determining the solution.

As noted, emotions generate a coordinated set of experiential, behavioural and physiological states that shape how we respond to any given situation (Gross, 2002; Moors, 2010). The nature of these responses, however, is affected by whether the emotions are experienced as pleasant or unpleasant by the individual. For example, anger can be accompanied by physical sensations of strength and tension in the arms and hands, cognitive changes such as sharp focused thinking, action urges to approach the situation, and increased heart and breathing rate (Kreibig, 2010). By contrast, sadness is accompanied by thoughts of loss and sorrow, heaviness in the chest and head, an urge to withdraw or cry, and decreased sympathetic and cardiovascular activity (Kreibig, Wilhelm, Roth, & Gross, 2007). Amusement, however, is expressed through smiling, and involves laughter, feelings of exhilaration, accompanied by approach related behaviours, and increased electrodermal and respiratory activity (Herring, Burleson, Roberts, & Devin, 2011).

Role of emotions. Emotions are fundamentally adaptive in our everyday lives, providing us with internal signals which highlight our goals and direct our action tendencies (Gross, 2002). For instance, anger triggers a need to protect ourselves when our boundaries are being threatened, fear readies us for escape, disgust turns us away from decay, happiness enhances openness and creativity, and joy enhances life and promotes the pursuit of happiness (Greenberg & Paivio, 2003; Prinz, 2012). Emotions motivate and prepare us for action, provide meaning, guide and enhance our decisions, and focus our attention on what is important and to be remembered (Mather, 2012).

Furthermore, emotions organise us for action by directing our attention to what is important and of concern for us, and by motivating us for change (Chambers et al., 2009). LeDoux and Phelps (2011) report that sensory information arrives faster to the emotional areas of the brain, such as the amygdala, thereby allowing us to rapidly process and quickly respond without requiring more complex time-consuming cognitive processing (Chambers et al., 2009). Cognitions and higher order thinking can then make sense of these experiences in relation to a specific context or situation. Regardless of whether the emotional experience or expression is automatic or purposefully generated, such an experience motivates us for actions through changes to the autonomic nervous system (ANS), with the ultimate goal of changing our experience, response, situation or environment (Greenberg & Paivio, 2003; Levenson, 2014). Once the desired goal has been achieved, such as crying to receive comfort from a parent, or anxiety to detect and avoid danger, the emotion is no longer needed and ceases.

When emotions are maladaptive. Generally, emotions serve us well, however, not all emotional responses are adaptive, with their appropriateness largely dependent on their valence, intensity, and duration as well as the context in which they are experienced and expressed (Opitz et al., 2012). Emotions tend to become maladaptive when they are experienced for long periods of time, such as sustained feelings of shame leading to a sense of worthlessness, or in situations where they are inappropriate, such as heightened anger at a fleeting misunderstanding with a friend (Gross & Thompson, 2007). Emotions may also mislead us and direct us towards unhelpful goals and circumstances (Gross, 2002), and at times, it can be difficult to stop or ignore feelings. In such instances, it can be crucial that we modify and regulate how we experience and respond to our emotional states to better serve our goals and wellbeing (Gross, 1999b, 2002). This process is known as emotion regulation.

2.1.2 What is Emotion Regulation?

Defining emotion regulation. Emotion regulation refers to the process of managing and influencing our emotional experience and responses to internal and external stimuli (Chambers et al., 2009). More, specifically, Gross (1998b, p. 275) defines emotion regulation as, “the process by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions”.

According to Gross (2014), there are three core features of emotion regulation: (1) the activation of regulatory goals, (2) the engagement of regulatory processes, and (3) the modulation of the emotion trajectory. Simply put, these core features refer to the goals, strategies, and outcomes of emotion regulation. The current research project focuses on the strategies for *intrinsic* regulation and the outcomes of these on emotional responses (e.g., expression, experience, physiology) and cognitive performance (e.g., memory recall). Intrinsic regulation primarily aims to manage the intrapersonal emotional experience and reactions of oneself to achieve a desired goal or outcome, which is in contrast to *extrinsic* regulation involving the management of another’s emotional responses, such as those of children.

Emotion and emotion regulation. Within the field of emotion, the distinction between emotional processing and emotion regulation can be complex and difficult to identify, and consequently, the boundaries between where emotion ends and regulation begins is often debated (Koole, 2009). Emotion regulation can be an automatic and rapid process and unconsciously triggered early in the emotion-generation process (Barrett, Gross, Christensen, & Benvenuto, 2001; Gross, 2001; Koole & Fockenberg, 2011), making it difficult to measure differences between regulated emotions and unregulated emotions (Gyurak, Gross, & Etkin, 2011). Importantly, some researchers would argue that emotions are never truly free from regulation, but instead, all emotional states and responses are regulated in some form or another (Gross, Sheppes, & Urry, 2011).

A two-factor model has been proposed by some researchers to distinguish between emotion and emotion regulation (Cole, Martin, & Dennis, 2004; Gyurak et al., 2011). The model proposes that emotions themselves regulate other processes (e.g., cognitive, perceptual, behavioural, interpersonal) automatically to achieve goals that are fundamentally adaptive (e.g., fleeing with fear at the sight of a snake; Chambers et al., 2009). However, this differs from emotion regulation, which involves modulation of the emotional state to achieve an alternative goal or emotional outcome (Cole et al., 2004).

An additional issue involves distinguishing between conscious and unconscious emotion regulation. Whilst there is some disagreement in the literature (see Eisenberg & Spinrad, 2004; Thompson, 1994), both are generally regarded as forms of regulation that alter the flow of emotions (Gross, 1998a). Conscious regulation involves purposeful processes using a range of potentially effortful strategies, whereas, unconscious regulation involves automatic processes that are less taxing to the individual (Chambers et al., 2009). Over time, repeated use of specific strategies that initially required conscious activation, may become utilised automatically and thereby requiring minimal effort and conscious control (Chambers et al., 2009). Regardless of the level of awareness in the process, appropriately employed regulatory strategies are adaptive and beneficial for our day-to-day functioning.

Role of emotion regulation. Individuals aim to regulate their emotional states in order to achieve specific goal-oriented functions and psychological outcomes, including meeting hedonic needs and improving social relations, optimising psychological and physiological states, and achieving task and goal priorities (Koole, 2009). Emotion regulation does not necessarily require significant changes to emotional experiences and responses, but instead, could involve subtle shifts to these experiences and responses, which lead to better tolerating the emotional states (Greenberg & Safan, 1987). In some circumstances, optimal functioning achieved through emotion regulation is considered to be between hypo- and hyper-aroused emotional states (Chambers et al., 2009). Regulation can also be regarded as directing changes along the dimensions of valence, arousal and approach-avoidance, rather than focused on switching discrete emotions ‘on’ or ‘off’ (Koole, 2009; Mauss & Robinson, 2010). Furthermore, even though regulation may be desirable in certain situations, it may not always be beneficial. For instance, allowing the expression of anger, rather than inhibiting this affective state, may be better suited to achieving confrontational goals (Opitz, Gross, et al., 2012).

That said, whilst emotion regulation was traditionally conceptualised as limited to promoting positive pleasurable emotions and reducing vulnerability and pain to negative emotions for hedonic needs (Gross, 1999b; Gross, Richards, & John, 2006), this view is no longer commonly held (Giuliani, McRae, & Gross, 2008; Koole, 2009; Tugade & Fredrickson, 2006). Indeed, it is now generally recognised that positive emotional states are not always beneficial (such as laughter at another's misfortune), nor are negative states detrimental (such as grief during the loss of a loved one), but instead these emotional states are appropriate for a range of situations (e.g., see Fredrickson, Mancuso, Branigan, & Tugade, 2000; Kalokerinos, Greenaway, Pedder, & Margetts, 2014). Emotion regulation is a multifaceted construct that involves dealing with the full spectrum of emotional experiences and responses across continuously changing internal and external situational demands (Chambers et al., 2009; Nezlek & Kuppens, 2008).

Gross' (1998b) process model of emotion regulation. Rather than a single process, emotion regulation involves multiple processes to achieve the desired emotional goal or outcome (Lohani & Isaacowitz, 2014). Regulation may involve conscious implementation of skills and strategies to directly change an outcome, or may be unconsciously driven through automatic processes that modify the emotional state without effort. These processes may include redirecting attention, avoiding certain situations, revaluating the event in a different light, or modifying behaviour or facial displays of emotion. Gross' (1998b) model of emotion regulation provides a framework for mapping different strategies according to their temporal occurrence in the emotion-generation process, as displayed in Figure 2.1.

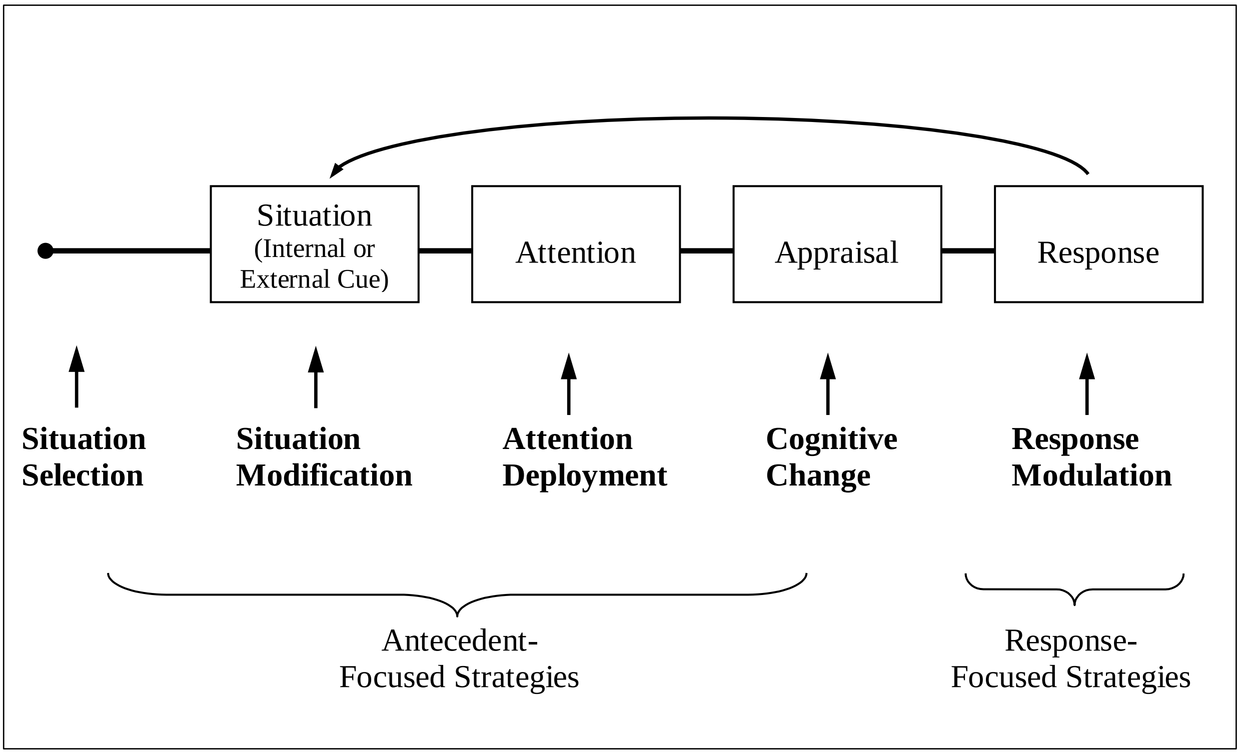

Figure 2.1. Gross' (1998b) process model of emotion regulation. The model illustrates that emotion generation unfolds over time, starting with the initial internal or external emotional cue, followed by attention to and appraisal of the emotional situation, which lastly triggers the emotional response. Strategies can intervene at any of the stages, impacting the outcome of emotion response tendencies, such as experience, expression, behaviour, and physiology.

Gross (1998b) developed the process model of emotion regulation to represent and categorise the potentially endless number of regulation strategies that could be applied during different stages of the emotion generation process (Gross, 2002). The widely used model organises groups of strategies along a timeline of unfolding emotional experience and responses (Gross, 2002). The emotion generative cycle begins with the input of internal or external cues, which is attended to and evaluated in certain ways, before ultimately leading towards an emotional response (Phillips, Henry, Hosie, & Milne, 2008). Fundamentally, the model asserts that given that emotions unfold over time, approaches to implementing strategies are distinguished based on the temporal stage at which they intervene in the unfolding timeline (Gross, 2002; John & Gross, 2004; Morgan & Scheibe, 2014). Strategies applied at each stage rely on different skills and processes, which subsequently alters the course of emotion, affecting emotional experience, expression, physiology, and behaviour differently (Shiota & Levenson, 2009; Yeung, Wong, & Lok, 2011). The different strategic approaches to regulation are shown in Figure 2.1, as are the temporal stages when emotion regulation can occur.

The process model of emotion regulation distinguishes between strategies that are implemented prior to (i.e., antecedent-focused) or following (i.e., response-focused) the activation of emotional response tendencies (Gross, 1998a). Antecedent-focused strategies proactively modify the situation early in the emotion generation cycle, before the emotional experience and response is elicited (Yeung et al., 2011), thereby representing manipulation of the input to the emotional systems (Chambers et al., 2009). For example, this could involve re-evaluating a job interview as a chance to meet and learn from the potential employer, rather than pressure not to fail, which ultimately reduces anxiety related to the interview. By contrast, response-focused strategies manage our emotional behaviour and physiological responding at the end of the emotion generation cycle, and involve the manipulation of emotional outputs (Chambers et al., 2009; Gross, 2002). This could include inhibiting behavioural expressions of anxiety conveyed during the interview, such as hiding facial displays of worry and nervousness.

According to Gross' (1998b) model, emotion regulation strategies are grouped into five broad stages that are identified across the emotion generative cycle. These stages are: (1) situation selection, (2) situation modification, (3) attentional deployment, (4) cognitive change, and (5) response modulation. Each stage includes an extensive set of strategies, each of which relies on different skills and processing characteristics to regulate emotion, that allow individuals to modify their emotional trajectory as it unfolds over time (Chambers et al., 2009). As per Figure 2.1, the first four stages are linked to antecedent-focused strategies, whereas the final stage is associated with response-focused strategies. Whilst the model does imply that the emotion generative process involves a set progression through each stage, in reality, the stages are not fixed in any sequential order, and they do vary (Koole, 2009). For example, attending to an emotional event may elicit behavioural responses without the facilitation of cognitive appraisals.

Situation selection. In the first temporal stage of Gross' (1998b) model, situation selection provides the earliest opportunity for emotion regulation and involves choosing which situations to approach or avoid so as to alter any expected emotional responses. These situations could involve people, places, events, or objects that are known to elicit potentially pleasant or unpleasant emotional states (Gross, 2002). An example of situation selection is proactively avoiding travelling via aeroplane due to a fear of flying. Situation selection often involves complex trade-offs, such as short-term benefits in managing emotions versus long-term consequences of not confronting or learning to cope with the anticipated emotion (e.g., reinforcing the fear of flying; Gross, 2002). According to the model, this form of emotion regulation occurs prior to the onset of emotion, however, it has been shown that anticipating an emotional state itself results in subtle brain and physiological activation leading to partial experience of that emotion (Koole, 2009; Schumacher et al., 2015).

Situation modification In the second stage, situation modification involves altering aspects of the situation in order to change the emotional impact (Opitz, Gross, et al., 2012). This form of emotion regulation engages processes (e.g., behavioural or social skills) that tailor a situation in order to modify anticipated emotional experiences and responses. Examples of situation modification are keeping close to a friend before feeling anxious at a large social gathering and establishing boundaries with a colleague when anticipating the current conversation may elicit anger. As with situation selection, situation modification involves considering the likely impact of a situation and our associated emotional responses, and recognising ways to modify this to achieve personal goals.

Attention deployment. In the third stage of Gross' (1998b) model, attentional deployment involves shifting attentional resources and focusing on other aspects within the emotional situation in order to regulate emotion. Such strategies could involve thinking about something entirely different (Urry & Gross, 2010) or paying attention to a neutral activity or object (Van Dillen & Koole, 2007). Another strategy could include using distraction to disengage from thoughts or awareness related to the emotional situation (Martins, Ponzio, Velasco, Kaplan, & Mather, 2015), such as focusing attention on work responsibilities following a romantic break-up. Strategies within the attentional deployment stage provide individuals with the opportunity to select what they attend to in a situation, and thus, limit the anticipated emotional response (Gross, 2002).

Cognitive change. The fourth stage of the model, cognitive change, involves reinterpreting the emotional meaning of the event by cognitively reframing how one thinks and relates to the event (Ahn et al., 2015). Within this stage, there are a number of different approaches that can be applied in order to cognitively reappraise an emotional event to alter the emotional response (Opitz, Gross, et al., 2012). Examples include using a 'detached' reappraisal approach which involves viewing the emotional event objectively, or using a 'positive' reappraisal approach which focuses on recognising the positive aspects of the emotional event (Shiota & Levenson, 2009).

Cognitive reappraisal is understood to be an adaptive approach with many benefits, such as, in the short-term, reducing emotional experience, facial expression, and physiological arousal (Gross, 2002; Jackson, Malmstadt, Larson, & Davidson, 2000). Unlike distraction, cognitive reappraisal strategies promote continued engagement with the emotional event while still reducing the undesired emotion (Martins et al., 2015) and has been shown to result in improved memory for the event (Kim & Hamann, 2012). Furthermore, cognitive reappraisal has been theorised to be less demanding on cognitive resources due to being applied relatively early in the emotion generation process before emotional reactions have been fully activated compared to strategies applied later in the process (Gross, 1998a). The long-term benefits associated with implementing cognitive reappraisal include increased positive emotions, life satisfaction, psychological wellbeing, and closer relationships (Gross & John, 2003; John & Gross, 2004; McRae, Jacobs, Ray, John, & Gross, 2012).

Response modulation. In the final stage of Gross' (1998b) emotion regulation model, response modulation involves directly altering emotional reactions once they have been activated (Gross & Thompson, 2007). This involves inhibiting emotional facial expressions, behaviour, or physiological arousal. One response modulation strategy that has received a considerable amount of research is expressive suppression, which involves concealing the outward visible display of emotion through controlling facial muscles so that others cannot recognise what that individual is feeling (Demaree, Robinson, Pu, & Allen, 2006). However, due to the late timing of expressive suppression in the emotion generation process, this strategy does not reduce the internal experience of negative emotions, and consequently, increases physiological states (e.g., skin conductance, heart rate; Gross, 1998a; Gross & Levenson, 1997), and decreases memory performance (Richards, 2004; Robinson & Demaree, 2009). In addition, persistent use of expressive suppression has been found to be detrimental to a range of psychological, cognitive, health, and social related outcomes (Butler et al., 2003; Mauss & Gross, 2004; Richards & Gross, 2000).

In summary, Gross' (1998b) model provides a useful framework to distinguish between types of emotion regulation strategies and the temporal stage in which they occur along the emotion generation process (Eisenberg & Spinrad, 2004; Gross, 1999a; Koole, 2009).

Alternative approaches to conceptualising emotion regulation. Whilst Gross' (1998b) process model has received considerable attention and research over the last few decades, there are alternative models for organising and conceptualising emotion regulation strategies. Although, these frameworks have been less influential and are cited far less often in the literature than Gross' (1998b) model. These include Thayer, Newman, and McClain's (1994) biopsychological model of mood-regulation, Parkinson and Totterdell's (1999) conceptual distinctions of affect-regulation strategies, Larsen's (2000) model of mood regulation, and Koole's (2009) dual classification of emotion regulation strategies (for a summary, see Webb, Miles, & Sheeran, 2012).

In Koole's (2009) model, for example, the author proposes that emotion regulation strategies can be classified according to their *target* and *function*. Emotion regulation targets include the attention, knowledge (e.g., cognitions, appraisals), and bodily states (e.g., facial expressions, physiology) of the emotion-generating system to be regulated. Emotion regulation functions include satisfying hedonic needs (e.g., avoiding pain), obtaining specific goals (e.g., inhibiting facial expression to maintain social norms), and supporting personality systems (e.g., controlled breathing to promoting overall personal functioning). More than 20 different strategies are classified in relation to these two factors. For instance, cognitive reappraisal is considered a knowledge-based and goal-oriented strategy, whereas expressive suppression is considered a body-based and goal-oriented strategy. The model also considers mindfulness approaches to regulating emotion, considering it an attention-based and person-oriented strategy (Lalot, Delplanque, & Sander, 2014). By mapping strategies according to both their target and function, the author outlines the efficiency of specific strategies according to specific emotional goals (for results, see Koole, 2009). Thus, Koole's (2009) model goes beyond simply categorising what emotional systems are being regulated by also considering the psychological functions of emotional goals.

In a recent extension of Gross' (1998b) process model of emotion regulation, Riediger and Luong (2015) proposed a developmental perspective. The authors adjust the model to consider age-related differences in the processes involved in emotion regulation and the short and long-term emotional outcomes. As such, the extended model integrates developmental evidence from adolescence to old age so as to include age-related factors that shape emotion regulation goals, skills, and strategies (Riediger & Luong, 2015). Such factors may include age specific motivations, daily emotional experiences, life context, and level of emotional arousal. However, Riediger and Luong (2015) proposed that the model still requires further refinement in its representation of the age-related developmental factors that contribute to the relationship between emotion and emotion regulation.

Importance of emotion regulation. Emotion regulation is a necessary part of emotional processing, as initial emotional experiences and responses are not always adaptive or appropriate in every situation. Regulation allows us to refocus our emotional trajectory in order to achieve intra- and interpersonal goals and outcomes (Koole, 2009), and is associated with improved psychological health and adjustment (Bonanno, Papa, Lalande, Wesphal, & Coifman, 2004; Hopp, Troy, & Mauss, 2011; Westphal, Seivert, & Bonanno, 2010), physical health (Bambling, 2006; Sapolsky, 2007), social relationships (Coan, 2011), work participation (Scheibe & Zacher, 2013), and overall quality of life (Alberts, Schneider, & Martijn, 2012; Gross & John, 2003; Schutte, Manes, & Malouff, 2009). For instance, flexible use of expressive suppression and amplification strategies in appropriate situations has been linked to long-term successful management of distress and adjustment (Bonanno & Burton, 2013; Bonanno et al., 2004). As a result of these adaptive implications, emotion regulation is an essential component of *emotional competence*, a larger construct that refers to the capacity to deal with complex emotions (Robinson & Demaree, 2009; Thompson, 1994). However, just as emotions are not always helpful, the same can be said about emotion regulation.

Poorly regulated emotions can lead to aversive affective, cognitive, physiological, health and social consequences (Gross, 2002; Opitz, Gross, et al., 2012), such as increased heart rate (Robinson & Demaree, 2009), or reduced working memory (Scheibe & Blanchard-Fields, 2009). Additionally, habitual use of particular regulatory processes, including repeated over-regulation (e.g., suppressing all facial expressions) or under-regulation (e.g., inability to reduce distressing thoughts), could also be problematic (Greenberg & Bolger, 2001; Opitz, Gross, et al., 2012). Thus, an inability to appropriately regulate emotions can impact relationship satisfaction (Richards, Butler, & Gross, 2003), and workplace performance (Scheibe & Zacher, 2013).

Emotion dysregulation, which refers to deficits in regulating emotional experience and responses, as well as inappropriate use of strategies, can have significant clinical implications (Chambers et al., 2009). Continued dysregulation of positive and negative emotions (Ortner & de Koning, 2013), including over- or under-regulation, are common features of mood, anxiety, and personality disorders outlined in *The Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5; American Psychiatric American Psychiatric Association, 2013). As such, emotion regulation is a central goal of cognitive behaviour therapies (Beck, 2011; Hayes, Strosahl, & Wilson, 1999), mindfulness-based therapies (Kabat-Zinn, 1990; Williams, Teasdale, Segal, & Kabat-Zinn, 2007), and dialectical behaviour therapy (Linehan, 1993). Accordingly, appropriate use of a range of regulation strategies and processes is essential in order to experience the adaptive benefits of emotion regulation in maintaining optimal psychological functioning (Chambers et al., 2009).

Emotion regulation capacity. Whilst emotions may be deemed as irresistible forces that take our thoughts and actions hostage, individuals are in fact relatively effective and capable of monitoring and modulating their emotional states (Kim & Hamann, 2012). Indeed, research demonstrates that generally, people are effective at reducing unwanted negative feelings (Samson & Gross, 2012), modifying their facial displays of emotion (Dan-Glauser & Gross, 2011), and reducing sweat and heart rate (Driscoll, Tranel, & Anderson, 2009). The skills, knowledge, and processes involved in emotion regulation improve with practice and experience, and are influenced by developmental factors across the life span

(Opitz, Gross, et al., 2012). For instance, a young child's emotional state is often regulated by a parent, whereas, adolescents to adults in later life increasingly become self-sufficient in managing their own emotional experiences (Koole, 2009).

Learning to tolerate and manage the experience and expression of emotion is an important ongoing developmental task. From an early age, caregivers play a fundamental role in regulating the emotional states of infants and children (Koole, 2009). This is an example of interpersonal regulation, where the processes to manage emotion extend to others (Chambers et al., 2009; Cole et al., 2004). Over time, self-regulatory processes drive emotion regulation. Adult life comprises of multiple situations in which we are required to manage our emotions, such as difficulties with friends, problems at work, and health-related concerns (Kunzmann, Kupperbusch, & Levenson, 2005). Accumulated practice in regulation, coupled with life experiences and wisdom, have been thought to contribute to age-related stability or even improvements in managing emotional states and responses (Ardelt & Ferrari, 2014; Kunzmann et al., 2005), however, emotion regulation processes have been shown to continually shift and change throughout adulthood and into later life (John & Gross, 2004). Much of the research in emotion regulation has fundamentally focused on the acquisition of such skills from infancy through childhood (Thompson, 1994). However, until recently, fewer studies have in comparison examined the capacity for regulation into old age (John & Gross, 2004); a focus of the current thesis.

2.2. Emotion Regulation and Ageing

Whilst ageing is typically considered a time of loss and decline in cognitive, physiological, social, and health related domains, aspects of emotional processing appear to be spared as we grow older (Morgan & Scheibe, 2014). Older adults have been shown to approach emotion regulation differently to young adults, with such regulatory processes continuing to develop and change with age (John & Gross, 2004). With shifts in goals and motivations (see SST; Carstensen, Isaacowitz, & Charles, 1999), older adults demonstrate increased priorities and skills in efficiently regulating emotional states. Research into emotion regulation and ageing has substantially increased in the last few decades, with increasing focus on the preferences for particular strategies and the success of using different regulation strategies (Charles & Carstensen, 2007; Suri & Gross, 2012; Urry & Gross, 2010). Further knowledge about regulatory processes towards the end of the life span is beneficial in improving understanding of developmental changes in emotion processing, as well as age-related shifts in emotion regulation, and daily emotional experiences of older adults in comparison with young adults (John & Gross, 2004).

2.2.1 Successful Ageing and Wellbeing

Traditionally, research has focused on the declines and losses within the ageing population. Physically, old age is associated with multiple health conditions (e.g., high blood pressure, osteoarthritis, chronic illness), reduced sensory functioning (e.g., visual and auditory), and difficulties managing activities of daily living (Urry & Gross, 2010). Cognitively, older adults experience memory declines, reduced inhibition, processing speed, and deterioration in higher order executive functions (Eckert, 2011; Hedden & Gabrieli, 2004; Opitz, Gross, et al., 2012; Park et al., 2002). Socially, with increasing age, individuals are more likely to lose friends and family to ill health or death, and have reduced social networks (Carstensen, Fung, & Charles, 2003; Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001). Despite these age-related declines, growing research is demonstrating continued emotional wellbeing in older adults (e.g., Ong, Mroczek, & Riffin, 2011). Consequently, a prominent question within the ageing literature is that given these age-related losses, how is it that older adults do not, in fact, feel worse or report lower levels of wellbeing? Researchers have come to describe this as the emotional paradox of ageing, that despite these declines, emotional wellbeing remains relatively high into old age (Löckenhoff & Carstensen, 2004).

Increasing attention has in fact been paid to successful emotional ageing in the research literature (for a review, see Jeste, Depp, & Vahia, 2010). In the past three decades in particular, there has been a refreshing shift in the ageing literature to examine some of the positive attributes of ageing (Charles, Mather, & Carstensen, 2003). Successful ageing and emotional wellbeing is defined as the balance between positive and negative emotions, happiness, optimism, meaningful relationships, connectedness, sense of purpose, life satisfaction, and resilience from age-related declines (Charles & Carstensen, 2010; Jeste et al., 2010).

There are important considerations to note when conceptualising emotional wellbeing in later life however. First, old age is not characterised by only seeking hedonistic states and positive experiences, but also involves the desire to engage in complex emotional experiences that allow for meaning and importance with the time remaining in life (Carstensen et al., 2003). Second, it is possible that the assumption of losses in old age leading to poor wellbeing is anticipated incorrectly (Urry & Gross, 2010). For instance, the affective forecasting literature demonstrates that younger individuals often incorrectly predict the duration and intensity of their emotional responses to future events, such as increased negative emotion and arousal during anticipated times of loss (Nielsen, Knutson, & Carstensen, 2008). Therefore people may mistakenly anticipate that due to older adults' experiencing declines in cognitive, physical, and health related domains, that this would consequently lead to lower levels of wellbeing compared to young adults (Urry & Gross, 2010).

However, according to cross-sectional and longitudinal studies, older adults experience higher levels of wellbeing than young adults (for a review, see Urry & Gross, 2010). This includes higher levels of positive affect and lower levels of negative affect.

More specifically, compared to young adults, older adults maintain positive emotional states longer (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Riediger, Schmiedek, Wagner, & Lindenberger, 2009), recover from negative states faster (Charles & Carstensen, 2008; Hay & Diehl, 2011), and experience less negative interactions in close relationships (Akiyama, Antonucci, Takahashi, & Langfahl, 2003). Additionally, relative to young adults, older adults report equal to, and at times higher, intensity of positive emotions and lower intensity of negative emotions with friends and family members (Charles & Piazza, 2007). Older adults also report greater life satisfaction than young adults (Mroczek & Spiro III, 2005). Furthermore, with advancing age there are notable shifts in motivations and goals towards optimising emotional experience and wellbeing in daily life (Carstensen et al., 2003; Kennedy, Mather, & Carstensen, 2004).

Socioemotional selectivity theory (SST). Carstensen’s (1991) SST provides a theoretical explanation for how older adults are able to maintain high levels of wellbeing and positive emotional experience as they age. SST suggests that when there is awareness of limited time left in life, attention and resources are given to improving emotional states as well as having emotionally meaningful experiences and relationships (Carstensen, 1992). This is in comparison to when time remaining is viewed as unlimited, as with young adults, where motivations and goals are instead directed towards personal development, acquiring knowledge, and establishing careers. Indeed, the theory is centred around a limited time perspective, not chronological age, but is fundamentally relevant for older adults due to the connection between old age, mortality, and perceived time remaining in life (Löckenhoff & Carstensen, 2004). Evidence demonstrates that there are age differences in time perspectives, with older adults reporting greater importance of emotionally meaningful goals due to perceived limited time than young adults (F. R. Lang & Carstensen, 2002).

Due to the noted changes in late adulthood, SST suggests that emotion-based goals become increasingly important and central for older adults (Carstensen et al., 1999; Mather

& Knight, 2005). Goals that were once knowledge-based, focused on careers, finances, and information acquisition, now become increasingly focused on areas of life that are emotionally meaningful and contribute to wellbeing (Carstensen et al., 1999; Mather & Knight, 2005), such as the emotional aspects of relationships and everyday living (Blanchard-Fields, Stein, & Watson, 2004; Coats & Blanchard-Fields, 2008; Kunzmann et al., 2005). For instance, in an experience sampling study (Riediger et al., 2009), older adults, compared with young adults, reported stronger motivations to maintain positive and reduce negative emotions (e.g., see positivity effect; Sasse, Gamer, Buchel, & Brassen, 2014). Thus, according to SST, older adults place greater emphasis on regulating emotional states to achieve emotion-related goals with greater flexibility in response to different situations (Carstensen et al., 2003; Löckenhoff & Carstensen, 2004).

Healthy ageing and emotion regulation. This increased focus on emotion-based goals brings with it increased reliance on emotion regulation in older adults (Kunzmann et al., 2005). Not surprisingly then, the ageing literature suggests that successful and healthy emotional ageing involves, at least partly, the effective regulation of emotion (Charles & Carstensen, 2007; Morgan & Scheibe, 2014; Suri & Gross, 2012). This includes the regulation of both positive and negative emotional states. Until recently, the majority of ageing research has concentrated on the regulation of negative emotions (e.g., anger and sadness) in maintaining wellbeing into old age (Haase, Seider, Shiota, & Levenson, 2012; Lohani & Isaacowitz, 2014; Phillips, Henry, Hosie, & Milne, 2006; Scheibe & Zacher, 2013; Shallcross, Ford, Floerke, & Mauss, 2013). However, the regulation of positive emotions (e.g., happiness and surprise) is equally important in contributing to healthy and adaptive ageing (Henry, Rendell, Scicluna, Jackson, & Phillips, 2009; Ong et al., 2011; Suri & Gross, 2012). For example, evidence has demonstrated that emotion regulation strategies that promote positive emotions are associated with improved resilience during stressful events (Tugade & Fredrickson, 2006).

The strength and vulnerability integration model (SAVI; Charles & Piazza, 2009) highlights that through experience in dealing and coping with difficult emotional events across the life span, older adults may become more resilient and proficient at maintaining emotional wellbeing. In addition, Labouvie-Vief's (1998) theory of cognitive-emotional integration in adult development, states that with age there is an increased ability to integrate, organise, and differentiate information about oneself and others, which results in more complex knowledge and management of emotions (Labouvie-Vief, Gilet, & Mella, 2014; Labouvie-Vief, Grühn, & Studer, 2010). Cognitive-affective complexity is enhanced with advancing age, involving the ability to flexibly regulate positive and negative emotions through such processes of inhibition and evaluation (Labouvie-Vief & Medler, 2002). Thus, increased complex knowledge and analysis of emotion, coupled with considerable life experience, may better equip this age group in dealing with emotionally challenging experiences, interpersonal situations, and ultimately maintaining emotional wellbeing (Coats & Blanchard-Fields, 2008; Kunzmann et al., 2005).

However, not all emotional processing abilities remain or are enhanced into old age. For example, older adults demonstrate increased difficulty compared to young adults in recognising and distinguishing between discrete emotions (e.g., anger and sadness) exhibited in the facial, vocal, or bodily expressions of others (see meta-analysis by Ruffman, Henry, Livingstone, & Phillips, 2008). Older adults also demonstrate lower responses than young adults in theory of mind tasks (Slessor, Phillips, & Bull, 2007), emotional autonomic activity (Gross et al., 1997; Tsai, Levenson, & Carstensen, 2000), and emotional neurological activity, such as amygdala activation (Mather et al., 2004). Nonetheless, as with emotion regulation ability, other aspects of emotional processes are maintained into later life. Older adults continue to perform just as well, if not better, than young adults on measures of affective forecasting (Scheibe, Mata, & Carstensen, 2011), empathy (Richter & Kunzmann, 2011), and facial mimicry (Bailey, Henry, & Nangle, 2009), including subconscious mimicry (Bailey & Henry, 2009).

In summary, there is considerable empirical evidence and theoretical explanations suggesting that maintained wellbeing in old age is substantially influenced by preserved emotion regulation. Theories such as SST and SAVI postulate that as people age, emotion regulation is prioritised, with greater motivation and reliance on experience and skills developed throughout one's life (Carstensen, 1992; Charles & Piazza, 2009). Evidence demonstrates multidirectional changes that occur with the age, where general cognitive functioning declines, yet older adults continue to be effective at managing their emotion (Kunzmann et al., 2005). Given emotion regulation has been suggested to strongly facilitate wellbeing in old age, the next section reviews older adults' capacity to regulate their experience and expression of emotional states.

2.2.2 Emotion Regulation Capacity

As previously noted, the capacity for emotion regulation appears to be well maintained into later life, with research demonstrating that older adults continue to be successful at regulating their emotional states as well as their younger counterparts (e.g., Lohani & Isaacowitz, 2014). Specifically, when instructed to consciously regulate emotion, older adults are able to effectively modify their internal experience and facial expressions of emotion (Kunzmann et al., 2005). However, despite the general consensus on this issue in the ageing literature (e.g., Blanchard-Fields, 2007; Jeste et al., 2010; Morgan & Scheibe, 2014; Suri & Gross, 2012), there is surprisingly little empirical evidence that directly tests emotion regulation ability in older adults. Understanding emotion regulation in old age is complex, with research needing to further consider age differences in the skills, goals, and processes involved in emotion regulation (Consedine & Mauss, 2014; Opitz, Gross, et al., 2012). Such complexities are also reflective of age differences in emotion elicitation and the changes to subjective experience, facial expressions, and physiological reactions (Carstensen, Mikels, & Mather, 2006).

Ageing and the regulation of emotional responses. According to studies utilising self-report questionnaires, older adults rate themselves with greater ability than young adults in managing challenging emotional experiences (Gross et al., 1997; Lawton, Kleban, Rajagopal, & Dean, 1992; Phillips et al., 2006). Compared with young adults, older adults regarded themselves as being particularly more confident and effective in regulating their internal feelings and inhibiting their external behavioural responses of emotion (Gross et al., 1997; Lawton et al., 1992). Older adults also report regulating emotions more often than young adults (Gross et al., 1997; Labouvie-Vief & Medler, 2002; Lawton et al., 1992). Together, these findings contribute to the ‘older but wiser’ view of older adults, suggesting that with age, comes the belief that greater life experience, maturity, and balanced attitudes, result in an enhanced ability in dealing with daily emotional situations (Carstensen et al., 2000; Mather & Knight, 2005; Shiota & Levenson, 2009).

However, there are limitations with such subjective questionnaire based research, which is prone to self-report biases and beliefs, and as such does not provide objective evidence of age-related regulation capacities (Kunzmann et al., 2005). Specifically, older adults’ self-evaluation may be positively biased, reflecting influential factors such as social desirability, selective memory, and assumptions about age-appropriate skills. Furthermore, older adults may more likely than young adults to engage in downward social comparisons during self-evaluations (Haase, Heckhausen, & Wrosch, 2013; Hess & Blanchard-Fields, 1999; Kunzmann et al., 2005; Wrosch, Heckhausen, & Lachman, 2000). In understanding older adults’ capacity for emotion regulation, there are clear limitations in questionnaire data of self-perceptions of this ability. In contrast, experimental studies provide substantially more information about how effective older adults are at regulating their feelings, expression, and physiological reactions of emotion.

Regulation of emotional experience and expression. Experimental-based studies, for example, have shown that under laboratory conditions, older adults maintain the ability to regulate their subjective feelings of emotion (Kunzmann et al., 2005). Other studies have also shown that older adults are more effective than young adults at reducing emotional experience in response to negative stimuli (Kliegel, Jager, & Phillips, 2007; Lohani & Isaacowitz, 2014; Phillips et al., 2008). However, these findings are mixed, with further studies reporting that older adults were unable to reduce positive feelings when regulating behavioural responses to amusing films (Henry et al., 2009).

Over recent years, a few studies have examined the age-related capacity for emotion regulation of facial expressions (e.g., Kunzmann et al., 2005; Phillips et al., 2008). Objective evidence of how effective older adults are at implementing emotion regulation processes can be obtained through measuring overt facial expressions in controlled experimental settings. With the exception of one study (Lohani & Isaacowitz, 2014), ageing studies have relied on independent coders to rate observed changes in overt facial displays (Emery & Hess, 2011; Henry et al., 2009). Psychophysiological equipment, such as facial electromyography (EMG), offers a robust and sensitive technique for measuring subtle changes in facial muscles when expressing emotion (Lohani & Isaacowitz, 2014). These more objective techniques using independent coders or facial EMG provide important data to increase our understanding of the degree of emotion regulation capacity across the life span, thereby extending findings beyond self-report based studies.

So far, experimental studies have found no age group differences in the extent to which young and older adults can regulate their facial displays of emotion (Emery & Hess, 2011; Lohani & Isaacowitz, 2014), despite the age-related improvements in self-rated emotion regulation ability (Kliegel et al., 2007; Phillips et al., 2008). A small number of studies have reported that the ability to regulate negative facial expressions remains intact for older adults (Emery & Hess, 2011; Kunzmann et al., 2005; Lohani & Isaacowitz, 2014;

Magai, Consedine, Krivoshekova, Kudadjie-Gyamfi, & McPherson, 2006; Phillips et al., 2008; Shiota & Levenson, 2009).

For example, in one study of negative emotions, Kunzmann et al. (2005) presented young and older adults with films depicting medical procedures and instructed then to regulate their emotional behaviour by increasing or decreasing their facial expression. Independent coders rated participants' facial expressions and found both age groups were effective at regulating their emotional behaviour. Another study instructed participants to regulate emotional expressions while they recounted sad and angry personal experiences (Magai et al., 2006). The authors found similar findings, with no age differences in the ability to regulate emotional expression. In a separate study investigating older adults' capacity to regulate negative behaviour, older adults were able to reduce facial expression and frequency of gaze aversion and face touching as well as young adults (Phillips et al., 2008). Three further studies have demonstrated young and older adults were equally able to regulate their facial expressions when viewing negative pictures (Emery & Hess, 2011) and sad films (Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009).

With most of the emphasis on the regulation of negative emotions, there are even fewer studies examining the regulation of positive emotions in older adults. As is often the case in the young adult literature (Kashdan, 2006; Langston, 1994; Sheibe & Blanchard-Fields, 2009), previous ageing studies have discussed general emotion regulation outcomes by only examining negative emotions. It is important to address the gap regarding positive emotions in the emotion regulation ageing research, particularly given young and older adults process and respond to positive and negative stimuli differently (e.g., Mather et al., 2004; Mather & Carstensen, 2005). Among the limited research that has been conducted, one recent study found that young and older adults were equally effective in regulating their behavioural expressions in response to positive pictures (Emery & Hess, 2011). A second study demonstrated that the capacity for reducing facial displays in response to amusing films was preserved in healthy older adults and in those in the early stages of dementia (Henry et al., 2009). However, this study did not compare older adults' performance with young adults, limiting the comparability in regulation performance across age groups.

Regulation of physiological activity. Emotional states, however, are not limited to the experience and expression of emotion, but also manifest in changes in physiological responses. In determining the capacity for the regulation of physiological activity, experimental studies tend to examine bodily responses when instructing participants to directly change their subjective feelings or behavioural responses of emotion. The effects of emotion regulation on physiological responses are important for several reasons. First, emotional responses are expressed through unfolding bodily states, with changes to physiological functions, such as cardiovascular, respiratory, and electrodermal activity (Koole, 2009). Second, changes in these physiological states indicate alterations to the sympathetic (SNS) and parasympathetic nervous systems (PSNS), which underlie the activation of autonomic processes involved in emotion regulation, such as the stimulation of the vagus nerve which lowers SNS responses (Edwards, 2008; Greenberg, 2010; Gross, 1998a). Lastly, previous studies involving young adults have demonstrated that certain emotion regulation processes (e.g., expressive suppression) lead to increases in physiological arousal, demonstrating the possible physiological consequences of regulation (Gross, 1998a; Gross & Levenson, 1997; Robinson & Demaree, 2007; although see Dan-Glauser & Gross, 2011).

In one ageing study, the authors investigated age differences in the effects of emotion regulation on physiological outcomes, such as heart rate, skin conductance, respiration, blood pressure, and finger pulse amplitude (Kunzmann et al., 2005). They demonstrated that young and older adults did not differ in their physiological consequences of emotion regulation. Specifically, during regulation of negative facial expressions, both age groups produced increased physiological responses in the form of SNS activity (e.g., skin conductance; Kunzmann et al., 2005). A recent study found a similar pattern of findings, with both age groups producing increased skin conductance when regulating emotion, though this increase was greater for young than older adults when using positive reappraisal (Lohani & Isaacowitz, 2014). A third study found that young adults were more effective at reducing physiological responses using one strategy type (i.e., detached reappraisal), whereas, older adults were more effective at using another strategy (i.e., positive reappraisal; Shiota & Levenson, 2009). The limited availability of published studies, however, indicates that the effects of emotion regulation on physiological responses (i.e., changes in cardiac, vascular, electrodermal, and respiratory systems) associated with ageing, while apparently complex, require further investigation. In summary, across all emotion modalities, the evidence currently available generally demonstrates that the capacity to regulate emotions is preserved in older adulthood. A clearer understanding of how this occurs may come from examining the specific forms of emotion regulation strategies used by older adults.

Ageing and emotion regulation strategies. Emotion regulation is not a single process, but involves a range of processes and skills that are differently affected by ageing (Shiota & Levenson, 2009). Furthermore, as previously noted, emotional experience and expression can be regulated via a number of different approaches and at different temporal stages of the emotion generation process (Gross, 2001; Sheppes et al., 2012). Evidence suggests that emotion regulation capacity in older adults is strategy specific, with findings indicating age-related differences in the implementation and effectiveness of certain strategies types (for a review, see Morgan & Scheibe, 2014). For example, studies have shown that older adults are better at reappraising an emotional situation using a positive rather than a detached method (Nowlan, Wuthrich, & Rapee, 2014; Shiota & Levenson, 2009). Furthermore, it has been proposed that there is a shift in older adulthood from using response-focused strategies (which are often cognitively demanding, at least in young adults; Dillon, Ritchey, Johnson, & Labar, 2007; Scheibe & Blanchard-Fields, 2009) to using more antecedent-focused strategies to efficiently manage emotionally arousing situations (Carstensen et al., 1999; Phillips et al., 2008; Yeung et al., 2011). To better understand older adults' capacity in emotion regulation, Gross' (1998b) process model of emotion regulation offers a framework for organising and mapping the range of regulation strategies that have been researched in older adults so far.

Ageing and situation selection and modification. Collective evidence has demonstrated that regulatory strategies applied during the situation selection and situation modification stages of Gross' (1998b) model may be better suited for older adults than young adults (Urry & Gross, 2010). In the selection of preferred situations, older adults construct smaller social networks with members who are more closely related, familiar, and positively oriented, allowing for optimal emotional experiences (Carstensen et al., 2003; English & Carstensen, 2014). In modifying situations, older adults experience lower negative affect than young adults by avoiding unpleasant situations and interpersonal conflicts (Blanchard-Fields, 2007; Charles, Piazza, Luong, & Almeida, 2009; Coats & Blanchard-Fields, 2008; Rovenpor, Skogsberg, & Isaacowitz, 2013). Specifically, compared with young adults, older adults are more likely to avoid arguments by using non-confrontational strategies such as withdrawing or sidestepping the conflict with others (Birditt, Fingerman, & Almeida, 2005; Blanchard-Fields, Mienaltowski, & Seay, 2007; Blanchard-Fields et al., 2004). These findings indicate that older adults are more motivated than young adults, and remain effective, at selecting and modifying situations so as to achieve improved emotional outcomes and wellbeing.

Ageing and attentional deployment. Older adults appear to be particularly effective at using emotion regulation strategies that occur during the attentional deployment stage of Gross' (1998b) model. Evidence indicates that older adults deploy more attention towards positive and ignore negative information, which can assist in improving subsequent mood and emotion-related goals (Isaacowitz, 2012; Isaacowitz & Noh, 2011; Isaacowitz, Toner, Goren, & Wilson, 2008; Noh, Lohani, & Isaacowitz, 2011; Scheibe, Sheppes, & Staudinger, 2015). Specifically, in one study, older adults were more effective than young adults in reducing negative feelings by orientating their attention to neutral rather than negative content of films (Lohani & Isaacowitz, 2014). Furthermore, another study revealed age-related improvements in emotion regulation when using a positive refocusing strategy, which involved focusing attention on a positive autobiographical memory (Phillips et al., 2008). Studies have also demonstrated that distraction and gaze preferences are effective in reducing negative behavioural expressions for both age groups (Phillips et al., 2008; Tucker, Feuerstein, Mende-Siedlecki, Ochsner, & Stern, 2012).

Indeed, positive gaze preferences have also been suggested to contribute to a positivity bias in old age, where older adults focus less attention on negative and more on positive information to enhance positive emotional states and memories (Carstensen & Mikels, 2005; Sasse et al., 2014; Tomaszczyk & Fernandes, 2013), although some caution has been suggested in interpreting positivity biases as directly serving emotion regulation goals (see Isaacowitz & Blanchard-Fields, 2012). Nevertheless, older adults appear to experience a positivity effect, where they recall greater positive than negative experiences (Charles et al., 2003; Mather & Carstensen, 2005). However, this may be better conceptualised as a negativity bias, where older adults avoid negative stimuli, and subsequently recall less negative information than young adults (for a review, see Mather, 2012). Overall, findings suggest that older adults continue to be effective at using attentional deployment strategies to modulate their emotional experiences and responses, and at times may be more effective than young adults.

Ageing and cognitive change. Findings regarding the capacity for successfully implementing emotion regulation strategies during the cognitive change stage of Gross' (1998b) model are somewhat mixed for young and older adults. Research has shown that older adults report a greater frequency of using cognitive reappraisal than young adults

(Gross et al., 1997; John & Gross, 2004; Wrosch et al., 2000; Yeung et al., 2011), and more use of this strategy than other strategies (e.g., expressive suppression; John & Gross, 2004). Whilst some studies have demonstrated no age differences in the subjective outcomes of cognitive reappraisal on reducing negative experience (Allard & Kensinger, 2014a; Martins et al., 2015), other studies have found young adults to be more effective than older adults (Opitz, Rauch, Terry, & Urry, 2012; Tucker et al., 2012). Furthermore, one study revealed that healthy older adults, and those with major depressive disorder, continue to be effective at reducing negative emotions when using cognitive reappraisal (Smoski, LaBar, & Steffens, 2013).

However, older adults' ability to reduce emotional states may depend on the type of cognitive reappraisal strategy that they are implementing. Two types of cognitive reappraisal strategies widely researched in ageing include 'positive' and 'detached' reappraisal. These involve reinterpreting the emotional event through different approaches, and have differing age-related effects. Regarding self-reported frequency of positive reappraisal strategies (i.e., thinking about the positive attributes of a negative event), two studies have revealed that older adults demonstrate greater use of positive reappraisal in daily life compared with young adults (Charles & Carstensen, 2008; Wrosch et al., 2000), whereas another study has revealed that older adults report less use of positive reappraisal (Nolen-Hoeksema & Aldao, 2011). When instructed to use positive reappraisal in the laboratory context, older adults were better than young adults at reducing their negative feelings and physiological arousal (Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009). Moreover, for older adults, positive reappraisal has been found to be more effective than attentional deployment strategies in decreasing negative experience without increases to physiological arousal (Lohani & Isaacowitz, 2014).

It has been suggested that cognitive reappraisal to increase positive emotion (as opposed to decrease negative emotion) may not require the same level of executive functions that are known to decrease with age (Consedine & Mauss, 2014). That is, older adults may rely on different cognitive and neural mechanises to effectively regulate their emotion by considering the positive aspects of a challenging emotional situation (Consedine & Mauss, 2014). This is consistent with the positivity bias, in which older adults seek out and experience positive emotions more than young adults (Charles & Carstensen, 2007). Moreover, a systematic literature review by Nowlan et al. (2014) found that positive reappraisal is a particularly adaptive and valuable strategy for older adults with benefits shown through improved mental health, life satisfaction, self-acceptance, social relations, and psychological wellbeing during physical illness.

In contrast to positive reappraisal, a detached reappraisal approach (i.e., thinking about the event in an objective way) appears to become more difficult in old age (Consedine & Mauss, 2014). In experimental studies, older adults were less effective than young adults at reducing negative emotional experience and physiological arousal when using this approach (Opitz, Rauch, et al., 2012; Shiota & Levenson, 2009), although this age difference ceased when the emotional load was reduced (Winecoff, Labar, Madden, Cabeza, & Huettel, 2011). However, no age differences were observed in the effects of detached reappraisal on negative facial expressions, with both young and older adults able to reduce their behavioural displays of emotion (Shiota & Levenson, 2009). There has been minimal investigation of positive emotions, although one study did demonstrate that both young and older adults were equally effective at using detached reappraisal to regulate positive experience (Winecoff et al., 2011).

Overall, older adults capacity to effectively implement cognitive change strategies appears to be dependent on the type of strategy (e.g., positive vs. detached reappraisal) and the emotion being regulated (i.e., positive vs. negative emotion). Furthermore, the emotional experience, expression, and physiological outcomes during regulation may also be dependent on the type of cognitive reappraisal strategy being used by young and older adults.

Ageing and response modulation. In relation to the last stage of Gross' (1998b) model evidence has demonstrated maintained emotion regulation capacity in terms of response modulation in old age. In particular, experimental research examining the response-focused strategy of expressive suppression (i.e., inhibiting facial display of emotion) has shown that young and older adults are equally effective at reducing their outward expression of positive and negative emotion (Emery & Hess, 2011; Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Magai et al., 2006; Phillips et al., 2008; Shiota & Levenson, 2009). However, young adults, but not older adults, experience unintended consequences such as heightened physiological arousal (Lohani & Isaacowitz, 2014) and impairments to memory performance with the use of this strategy (Emery & Hess, 2011).

While some studies have found no age differences in the frequency of using expressive suppression in daily life (Yeung et al., 2011), other studies have demonstrated older adults report using expressive suppression less frequently than their younger counterparts (John & Gross, 2004). This is of interest, as excessive and persistent use of expressive suppression has often been found to be associated with negative consequences, such as enhanced unpleasant feelings and physiological arousal, reduced wellbeing, and costs during social interactions (for a summary, see Morgan & Scheibe, 2014). Older adults may either be unconsciously aware of the consequences of persistent use of this strategy, or given the age-related declines in cognitive and physical resources, older adults may be more likely to use alternative and more efficient strategies to achieve emotion regulation goals, thereby maintaining emotional wellbeing (Morgan & Scheibe, 2014).

2.2.3 Emotion Regulation and Cognition

In order to better extend our understanding of emotion regulation in ageing, recent research has begun to more closely consider the influence of cognition (Allard & Kensinger, 2014a; Carstensen et al., 2006; Kryla-Lighthall & Mather, 2008; Opitz, Gross, et al., 2012). For example, studies have begun to demonstrate the role of cognition in implementing emotion regulation strategies for young and older adults (Noh et al., 2011; Opitz, Lee, Gross, & Urry, 2014; Winecoff et al., 2011). Emotion regulation is a cognitively demanding skill requiring effortful processes to alter the emotional trajectory of emotional experiences and responses (Mather & Knight, 2005). Such regulation efforts are suggested to utilise multiple cognitive processes throughout the emotional event, such as self-monitoring, inhibition, working memory, and attentional resources (Gross, 2002; Ortner & de Koning, 2013; Richards, 2004). Given old age is associated with cognitive declines, it is even more surprising that older adults' capacity for emotion regulation is preserved into later life.

Implications of cognitive ageing on emotion regulation. Implementing emotion regulation strategies relies on a range of factors, such as executive functioning, cognitive control, and fluid cognitive ability (Ochsner & Gross, 2005). Indeed, there are a number of cognitive and neural contributors to emotion regulation in young and older adults (Winecoff et al., 2011). Moreover, emotion and cognition share a complex relationship, with different trajectories towards the end of the life span (Carstensen et al., 2006; Mather, 2012; Mather & Knight, 2005). For example, cognitive control abilities decline in old age (Hedden & Gabrieli, 2004; Park et al., 2002), whereas, emotion regulation abilities improve (Carstensen et al., 1999; Labouvie-Vief & Medler, 2002). Thus, improved emotion regulation capacity co-occurs with age-related declines in cognitive functioning, highlighting the emotional paradox of ageing (Prakash, De Leon, Patterson, Schirda, & Janssen, 2014).

It has been suggested that the development and maturation of more elaborated cognitive and neural networks enables enhanced emotional processing and emotion regulation (Izard, 1990). As such, older adults may experience age-related improvements in cognitive-emotional mechanisms that assist in efficient management of emotional states (Magai et al., 2006). However, as noted in ageing there are declines in executive functions, such as inhibition, planning, and task switching (Braver & West, 2008; N. L. Watson et al., 2010), which may make emotion regulation more challenging for older than young adults. Alternatively, such declines in executive functions and cognitive resources which are implicated in emotion regulation, may prompt older adults to compensate with the use of different cognitive networks and neural pathways to achieve emotion regulation goals (Urry & Gross, 2010).

It has also been proposed that with increased motivations to manage emotional states, older adults may be devoting larger proportions of their available (albeit limited) resources, to emotion regulation goals (Morgan & Scheibe, 2014). Older adults who demonstrate higher cognitive control ability are more likely to effectively engage in emotion regulation processes, such as achieving positivity biases (Mather & Knight, 2005). However, when resources are taxed, as through divided attention tasks, older adults experience difficulty in achieving emotion regulation, resulting in enhanced negativity biases (Mather & Knight, 2005). Currently, researchers are working to uncover the cognitive aspects of emotion regulation, particularly in understanding the implications of ageing on the cognition-emotion interaction (Moors, 2010).

Neurological networks involved in emotion regulation. Recent advances in brain imaging techniques have begun to reveal the potential neural circuitry of emotion regulation. Evidence indicates clear links between specific areas of the prefrontal cortex (PFC) and emotion regulation (Zelazo & Cunningham, 2007). Active emotion regulation processes appear to rely on the same PFC brain regions involved in cognitive control processes, such as reflection, planning, and execution (Ochsner & Gross, 2005). Furthermore, neuroscience research suggests emotion regulation involves specific pathways between the PFC and the limbic system, primarily comprising the amygdala (Banks, Eddy, Angstadt, Nathan, & Phan, 2007; Ochsner, Silvers, & Buhle, 2012). The amygdala is strongly regarded as the emotional centre of the brain, activated when young and older adults experience emotional arousal (Mather et al., 2004).

Successful emotion regulation (particularly cognitive control strategies) activates areas of the PFC, which decrease amygdala activity, and in turn, reduce subjective emotional states (Banks et al., 2007; Ochsner & Gross, 2008). However, whilst the specific PFC-limbic interactions represent a consistent pattern of findings, studies have demonstrated a diversity of brain regions associated with emotion regulation (see Winecoff et al., 2011). For instance, the medial and lateral PFC, the orbitofrontal cortex, and the anterior cingulate cortex have all been implicated in modifying emotional responses through decreasing activity in the limbic system (Green & Malhi, 2006; Ochsner & Gross, 2005; Quirk & Beer, 2006; Zelazo & Cunningham, 2007).

Neurological research also demonstrates that during the ageing process, the brain regions responsible for emotion regulation are mostly preserved into late adulthood (for a review, see Silvers, Buhle, & Ochsner, 2013). Although the PFC is vulnerable to decline, the cortical thickness of the medial PFC and the anterior cingulate cortex are maintained in normal ageing (Fjell et al., 2009). In ageing, cortical thickness declines are, however, more prominent in the dorsal, lateral, and superior regions of the PFC responsible for cognitive executive functions that also support emotion regulation (Fjell et al., 2009; Mather, 2012). Therefore, whilst some areas of the PFC are maintained in ageing and support emotion regulation abilities, other areas decline, limiting the availability of higher order cognitive functions (Silvers et al., 2013). Such findings from neurological research strengthen the view that older adults may be selecting different emotion regulation strategies to compensate for cognitive declines.

SOC-ER. The selection, optimisation, and compensation with emotion regulation (SOC-ER) framework provides a theoretical perspective for understanding how older adults' continue to achieve emotion regulation goals (Urry & Gross, 2010). According to this theory, older adults may be selecting and optimising particular emotion regulation strategies to compensate for age-related changes in cognitive functioning and neurological networks (Lohani & Isaacowitz, 2014). For instance, when specific cognitive abilities are depleted, older adults may allocate greater internal resources to selecting alternative strategies, or optimise their ability to implement such strategies using less cognitive resources (Opitz, Gross, et al., 2012). Similarly, older adults may utilise external resources (e.g., social support) as a form of receiving extrinsic emotion regulation to compensate for internal losses (Urry & Gross, 2010).

Given older adults demonstrate reduced general cognitive abilities (e.g., cognitive control, working memory; Hedden & Gabrieli, 2004), it has been suggested that they capitalise on emotion regulation strategies that are less demanding on resources (Opitz, Gross, et al., 2012). Accordingly, compared with young adults, older adults report using antecedent-focused strategies more frequently and efficiently to achieve desired emotional outcomes (John & Gross, 2004). Regulation strategies that occur early in the emotion generation trajectory, such as situation selection and distraction, are suggested to utilise less cognitive resources compared to response-focused strategies, which demand greater effort due to the full emotion response being activated (Gross, 1998b).

Thus, different emotion regulation strategies draw on different aspects of cognitive and neural mechanisms, and consequently will be differentially affected by the age-related changes in cognitive abilities and strength of neural networks (supporting the SOC-ER framework). Studies have shown that attentional deployment strategies (e.g., selective attention, distraction) are not as cognitively demanding for older adults as other strategies (e.g., expressive suppression; Allard & Kensinger, 2014b). In contrast, cognitive reappraisal produces greater PFC activation for older adults, suggesting greater demands on the limited availability of cognitive control resources to reduce amygdala activity (Allard & Kensinger, 2014b; Winecoff et al., 2011). Expressive suppression is suggested to also rely on cognitive resources and demands on self-monitoring to implement behavioural inhibition (Richards & Gross, 2006), and has been shown to slow PFC responses, yet increase activity in the insular cortex and amygdala (Goldin, McRae, Ramel, & Gross, 2008). Thus, it is clear that specific emotion regulation strategies vary in the levels of cognitive resources (e.g., cognitive control), they require in order to alter emotional states.

However, it should also be noted that not all emotion regulation strategies are explicit and require effortful processes to implement (Suri & Gross, 2012). The distinction between implicit and explicit emotion regulation strategies highlights the degree of resource demands devoted to different regulation processes (Gyurak et al., 2011; Mauss, Bunge, & Gross, 2007). Some emotion regulation strategies may be automatic and require fewer resources than explicit effortful strategies (Opitz, Gross, et al., 2012). Mather and Knight (2005) suggested that especially for older adults, emotion regulation is available at an unconscious implicit level. For instance, when viewing negative stimuli without instructions to regulate emotion, older adults appear to engage in spontaneous emotion regulation with PFC activation and reduced amygdala activity (Mather et al., 2004). Automatic emotion regulation may thereby become more common and beneficial to older adults at the end of the life span (Consedine & Mauss, 2014). With the use of automatic strategies, fewer executive resources are implicated to effectively regulate emotional states, thereby leaving resources available to engage with the emotional event (Consedine & Mauss, 2014). Automatic and implicit emotion regulation strategies may therefore be resilient to age-related cognitive losses, as they place reduced demands on cognitive resources (Opitz, Gross, et al., 2012). However, not all emotional situations present with the opportunity for automatic emotion regulation, and as such, young and older adults must actively engage in explicit forms to achieve their emotional goals.

Cognitive consequences of emotion regulation. As well as considering the cognitive demands of different strategies, our understanding of emotion regulation in ageing can also be enhanced through exploring the impact of emotion regulation on concurrent cognitive processes, such as memory (Isaacowitz & Blanchard-Fields, 2012; Scheibe & Zacher, 2013). For example, in situations of everyday life, individuals engage in emotion regulation whilst concurrently performing other common tasks that rely on similar resources. For instance, engaging in an emotionally challenging interaction with another person may elicit the need to regulate emotional facial expressions whilst also attending to and forming memories of the conversation (Richards et al., 2003; Richards & Gross, 1999). Thus, individuals experience additional demands beyond simply regulating the emotionally eliciting stimuli. Experimental studies that investigate dual processes (e.g., emotion regulation and information encoding into memory) provide empirical evidence regarding such dual processing effects that occur in real life contexts. Such research extends beyond simply instructing young and older adults to regulate their responses to emotion-eliciting stimuli, but also tests their performance on a concurrent cognitive task, such as memory encoding, consolidation, and retrieval.

Investigating the cognitive consequences of emotion regulation provides an indication of the cognitive resources required to implement specific regulation strategies for young and older adults. Evidence indicates that efforts to reduce emotional subjective experience and facial expression have unintended cognitive consequences, at least, for young adults (Richards, 2004). Limited availability of cognitive resources (according to the limited strength model; Muraven, Tice, & Baumeister, 1998) can result in reduced resources for self-control processes (i.e., ego depletion; for a meta-analysis, see Hagger, Wood, Stiff, & Chatzisarantis, 2010), and thereby impact the successful execution of emotion regulation.

Conceptually, cognitive load theory (Lavie, Hirst, De Fockert, & Viding, 2004) outlines that undertaking two concurrently cognitively demanding tasks can impact the performance of one or both tasks, such as costs to emotion regulation or another cognitive task (Ortner & de Koning, 2013). For example, reduced memory recall for the emotional material during the engagement of effortful emotion regulation has been observed in young adults (Alberts et al., 2012; Richards et al., 2003; Robinson & Demaree, 2009), reflecting the cognitive load associated with modifying emotion and the effects on memory recall. Therefore, examining memory performance following emotion regulation provides an indication of the cognitive demands required during the emotion regulation process for young and older adults.

Emotion regulation effects on memory. To examine this connection between emotion regulation and cognitive functioning, experimental studies have investigated how emotion regulation strategies affect memory performance, a cognitive process crucial for everyday living (Richards, 2004). So far, the primary paradigm for testing this involves instructing participants to regulate their emotional experiences and responses whilst viewing valenced stimuli, then asking participants to recall the details of the stimulus in a surprise memory test (Dillon et al., 2007; Gross, 2002; Kim & Hamann, 2012; Robinson & Demaree, 2007). Recall performance is then compared between the emotion regulation condition and the watch condition (Bonanno et al., 2004). Recall impairments under the regulation condition are therefore considered indicative of the efforts and demands on cognitive resources required to implement specific emotion regulation strategies for different age groups (Emery & Hess, 2011; John & Gross, 2004).

Young adults. Experimental evidence demonstrates that for young adults, engaging in emotion regulation results in poorer performance on memory, compared to when not regulating emotion (Gross, 2002; Richards & Gross, 2006). Specifically, regulating overt negative emotional behaviour using expressive suppression has been shown to impair memory for the emotional material in young adults (Bonanno et al., 2004; Dillon et al., 2007; Dunn, Billotti, Murphy, & Dalgleish, 2009; Richards & Gross, 1999, 2000; Robinson & Demaree, 2007), although not in all studies (Ortner & de Koning, 2013). It has been suggested that emotion regulation, particularly the use of response-focused strategies, relies on attentional resources directed at the inhibition of emotional facial expressions, which limits the available attentional resources to process the emotional material (Gross, 2002). Moreover, continuously self-monitoring and modifying expressive behaviour diverts attention away from the emotional material potentially disrupting the information encoding process and reducing the ability for the material to be later remembered (John & Gross, 2004; Richards, 2004). This is problematic in the real world when one is required to recall information from an emotional event in which an individual regulated their emotional expressions (e.g., a police officer failing to recall important information from an emotionally-intensive and stressful situation during which they were also required to maintain a neutral facial expression).

However, other strategies of regulating emotional states have differing effects on memory performance for young adults. For example, in contrast to response-focused strategies (e.g., expressive suppression), the use of antecedent-focused strategies (e.g., cognitive reappraisal) does not appear to result in reduced memory performance for young adults, and may actually improve it (Dillon et al., 2007; Ortner & de Koning, 2013; Richards & Gross, 2000). This is because strategies like cognitive reappraisal are understood to orientate attention towards the emotional material through the process of reinterpreting how one relates to that material, whereas strategies like expressive suppression as noted draw attention away from the emotional material (Ahn et al., 2015; Kim & Hamann, 2012).

The absence of memory costs, however, does not imply that cognitive reappraisal is without cognitive demands. Rather, it suggests that different cognitive processes are involved in cognitive reappraisal compared with expressive suppression, which result in deeper encoding of the emotional material in the memory consolidation stages (Morgan & Scheibe, 2014). For instance, cognitive reappraisal encourages greater elaboration and manipulation of emotional material, resulting in improved attention to the material, thereby increasing memory encoding and consolidation processes (Dillon et al., 2007). Therefore, for young adults, the effects of emotion regulation on memory performance can have different impacts depending on the type of regulation strategy that is utilised.

Older adults. Whilst there are limited studies in comparison with young adults, interestingly, evidence so far indicates that in older adults, emotion regulation does not negatively affect memory performance (for a review, see Morgan & Scheibe, 2014). In particular, three recent studies have shown that compared with young adults, older adults do not experience memory costs when regulating their emotional experience and expression (Emery & Hess, 2011; Martins et al., 2015; Scheibe & Blanchard-Fields, 2009). This is surprising, given the cognitive demands of emotion regulation, coupled with the age-related cognitive declines previously outlined.

In the first study, Scheibe and Blanchard-Fields (2009) instructed participants to regulate their negative emotional responses concurrently as they performed a difficult working memory task. Despite young adults performing worse on the resource-demanding memory task when also engaging in emotion regulation processes, older adults' memory performance was unaffected by emotion regulation. It was suggested that older adults might not require the additional resources to successfully regulate their emotion, thereby sparing resources for concurrent cognitive tasks (Scheibe & Blanchard-Fields, 2009). However, participants were only given general instructions to reduce their emotional experience; therefore participants were able to apply their own emotion regulation strategies. Prior research has demonstrated age-related preferences in the selection and effectiveness of specific strategies (e.g., Allard & Kensinger, 2014b; Lohani & Isaacowitz, 2014; Phillips et al., 2008; Scheibe et al., 2015), suggesting that older adults could have applied strategies that were less demanding.

In the second study, Emery and Hess (2011) instructed young and older adults to use the strategy of expressive suppression to regulate their outward facial display of emotion in response to positive and negative pictures. Both age groups were successfully able to reduce their facial expressions and demonstrated similar emotional experience. However, when asked to recall pictures immediately after the emotion regulation condition, young adults performed worse in recall compared with the watch condition, whereas older adults performed slightly better (Emery & Hess, 2011). The authors suggested that older adults might have been using a different strategy, such as cognitive reappraisal, which increases attention to encoding the stimuli. Alternatively, it is possible that regulation of expressive behaviour has become less effortful for older adults, allowing more resources for processing the emotional pictures rather than being required for self-monitoring their expression (Morgan & Scheibe, 2014). Additional research is needed to further explore possible explanations for how older adults are able to regulate emotion without impairing memory performance.

The third study examined young and older adults' memory performance following the implementation of two different emotion regulation strategies, positive reappraisal and distraction (Martins et al., 2015). For both age groups, a greater number of stimuli were recalled in the positive reappraisal than the distraction condition. However, the study did not include instructions to naturally view the negative pictures without regulating, therefore no control condition was available to compare the two strategy conditions (Martins et al., 2015). Consequently, it is unclear whether engaging in emotion regulation had an effect on memory performance for young or older adults. Therefore, explanations underlying older adults' lack of memory costs during emotion regulation remain unclear.

2.3. Contributors to Preserved Emotion Regulation Capacity

Particularly over the past decade, evidence has accumulated demonstrating possible contributors to sustained emotion regulation ability and the relationship with maintained emotional wellbeing in old age (Urry & Gross, 2010). Such contributors include motivational changes that involve a greater devotion of resources to achieve emotion regulation goals (SST; Carstensen et al., 2003), increased wisdom, resilience, and life experience that enhance emotion regulation capacity and selection of efficient strategies (Labouvie-Vief et al., 2014; Seery, 2011), and cognitive changes that involve the selection and optimisation of limited cognitive resources (SOC-ER; Urry & Gross, 2010). Additionally, a number of individual and situational factors may also contribute to successful emotion regulation in older adults, with such factors likely to interact in multiple and complex ways, requiring ongoing research to better understand how emotions are regulated in old age.

Recent research has begun to investigate the possibility that emotion regulation has become a less effortful task for older adults. Morgan and Scheibe (2014) proposed several explanations for how older adults are able to efficiently and effectively achieve emotion regulation goals despite age-related cognitive declines. The first explanation suggests that biological changes may result in older adults becoming less emotionally reactive, therefore reducing the degree of cognitive resources needed to regulate emotion (Morgan & Scheibe, 2014). Thus, emotion regulation may be easier to accomplish for older adults due to having less physiological and behavioural expression to reduce. The second explanation suggests that older adults may become more efficient at regulating their emotions due optimisation of resources, or through better use of specific strategies (Morgan & Scheibe, 2014). For instance, older adults may rely on strategies that require minimal cognitive resources and effort, or are more effective at specific strategies compared with young adults. In investigating the two proposed explanations of reduced emotional reactivity and greater use of efficient emotion regulation strategies, the following section examines evidence for how both suggestions may contribute to older adults preserved emotion regulation capacity.

2.3.1 Reduced Emotional Reactivity with Age

One potential explanation for maintained emotion regulation in older adults relates to age differences in emotional reactivity. This has received less attention in the literature, and has not been assessed in the context of emotion regulation due the restrictions associated with behavioural and self-report techniques that have been commonly used in studies of emotion regulation and ageing. The current thesis offers the objective EMG techniques to sensitively assess age differences in the subtle changes to emotional facial muscles reactivity.

Age-related changes in emotional reactivity (e.g., reduced emotional responses) may lower the degree of difficulty and effort required to achieve emotion regulation goals, thereby contributing to preserved emotion regulation capacity for older adults (Morgan & Scheibe, 2014). For instance, age-related declines in the neural and autonomic systems may result in older adults responding to emotional events with reduced expressive and physiological reactivity (Cacioppo, Berntson, Klein, & Poehlmann, 1997), thereby reducing the emotion regulation load for older adults. Thus, despite older adults demonstrating a reduction in available resources for emotion regulation (e.g., cognitive control), they may be more efficient at regulating emotional responses due to fewer resource demands than young adults (Morgan & Scheibe, 2014). This notion is in accordance with the premise of dynamic integration theory (Labouvie-Vief, 2008), which proposes that higher levels of emotional arousal place greater demands on resources in order to achieve emotion regulation goals. Across the current literature on emotional ageing, however, there are mixed findings regarding age-related similarities and differences in emotional reactivity.

Emotional reactivity refers to changes to subjective experience, facial expression, and physiological states in response to an emotional event (Haase et al., 2012; Levenson, 2007). Emotional reactivity is elicited using a range of techniques, including standardised stimuli (e.g., films, pictures), autobiographical memories, mental imagery, and scripted or unscripted social interactions in laboratory settings (Mauss & Robinson, 2010). Methods using films and pictures are particularly effective for examining individual differences in the intensity of emotional responses (Haase et al., 2012). It has been found that older adults respond differently than young adults to different types of emotional stimuli and discrete emotions, exhibiting differing magnitudes of emotional reactivity (Beaudreau, MacKay, & Storandt, 2009). For example, one study demonstrated that in response to emotional stimuli, older adults exhibited reduced facial muscle reactivity compared to young adults (D. P. Smith, Hillman, & Duley, 2005). However, studies have also demonstrated the importance of using age-relevant material to elicit emotional responses (Kunzmann & Grühn, 2005; Kunzmann & Richter, 2009).

Unsurprisingly, the research on emotion and emotion regulation in ageing has increased substantially over the last few decades (for a review, see Consedine & Magai, 2006). However, despite the growing empirical findings, a number of inconsistencies still remain with respect to the age-related differences in emotional reactivity in terms of facial expressive, physiological, and subjective responses. For instance, some studies have demonstrated age differences in facial reactivity of sadness (Kunzmann & Grühn, 2005; Lohani & Isaacowitz, 2014; Phillips et al., 2008), whereas other studies have found facial expressions and physiological responses related to sadness remain the same for young and older adults (Seider, Shiota, Whalen, & Levenson, 2011; Tsai et al., 2000). The following subsections examine the mixed findings regarding the impact of ageing on facial expressive, physiological, and subjective emotional reactivity.

Age differences in facial reactivity. An increasing number of laboratory studies have investigated whether young and older adults differ in their intensity of emotional facial expressions. These studies have typically involved the objective measurement of participants' spontaneous and unregulated emotional facial expressions to emotion-eliciting stimuli, noting any differences in magnitude between both age groups. Some studies have shown that young and older adults display similar levels of emotional facial reactivity in response to positive and negative pictures (Emery & Hess, 2011), films (Lohani & Isaacowitz, 2014; Seider et al., 2011; Tsai et al., 2000), and personal memories (Levenson, Carstensen, Friesen, & Ekman, 1991).

Other studies, however, have found that older adults produce less outward displays of emotion in response to negative films (Kunzmann et al., 2005; D. P. Smith et al., 2005), autobiographical memories (Magai et al., 2006), and social interactions with their romantic partner (Carstensen, Gottman, & Levenson, 1995). Using self-report accounts, older adults have also been shown to rate themselves as displaying lower levels of emotional expression compared with young adults (Lawton et al., 1992). It is possible that due to life experience, older adults become more desensitised to emotionally evoking stimuli, such as reduced reactivity to films of disgusting medical procedures (Kunzmann et al., 2005). It is also possible that older adults regulate negative expression automatically to maintain emotional wellbeing and social relationships (see SST; Carstensen, 1992). Thus, the regulation of emotions to reduce emotional expression could involve more automatic or implicit processes for older adults.

In contrast, other studies have found that older adults produce greater expressions of emotions than young adults in their response to negative films (Phillips et al., 2008; particularly with age-appropriate stimuli, Kunzmann & Grühn, 2005), and autobiographical memories (Malatesta-Magai, Jonas, Shepard, & Culver, 1992). Findings from these studies suggest that for older adults there are no age-related declines in the capacity to naturally respond with heightened emotional facial expressions.

The mixed pattern of findings might reflect the variability in measurements and accurate assessment of emotional facial expressions in young and older adults. For example, studies have traditionally relied on behavioural coding techniques where independent observers rate the level of positive and negative emotions expressed (e.g., Magai et al., 2006). As suggested by Phillips et al. (2008), it is possible that observers experience greater difficulty in interpreting and accurately coding older adults' facial displays of emotion due to the physical changes that occur with age (e.g., wrinkles). Behavioural coding methods are also prone to observer biases (Phillips et al., 2008) and are not able to capture the subtle and fleeting emotional responses associated with facial expression (Izard, 1990; Tassinary, Cacioppo, & Vanman, 2007). By contrast, facial EMG provides an objective measure of subtle changes in facial muscle activity and has been used to index the valence of emotional expressions (Cacioppo et al., 1997; Tassinary et al., 2007).

In EMG studies, two frequently targeted facial muscle groups are the *zygomaticus major* (indicative of positive emotions) and the *corrugator supercilii* (indicative of negative emotions), and these are increasingly used as overt indicators of emotion regulation (Driscoll et al., 2009; Kim & Hamann, 2012; Ray, Ochsner, McRae, & Gross, 2010). *Zygomaticus* muscle activity is associated with smiling by raising the corners of the lips, whereas *corrugator* muscle activity is associated with frowning by lowering and bringing the eyebrows closer together (Mauss & Robinson, 2010). Research demonstrates that young and older adults respond to emotional stimuli with similar patterns of emotion-related EMG activity (i.e., increased corrugator during negative stimuli; D. P. Smith et al., 2005). However, age group differences in the *intensity* of EMG activity found appear to be mixed across studies. Some studies have found older adults exhibit less *corrugator* EMG responses than young adults when naturally responding to negative stimuli (D. P. Smith et al., 2005).

In contrast, other studies have found no age differences in *corrugator* EMG activity (Lohani & Isaacowitz, 2014; Reminger, Kaszniak, & Dalby, 2000). There has been minimal research into the age-related *zygomaticus* EMG responses to positive stimuli (Slessor, Miles, Bull, & Phillips, 2010).

Age differences in physiological and neurological reactivity. Past research has also demonstrated a mixed pattern of findings for age differences in physiological reactivity to emotional stimuli (Cacioppo et al., 1997; Shiota & Neufeld, 2014). Physiological reactivity has generally been assessed with autonomic measures, such as skin conductance, heart rate, and respiration pattern (Levenson, 2014). Old age is associated with age-related biological declines, such as reduced efficiency and slowing of functioning in the sympathetic, parasympathetic, and somatic nervous systems (Arking, 2006; Whitbourne, 1985). Thus, when interpreting findings of reduced emotional reactivity, studies must determine whether decreased autonomic responses were due to emotion-specific reactivity with age, and not reflective of overall age-related degradation in ANS functioning or neural reactivity (D. P. Smith et al., 2005). However, reduced emotional reactivity in older adults may indeed be associated with age-related declines in ANS function and cardiovascular reactivity (D. P. Smith et al., 2005), which are activated with emotional provocation (Urry & Gross, 2010).

A number of studies have found age-related declines of physiological reactivity in response to emotion stimuli (Stanley & Isaacowitz, 2014). For instance, when viewing emotion-eliciting stimuli, older adults produce less autonomic arousal than young adults (Birditt et al., 2005; Gavazzeni, Wiens, & Fischer, 2008; Lawton, 2001; Levenson et al., 1991; Levenson, Carstensen, & Gottman, 1994; Lohani & Isaacowitz, 2014; Neupert, Almeida, & Charles, 2007; Tsai et al., 2000). Specifically, despite reporting high levels of subjective positive and negative emotions, older adults responded with lower levels of heart rate and pulse transit time (Levenson et al., 1991; Levenson et al., 1994; D. P. Smith et al., 2005; Tsai et al., 2000). One study revealed that older adults were less physiologically reactive across a range of outcome measures to negative films than young adults (e.g., skin conductance, heart rate, respiration period; Kunzmann et al., 2005). Older adults have also self-reported less physiological responses to daily life stressors (Charles et al., 2009; Lawton et al., 1992).

In contrast, other research has reported mixed age-related findings for emotional physiological reactivity. For instance, some studies have found that despite age differences in facial responses, young and older adults did not differ in their physiological responses to negative films (Kunzmann et al., 2005) or reported exposure to daily events (Stawski, Sliwinski, Almeida, & Smyth, 2008). However, further studies found older adults produced greater physiological reactivity in response to emotional stimuli than young adults, for example showing higher systolic blood pressure (Uchino, Birmingham, & Berg, 2010) and startle-blink reactivity (D. P. Smith et al., 2005). In diary studies performed outside of the laboratory, older adults also reported greater physiological responsiveness compared with young adults (Mroczek & Almeida, 2004; Uchino, Holt-Lunstad, Bloor, & Campo, 2005).

Evidence indicates that physiological reactivity in old age is also influenced by the nature of the stimuli (Scheibe & Carstensen, 2010). For example, when the emotional event was regarded as age-relevant and important to the older age group (e.g., emotional stimuli depicting interpersonal loss), older adults responded with autonomic reactivity of similar magnitude to young adults (e.g., skin conductance, heart rate, respiration; Kunzmann & Grühn, 2005). Thus, how older adults perceive and relate to the emotional event appears to have an impact on their emotional physiological reactivity.

There are also age-related neurological changes that occur, leading to age differences in the processing of positive and negative emotional stimuli, which influence emotional reactivity (Carstensen & Mikels, 2005; Ruffman et al., 2008). For example, older adults produce lower levels of event-related brain potentials (Kisley, Wood, & Burrows, 2007; D.

P. Smith et al., 2005) and amygdala activation in response to emotional stimuli (Gunning-Dixon et al., 2003; Mather et al., 2004; Tessitore et al., 2005). Older adults also demonstrated reduced amygdala connectivity to other brain regions, specifically posterior regions associated with visual processing, potentially reflecting decreased attention to emotional stimuli and thereby reduced emotional responses (St. Jacques, Dolcos, & Cabeza, 2009, 2010). However, for older adults, amygdala connectivity to PFC regions were increased, likely reflecting engagement of emotion regulation processes (Sakaki, Nga, & Mather, 2013; Silvers et al., 2013; St. Jacques et al., 2010), which in turn, also leads to decrease in subsequent behavioural and physiological emotional reactivity (Mather, 2012).

Age differences in subjective experience. Another source of information regarding age differences in emotional reactivity is through self-report. There are again, however, mixed age effects when reviewing the literature on young and older adults' self-rated emotional reactivity. Age effects may depend on the methodology of the study, including the intensity of the emotion-eliciting stimuli and the timing of self-report (Beaudreau et al., 2009; Phillips et al., 2008). For example, compared with young adults, older adults report less negative experience to low and high arousing stimuli, but greater positive experience in low arousing stimuli, and no age differences in high arousing positive stimuli (Kessler & Staudinger, 2009). Studies in this area are largely conducted by instructing participants to either rate their present emotional experience to stimuli, or to retrospectively report how they felt across a duration of time.

The findings from some self-report studies indicate no age differences in subjective intensity of emotional experience when viewing positive and negative stimuli (Emery & Hess, 2011; Phillips, Smith, & Gilhooly, 2002; Tsai et al., 2000). Self-reports of emotional intensity have also not differed between age groups when describing past emotional events (Levenson et al., 1991; Magai et al., 2006). In contrast, other studies have found older adults rate themselves as having less intense emotional experience than young adults when engaging with emotional stimuli (Charles & Carstensen, 2008; Kunzmann et al., 2005). Older adults also report less negative emotion generally (John & Gross, 2004; Mroczek, 2001). Further studies have reported contrasting findings, however, with older adults reporting experiencing greater subjective emotional intensity whilst viewing emotional stimuli (Lohani & Isaacowitz, 2014; Phillips et al., 2008), particularly when experiences involved age-relevant themes (e.g., loss; Kliegel et al., 2007; Kunzmann & Grühn, 2005; Seider et al., 2011).

2.3.2 New Approaches to Emotion Regulation

Given the value of efficient and effective emotion regulation strategies for wellbeing, it is important that we continue to try and identify, and in turn, promote the use of effective strategies particularly in older adults. Traditional emotion regulation techniques have originated from cognitive and behavioural therapeutic approaches (Farb, Anderson, & Segal, 2012; Gross, 1998a). For example, detached reappraisal (cognitive-based) involves altering cognitions to re-evaluate how one relates to the emotional event, whereas expressive suppression (behaviour-based) involves behavioural control to directly inhibit facial displays of emotion. However, the emotion regulation literature and therapeutic orientations are shifting to investigate more adaptive and effective strategies that do not rely on directly challenging or controlling emotional states (as with cognitive behaviour therapy; Chambers et al., 2009). For example, mindfulness approaches have attracted recent attention as a possible valuable method (Arch & Craske, 2006; Erisman & Roemer, 2010; Lalot et al., 2014). The momentum of mindfulness practices has been steadily increasing, and provides new avenues in examining adaptive emotion regulation techniques that may benefit affective, cognitive, and physiological outcomes against commonly used strategies.

Mindfulness-based approaches to emotional management have been recently termed mindful emotion regulation (for a review, see Chambers et al., 2009), and offer alternative techniques that promote adaptive regulatory processes through greater awareness, acceptance, and non-judgement (Kabat-Zinn, 1990; Lalot et al., 2014). Mindfulness-based approaches to emotion regulation rely on different mechanisms that involve learning to relate to and experience difficult emotions with greater awareness, acceptance, and flexibility (Erisman & Roemer, 2010). For example, *focused-breathing* is regarded as one crucial technique for managing emotional responses, which has broader benefits in terms of improved wellbeing (Davis & Hayes, 2011; Williams, 2010). Focused-breathing involves shifting attentional resources to focusing on the flow of each in-and-out breath to reduce emotional reactivity and ground the mind and body (Farb et al., 2010). Whilst there is currently minimal research into the use of focused-breathing as an intended emotion regulation strategy, evidence indicates that it is effective at reducing negative emotion for young adults (Arch & Craske, 2006). However, no studies have yet investigated the effectiveness of focused-breathing (indexing mindful emotion regulation techniques) for older adults.

The use of mindful breathing techniques may be particularly efficient for older adults who are experiencing cognitive declines (De Frias, 2013). For example, regular practice of mindfulness techniques has been found to improve working memory capacity (Davis & Hayes, 2011), use fewer resources than other strategies (Alberts et al., 2012), and promote the effective use of emotion regulation processes when cognitive networks are challenged (Chambers et al., 2009). If used regularly by older adults, focused-breathing may become relatively automatic, reducing the effort and resources required when engaging in emotion regulation (Goldin & Gross, 2010). Given the emphasis on maintaining emotional and social wellbeing, it is particularly important for older adults, who experience cognitive declines and neural deterioration, to achieve emotion regulation goals efficiently (Carstensen et al., 2003; Prakash et al., 2014). Importantly, experimental studies involving young adults have demonstrated that prior experience of mindfulness training is not essential to benefit from the immediate advantages of mindfulness techniques on emotional experiences (Erisman & Roemer, 2010; Feldman, Greeson, & Senville, 2010; Keng, Smoski, & Robins, 2011).

Furthermore, depending on the temporal stage within Gross' (1998b) model of emotion regulation in which focused-breathing occurs, the focused-breathing strategy may be efficient in altering the emotional trajectory. For example, due to reliance on attentional processes, focused-breathing may initially occur during the attentional deployment stage, which is found to be a more resource efficient group of strategies (Urry & Gross, 2010), particularly for older adults (Lohani & Isaacowitz, 2014; Phillips et al., 2008). However, focused-breathing may also involve the modulation of respiratory patterns to alter the emotional response, which occurs during the response-modulation stage and has been found to be more effortful and demanding on resources (Gross, 1998a).

According to the SOC-ER framework, older adults compensate for age-related declines in affective and cognitive functioning by selecting and optimising strategies that they can implement efficiently (Opitz, Gross, et al., 2012; Urry & Gross, 2010), and focused-breathing may be an efficient strategy for older adults to adaptively achieve emotional regulation goals (De Frias, 2013). It should be noted that given focused-breathing directly alters the emotion generative system, it is likely to require some level of cognitive resources to override automatic emotional responses (Alberts et al., 2012). More evidence is required to determine whether focused-breathing, as an index of mindful emotion regulation, is an effective strategy that older adults can implement well into old age (Prakash et al., 2014).

Despite limited research, recent evidence indicates promising benefits of mindfulness-based practices for older adults (McHugh, Simpson, & Reed, 2010; A. Smith, 2004). However, no research has yet compared young or older adults' emotion regulation performance using focused-breathing with other well-researched strategies (e.g., detached reappraisal, expressive suppression). Distinct strategies influence emotional outcomes differently, and the effects of ageing also influence the success of emotion regulation on outcomes such as facial reactivity and physiological arousal (Isaacowitz & Blanchard-Fields, 2012; Urry & Gross, 2010). Research that directly examines the effects of focused-breathing on emotional outcomes, in comparison with alternative strategies, would contribute greater knowledge to the emotion regulation literature.

Moreover, comparing young and older adults' ability to implement focused-breathing would increase the evidence into the effectiveness and efficiency of mindful emotion regulation in old age. Given focused-breathing has not yet been directly tested as an emotion regulation strategy for older adults, this raises the question of whether there are age differences in the effectiveness of focused-breathing in managing emotional responses. It is possible that mindful emotion regulation supports maintained and adaptive management of emotional responses across the life span (Erisman & Roemer, 2010).

2.4. Summary

Emotion regulation is a necessary and crucial aspect of daily living, with adaptive benefits to maintaining interpersonal relationships and day-to-day functioning across the life span. Theoretical frameworks and empirical evidence within the literature on emotional ageing suggest that older adults continue to be effective at regulating their emotions as well as young adults (Suri & Gross, 2012). As stipulated by the paradox of emotional ageing, despite cognitive and biological declines in old age, older adults continue to report high levels of wellbeing (Mather, 2012). The SST suggests that due to a limited time perspective, older adults are motivated to allocate more resources to regulating their emotions to maintain positive experiences and meaningful close relationships (Carstensen et al., 2003).

Using Gross' (1998b) process model to map the temporal stages of emotion regulation strategies, age differences occur in the frequency and success of particular strategies in altering the subjective, expressive, and physiological responses of emotion. The

SOC-ER framework provides a theoretical explanation for age effects on strategy outcomes, suggesting that due to changes in internal and external resources, older adults may be selecting and optimising particular emotion regulation processes to compensate for age-related declines (Urry & Gross, 2010). Whilst the literature has made headway in understanding emotion regulation in older adults, further research is needed to better understand how older adults are able to effectively regulate their emotion, as well as to better understand age-related limits to emotion regulation, and age differences in the impact of strategies on subjective, expressive, physiological, and memory outcomes. The use of psychophysiological methods, such as facial EMG and autonomic measures (e.g., SCL), coupled with self-report, would provide a comprehensive assessment of emotion regulation outcomes in young and older adults.

It is possible that older adults respond to emotional events with reduced emotional reactivity (e.g., facial expressions and autonomic arousal) than young adults, thereby lowering the resource demands to achieve emotion regulation goals (Morgan & Scheibe, 2014; D. P. Smith et al., 2005). This provides a possible contributing explanation to further understanding successful emotion regulation capacity in old age. There are, however, mixed findings in the literature on age-related patterns of emotional reactivity. How young and older adults emotionally respond may depend on a range of methodological differences, such as the nature of the stimuli, the discrete emotion elicited, and how participants' responses are measured (Lohani & Isaacowitz, 2014; Phillips et al., 2008).

It is also possible that emotion regulation capacity is preserved in old age due to better use of specific strategies or the use of more efficient regulation strategies (Morgan & Scheibe, 2014). Older adults may overcome age-related declines in cognitive functioning by regulating emotion more efficiently than young adults. Previous research has demonstrated that older adults can successfully regulate emotion without subsequent consequences, such as memory costs or increased sympathetic activation, whereas young adults show such changes. That is, older adults may rely on fewer cognitive resources (and thus less effort) to effectively implement the same strategies more efficiently than young adults. Furthermore, older adults may be more effective and efficient than young adults when implementing different emotion regulation strategies, particularly strategies that involve fewer effortful processes.

Research into emotion regulation in older adults requires ongoing investigation, as there is still limited knowledge in which strategies are most effective. New approaches to conceptualising emotion regulation strategies include those based in mindfulness. Given the improvements in emotion regulation with mindfulness practices, as well as older adults' preferences for attentional deployment strategies, it is possible that older adults could utilise focused-breathing techniques efficiently to manage difficult emotional states.

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CHAPTER 3: Reduced Facial Reactivity as a Contributor to Preserved Emotion Regulation in Older Adults (Study 1)

"There can be no knowledge without emotion. We may be aware of truth, yet until we have felt its force, it is not ours. To the cognition of the brain must be added the experience of the soul."

– Arnold Bennett (1897)

Overview of Chapter

The following chapter has been published as a manuscript in *Psychology and Aging*. The *Statement of Contribution of Others* and the editor's action letter of acceptance are included in Appendix F.1.

Pedder, D. J., Terrett, G., Bailey, P. E., Henry, J. D., Ruffman, T., & Rendell, P. G. (2016). Reduced facial reactivity as a contributor to preserved emotion regulation in older adults. *Psychology and Aging*, *31*, 114-125. doi:10.1037/a0039985

The current study provides initial empirical evidence and explanations for the current research thesis by investigating how older adults maintain emotion regulation capacity despite age-related cognitive declines, and can do so without costs to memory performance. Two possible contributing factors were explored and included whether age differences in facial reactivity, or strategy effectiveness, might partly explain how older adults can regulate their emotion as efficiently as young adults.

Young and older adults viewed static positive and negative pictures and were instructed to watch naturally or to regulate emotion using expressive suppression or detached reappraisal strategies. Emotion regulation and emotion reactivity were measured according to changes in zygomaticus (i.e., smiles) and *corrugator* (i.e., frowns) electromyography (facial EMG) muscle activity and subjective experience (self-report). Participants completed a surprise picture recall test following the emotion regulation task to index the cognitive resources utilised during emotion regulation.

Results demonstrated that older adults could reduce their facial expression and subjective experience of emotion as well as young adults, and could do so without impairing memory performance. For both age groups, there was no difference between the effects of expressive suppression or detached reappraisal on facial expressions and memory performance, suggesting that the type of strategy does not influence the capacity for older adults to regulate emotional responses to static pictures.

During the watch condition, relative to young adults, older adults produced less *zygomaticus* and *corrugator* EMG muscle activity in response to the emotional pictures, supporting the suggestion that emotion regulation might be less effortful for older adults partly due to having less facial reactivity to regulate. Findings provide greater insight into understanding how emotion regulation abilities are spared with ageing, and create an opening for a new stream of research. It is suggested that additional research investigate older adults' ability to regulate heightened emotional reactivity in response to emotionally arousing dynamic films.

Manuscript Title Page

Reduced Facial Reactivity as a Contributor to Preserved Emotion Regulation in Older Adults

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Abstract

This study investigated whether differences in the type of strategy used, or age-related differences in intensity of facial reactivity, might contribute to preserved emotion regulation ability in older adults. Young (*n* = 35) and older (*n* = 33) adults were instructed to regulate their emotion to positive and negative pictures under 3 conditions (watch, expressive suppression, cognitive ‘detached’ reappraisal). Participants were objectively monitored using facial electromyography (EMG) and assessed on memory performance. Both age groups were effectively, and equivalently, able to reduce their facial expressions. In relation to facial reactivity, the percentage increase of older adults’ facial muscle EMG activity in the watch condition was significantly reduced relative to young adults. Recall of pictures following regulation was similar to the watch condition, and there was no difference in memory performance between the 2 regulation strategies for both groups. These findings do not support the proposal that the type of strategy used explains preserved emotion regulation ability in older adults. Coupled with the lack of memory costs following regulation, these data instead are more consistent with the suggestion that older adults may retain emotion regulation capacity partly because they exhibit less facial reactivity to begin with.

Keywords: aging, emotion regulation, expression, facial electromyography, memory.

3.1. Introduction

Compared to the well-documented cognitive and physical declines seen in late adulthood, emotional functioning and wellbeing are relatively preserved with age (Carstensen & Mikels, 2005; Isaacowitz & Blanchard-Fields, 2012; Mather, 2012; Scheibe & Carstensen, 2010). This appears to include the capacity for emotion regulation, which refers broadly to our ability to influence our inner experience and outward expression of emotion. For example, recent studies have found that young and older adults are equally able to regulate their emotions (Emery & Hess, 2011; Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Phillips et al., 2008; Scheibe & Blanchard-Fields, 2009), and this capacity may even be preserved in the early stages of dementia (Henry et al., 2009).

One component of the multifaceted construct of emotion regulation is the capacity to minimize outward facial displays of emotion. When used appropriately, such regulation of expressive facial displays is not only crucial in managing social communication and interactions across a variety of situations, but also for indirectly influencing intrapersonal emotion (Bonanno et al., 2004; Gross et al., 1997; John & Gross, 2004; Westphal et al., 2010). By contrast, improper use or chronic reliance on minimizing outward displays of emotion have been associated with detrimental outcomes in areas such as physical health (Gross & Levenson, 1997; Sapolsky, 2007) and relationship quality (Butler et al., 2003; Richards et al., 2003). According to the socioemotional selectivity theory (SST; Carstensen & Mikels, 2005), maintaining meaningful relationships is particularly prioritized in later life, with older adults placing greater emphasis on and showing more motivation for regulating emotional states (Charles & Carstensen, 2010).

To date, six studies have examined age differences in the regulation of facial expressions (Emery & Hess, 2011; Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Magai et al., 2006; Phillips et al., 2008; Shiota & Levenson, 2009). Using stimuli designed to evoke positive or negative responses, these studies demonstrated that older adults could successfully regulate their outward display of emotion when asked, and at times could do so more effectively than young adults. Furthermore, it appears that that the process of consciously regulating emotional expression may not come at a cognitive cost to older adults. Specifically, in a study by Emery and Hess (2011) older adults were not only able to regulate outward displays of emotions in response to positive and negative pictures when instructed to "not show any emotional expression on your face," but when asked to subsequently recall the pictures, they performed as well as they did when asked to recall after simply watching the pictures. Indeed, there was a trend for them to recall pictures better in the regulation condition than in the watch condition. In contrast, while young adults were as able as older adults in regulating emotional expression, they performed worse on the recall tasks in the regulation condition relative to the watch condition. An additional study also found that older adults were able to regulate negative emotion without disrupting performance on a concurrent working memory task, whereas young adults' performance did suffer when regulating (Scheibe & Blanchard-Fields, 2009).

As the implementation of regulatory strategies requires cognitive resources (Kryla-Lighthall & Mather, 2008; Phillips et al., 2008; Richards & Gross, 2000), and given that older adults experience poorer memory when performing cognitively demanding tasks (Kirasic, Allen, Dobson, & Binder, 1996), it might appear paradoxical that older adults are able to regulate emotion as well as young adults, and additionally, can do so without incurring cognitive costs (at least as indexed by memory performance). What might underpin the apparent maintenance of emotion regulation ability as we age, however, is currently unclear.

One recently proposed explanation for the preservation of this ability is that older adults may be selecting particular emotion regulation processes to compensate for declines in internal resources (Isaacowitz & Blanchard-Fields, 2012; Lohani & Isaacowitz, 2014; Opitz, Gross, et al., 2012; Urry & Gross, 2010). Therefore, if older adults were selecting less cognitively demanding strategies to regulate their emotions relative to young adults, this would allow them to be as successful at regulating, and allocate greater attention towards the encoding of emotional information into memory.

In keeping with this explanation, some studies have identified age-related differences in the use of strategies to manage the experience and expression of emotion (Lohani & Isaacowitz, 2014; Mather, 2012; Urry & Gross, 2010). Older adults approach emotional situations differently to young adults (Blanchard-Fields et al., 2004; Coats & Blanchard-Fields, 2008), and more often report using affective regulation strategies that require fewer cognitive resources (Scheibe & Blanchard-Fields, 2009). Of particular relevance to the present study is evidence that older adults may be more likely to engage in cognitive reappraisal strategies than expressive suppression (John & Gross, 2004). Cognitive reappraisal influences facial muscles indirectly through reevaluating how one relates to the emotional stimuli or event (Kim & Hamann, 2012), whereas expressive suppression involves direct control of facial muscles. To achieve the same impact on behavior, expressive suppression may demand greater control resources than cognitive reappraisal (Gross, 1998a; John & Gross, 2004; Richards & Gross, 2000) due to being applied late in the emotion-generative process, after affective and physiological responses have been activated. Whereas detached reappraisal (a form of cognitive reappraisal) has been shown to be less effective in decreasing internal negative feelings for older adults, no age differences were found in the effectiveness of this strategy at reducing facial expressions (Shiota & Levenson, 2009).

In relation to their impact on memory, cognitive reappraisal requires the analysis and manipulation of the emotional attributes of the stimuli, which is thought to strengthen attention towards the stimuli and subsequently enhance the memory process during encoding (Kim & Hamann, 2012). In contrast, expressive suppression arguably impairs memory by focusing attention away from the emotional information (Richards, 2004). Indeed, expressive suppression has been shown in some studies to decrease memory performance in young adults with minimal changes to emotional experience (Bonanno et al., 2004; Richards et al., 2003; Richards & Gross, 1999), although other studies have not replicated this memory finding (Gross, 2002; Ortner & de Koning, 2013; Richards & Gross, 2000). It is possible then that older adults preserved capacity for emotion regulation is due to greater use of regulatory strategies such as cognitive reappraisal, an explanation that would be consistent with the finding that successful emotion regulation in older adults was not associated with cognitive costs in Emery and Hess' (2011) study.

An alternative explanation for the apparently preserved emotion regulation ability of older adults, however, could relate to age differences in the intensity of emotional responses to be regulated (Morgan & Scheibe, 2014). To date, there are mixed findings regarding age differences in intensity of such responses. Some studies have indicated that compared with young, older adults naturally respond to emotional scenes with lower facial expressivity (Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; D. P. Smith et al., 2005), and are less physiologically reactive than young adults (Levenson et al., 1991; Levenson et al., 1994; Tsai et al., 2000). However, other studies have not identified such age-related differences (Kunzmann & Grühn, 2005; Phillips et al., 2008; Reminger et al., 2000). Given the possibility, however, that there may be age differences in emotional reactivity, it could be suggested that the process of emotion regulation becomes less cognitively demanding in later life, requiring less effort to reduce the already lower levels of emotional expression and physiology (Kunzmann et al., 2005; Morgan & Scheibe, 2014). This in turn might lead to more attentional resources being given to encoding and consolidating the emotional stimuli into memory, and less to consciously reducing emotional reactivity (Morgan & Scheibe, 2014). Nevertheless, further evidence is required to determine whether the preserved ability to regulate emotions in older adults may contribute to less cognitive effort required to regulate less intense positive and negative emotional responses compared with young adults.

In summary, prior studies show that the capacity to consciously regulate outward displays of emotion may not decline as we grow older. Two possible explanations are that older adults may be using strategies relatively early in the emotion generation process (i.e., detached reappraisal) that require fewer resources than strategies that are applied later in the emotion-generative process (i.e., expressive suppression), or alternatively, stimuli may produce less intensive emotional facial expressions in older adults than young adults, making regulation easier. To investigate these possibilities further, the current study compared emotion regulation performance using strategies of expressive suppression and detached reappraisal with a watch-only condition, both within- and between-subjects, and also compared levels of emotional reactivity in young and older adults. The relative impact of the strategies on memory (as indexed by free recall of the emotional stimuli) was also assessed. To the best of our knowledge, this is the first aging study to directly compare the memory consequences of these different strategies. Furthermore, this is only the second study of regulation in aging (after Lohani & Isaacowitz, 2014) to use the objective psychophysiological measure of electromyography (EMG) and is the first to use EMG to assess potential age-related differences in the regulation of positive facial expression.

The Current Research

The present study sought to investigate possible explanations for previous findings showing that older adults can regulate their emotions as well as young adults. The primary aim of the current study was to investigate whether age differences in strategies utilized, or differences in the intensity of positive and negative emotional facial reactivity, might partly explain previous findings showing that older adults can regulate their emotions as well as young adults. To address this aim we first set out to confirm that both young and older adults can successfully regulate emotion. Specifically, it was predicted that across expressive suppression and detached reappraisal instructions, both age groups would effectively reduce their overt facial expressions of positive and negative emotion (as indexed via facial EMG), and self-reports of emotional experience. This was predicted as young and older adults have been shown to be proficient at using both strategies (e.g., Emery & Hess, 2011; Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009), and because of the priority given to efficient emotion regulation in later life (e.g., according to SST; Carstensen & Mikels, 2005).

Second, we compared the effects of different regulation strategies on memory. In line with the previously mentioned research regarding differing effects on memory per type of strategy, it was predicted that young and older adults would recall more information after using detached reappraisal than expressive suppression. Such a pattern of findings would add support to the view that, relative to young adults, older adults may indeed be using strategies such as detached reappraisal when regulating emotional expressions. Cognitive reappraisal has been argued to be not only more cognitively efficient than expressive suppression but also to benefit memory as a result of enhanced encoding of the emotional stimuli (Dillon et al., 2007; Gross, 2002). Third, we investigated age-related differences in intensity of emotional responses. This allowed us to explore the plausibility of the suggestion that reduced intensity of emotional responses may contribute to older adults' ability to regulate as well as young adults. Support for this contention would be provided if older adults displayed lower levels of *zygomaticus* (i.e., smiles) and *corrugator* (i.e., frowns) EMG activity relative to young adults during the watch condition, and by evidence of no memory cost associated with regulation for older adults, assuming that if less cognitive resources are required to regulate in older adulthood this will allow resources to be deployed to other cognitive tasks.

3.2. Method

Participants

Thirty-five young (M = 23.20 years, SD = 3.71; range 18–34; 24 women) and 35 older adults (M = 71.63, SD = 5.68; range 64–85; 21 women) participated in the current study. Because of equipment errors during the EMG recording process, experimental data from two older adults were excluded from subsequent data analysis. Participants were reimbursed $30 and recruited through newspaper advertisements, posters, and word of mouth. Exclusion criteria for older adults included scores of 84 or below on Addenbrooke's Cognitive Examination-Revised (ACE-R), which is a brief cognitive screening measure assessing orientation/attention, general memory, verbal fluency, language, and spatial memory (Mathuranath, Nester, Berrios, Rakowicz, & Hodges, 2000).

Participants demonstrated the typical age-related patterns of performance on background measures. Older adults (M = 118.83, SD = 5.06) performed better than young adults (M = 113.98, SD = 4.27), $t(66) = 4.28$, $p < .001$, d = 1.04, on verbal intelligence, as indexed by the National Adult Reading Test (Nelson & Willison, 1991). Compared with young (M = 25.02, SD = 10.34), older adults (M = 44.05, SD = 25.27), $t(66) = 4.11$, $p < .001$, d = 0.99, performed worse on task switching and processing speed (Trail Making Test; trail B - trail A; Reitan, 1992). Compared with young (M = 8.69, SD = 1.28), older adults (M = 6.82, SD = 2.04), $t(66) = 4.56$, $p < .001$, d = 1.10, recalled fewer words in a test of verbal recall (Short Word Test of Screening Examination for Cognitive Impairment; Beatty et al., 1995).

Young adults (M = 6.60, SD = 3.22) self-reported greater levels of anxiety than older adults (M = 4.94, SD = 2.33), $t(66) = 2.42$, $p = .018$, d = 0.59, over the past week (Hospital Anxiety and Depression Scale; Zigmond & Snaith, 1983). However, young (M = 2.40, SD = 1.85) and older adults (M = 2.52, SD = 1.86) did not differ in levels of depression, $t(66) = 0.26$, $p = .799$, d = 0.06. At the start of testing there were no age differences in self-reported positive affect (young: *M* = 35.31, *SD* = 5.59; older: *M* = 37.12, *SD* = 8.05), $t(66) = 1.08$, $p = .284$, $d = 0.26$, however, young adults (*M* = 11.91, *SD* = 2.02) reported greater negative affect than older adults (*M* = 10.94, *SD* = 1.58), $t(66) = 2.21$, $p = .031$, $d = 0.53$, on the Positive and Negative Affect Schedule (state version; D. Watson, Clark, & Tellegen, 1988). Young (*M* = 3.80, *SD* = 0.72) and older adults (*M* = 3.76, *SD* = 0.90) did not differ on a self-rated 5-point scale of overall health for the month ranging from 1 (*poor*) to 5 (*excellent*), $t(66) = 0.25$, $p = .830$, $d = 0.05$.

Stimuli and Procedure

Emotion regulation task. This task consisted of an initial practice, followed by three instruction conditions:[1] (a) watch with no instruction, (b) expressive suppression, and (c) detached reappraisal. The watch condition was always completed first, and the second and third conditions were counterbalanced within participants. This instruction order was used to prevent any carryover effects of using regulatory strategies (i.e., expressive suppression and detached reappraisal) on the unregulated watch condition.

In the watch condition, participants were instructed to “view the following pictures carefully by simply watching them as you naturally would.” In the expressive suppression condition, participants were instructed to “minimize any emotional expression on your face so if someone was watching you, they could not tell what you were feeling. To do this, we would like you to minimize your facial muscles from displaying any emotion by keeping the relevant muscles on your face very still.” In the detached reappraisal condition, participants

[1] An additional within-subjects instruction was tested (a simplified variation of expressive suppression), however, this was not included in the present analyses as it was not regarded as sufficiently distinct from the current suppression strategy. The first 37 participants completed both suppression conditions (young, $n = 20$, and older adults, $n = 17$), while the remaining participants (young, $n = 15$, and older adults, $n = 16$) completed only one. ANOVA analyses comparing participants who received both suppression strategies compared to those who received one showed no differences in pattern of *zygomaticus* and *corrugator* activity on any condition for either age group (all *p*s $\geq .139$).

were instructed to "refocus your thinking to imagine that the scenes in each picture are not real, but rather a part of a dream or movie. To do this, we would like you to view each picture with detached interest, viewing them objectively rather than as personally or emotionally relevant to you."

Each instruction condition consisted of one set of positive pictures and one separate set of negative pictures, with six randomized picture trials per set. The order of positive and negative sets was randomized as participants progressed through the instruction conditions. Each individual trial consisted of a blank screen (4.5 s), followed by a fixation cross and an orienting acoustic "bop" (0.5 s) before viewing the stimulus (5 s). Task instructions and stimuli were presented with E-Prime 2.0 Professional (Psychology Software Tools, Inc., Sharpsburg, PA) on a Microsoft Windows desktop computer and LCD screen. Trial onset and offset digital event markers were sent from E-Prime to Acq*Knowledge* recording software.

Thirty positive and 30 negative stimuli were selected from the International Affective Picture System (IAPS; P. J. Lang, Bradley, & Cuthbert, 2001). Six neutral IAPS stimuli were included to provide participants with practice and orientation to the task. Pictures were divided into five sets of six positive stimuli (P1, P2, P3, P4, P5) and five sets of six negative stimuli (N1, N2, N3, N4, N5).[2] Each set was matched for level of emotional valence and semantic content (e.g., nature of depicted scene, age range of individuals). IAPS norms (Bradley & Lang, 2007b) indicated that IAPS valence (*p*s > .636) and arousal (*p*s > .188) ratings did not differ among sets of stimuli. Each participant viewed three sets of positive and three sets of negative stimuli, which were counterbalanced across instruction conditions

[2]Selected IAPS pictures per set were (a) positive (P1: 1811, 2332, 2530, 4599, 8190, 8620), (P2: 1340, 1460, 1750, 4625, 5626, 8540), (P3: 1722, 2070, 2091, 2391, 5621, 7325), (P4: 1441, 1710, 2165, 2550, 8162, 8205), and (P5: 1440, 1601, 2340, 2352, 8496, 8497); (b) negative (N1: 2095, 2205, 6213, 9040, 9050, 9140), (N2: 1301, 3100, 3160, 6212, 9592, 9903), (N3: 2703, 3181, 7380, 9220, 7361, 9561), (N4: 1050, 2900, 3350, 9300, 9429, 9921) and (N5: 1201, 3005, 3230, 3300, 8485, 9042); and (c) neutral: 7002, 7004, 7009, 7041, 7090 and 7235.

(example of condition order: watch P1, N4; suppress P3, N2; reappraise N3, P5). The availability of additional picture sets to be counterbalanced, allowed greater variety of pictures viewed across participants.

Facial EMG. Subtle physiological muscle activity was recorded using EMG. Pairs of 4-mm Ag-Ag CI shielded fixed-wire electrodes containing conductance electrode gel were placed over the *zygomaticus major* (to index positive affect) and *corrugator supercilii* (to index negative affect) muscle regions on the left side of the face (Fridlund & Cacioppo, 1986; Tassinary et al., 2007). A ground electrode was placed in the center of the forehead. Muscle sites were prepared using skin abrasive pads and Nu Prep skin preparation gel before using adhesive washers to attach electrodes to skin surface with an inter-electrode distance of 1 cm. An impedance checker was used to ensure impedance level was below 20 kΩ during signal recording (Tassinary et al., 2007). Activity was recorded using biopotential amplifiers at a sampling rate of 1,000 Hz with an integrated MP150 system and Acq*Knowledge* software package (Biopac Systems, Inc., Goleta, CA). A 50 Hz notch interference filter, along with a 500 Hz low-pass and 10 Hz high-pass filter were applied.

Post data acquisition, raw signals were checked for noise and interference. A Logitech digital webcam recorded participants' visual facial responses to facilitate the removal of artifacts or non-task specific activity from the EMG signal. Root mean square (RMS) transformations were applied to normalize the distribution of values (De Luca, 2006). Percentage change in 500 ms epochs of RMS muscle activity was compared with baseline activity recorded 2.5 s to 0.5 s immediately prior to the onset of each picture (Dan-Glauser & Gross, 2011). The final score comprised of the RMS change in activity for the 5 s of stimulus exposure, thereby providing an indication of participants' subtle positive and negative facial muscle responses to the stimuli.

Self-report. For a subjective measure of strategy effectiveness, participants recorded their emotional experience following each set of stimuli in the regulation task. As stimuli were chosen to elicit pleasant and unpleasant feelings, not to evoke any single specific emotion, participants simply rated how "unhappy or happy" they felt on a nine-point *Likert* scale. The scale ranged from 1 (*unhappy*) to 9 (*happy*).

Picture recall test. Participants completed a surprise recall test following the regulation task,[3] which involved recalling brief descriptions of as many pictures as possible in approximately 10 min. Two independent coders (blind to experimental conditions) matched recalled pictures back to the stimuli sets and regulatory conditions. Descriptions that were unable to be matched back to pictures were coded as unmatched. The first 30% of data scored by both coders was tested for interrater reliability. Analyses for each condition returned intraclass correlations between .90 and .99, indicating excellent reliability (Hallgren, 2012). Because of the high agreement between both coders, one coder continued to score the remaining recalled pictures (Kim & Hamann, 2012).

3.3. Results

Emotional Expression as Indexed by EMG

Preliminary analyses. Positive and negative pictures were first checked for correctly associated increases in *zygomaticus* or *corrugator* muscle activity in the watch condition (Dan-Glauser & Gross, 2011). Increased *zygomaticus* activity was greater when viewing positive (M = 73.84, SD = 78.00) than negative stimuli (M = 2.07, SD = 19.50), $t(67) = 7.98$, $p < .001$, $d = 1.26$. Increased *corrugator* activity was greater when viewing negative (M = 40.08, SD = 47.67) than positive stimuli (M = -9.13, SD = 21.95), $t(67) = 8.66$, $p < .001$, d = 1.33.

[3]An additional surprise recall test was provided to participants 24 hr following the initial testing session to examine the effects of implementing regulation strategies on stimulus consolidation. However, data from this test was not included in the present analyses due to the likely influence of practice effects and rehearsal.

Baseline scores (resting EMG activity prior to stimulus onset) during each instruction condition were assessed for age differences. For the watch instruction, there were no age differences in baseline scores for *zygomaticus* (young: $M = 0.24$, $SD = 0.27$; older: $M = 0.21$, $SD = 0.14$), $t(66) = 0.71$, $p = .481$, $d = 0.14$, or *corrugator* activity (young: $M = 0.43$, $SD = 0.32$; older: $M = 0.45$, $SD = 0.33$), $t(66) = 0.30$, $p = .769$, $d = 0.06$. For the expressive suppression instruction, there were no age differences in baseline scores for *zygomaticus* (young: $M = 0.15$, $SD = 0.20$; older: $M = 0.14$, $SD = 0.06$), $t(66) = 0.33$, $p = .740$, $d = 0.07$, or *corrugator* activity (young: $M = 0.42$, $SD = 0.32$; older: $M = 0.49$, $SD = 0.41$), $t(66) = 0.78$, $p = .446$, $d = 0.19$. For the detached reappraisal instruction, there were no age differences in baseline scores for *corrugator* activity (young: $M = 0.50$, $SD = 0.33$; older: $M = 0.56$, $SD = 0.53$), $t(66) = 0.55$, $p = .584$, $d = 0.14$, however, there were age differences for baseline *zygomaticus* activity (young: $M = 0.11$, $SD = 0.07$; older: $M = 0.18$, $SD = 0.13$), $t(66) = 2.57$, $p = .012$, $d = 0.67$.

Because of the higher levels of reported anxiety for young compared with older adults, the association between anxiety and facial EMG reactivity was investigated. Pearson correlations indicated no significant associations between anxiety and facial EMG activity for young (*p*s > .116) or older adults (*p*s > .353). Consequently, no statistical control for level of anxiety was required for the following analysis of variance (ANOVA) analyses (Tabachnick & Fidell, 2006).

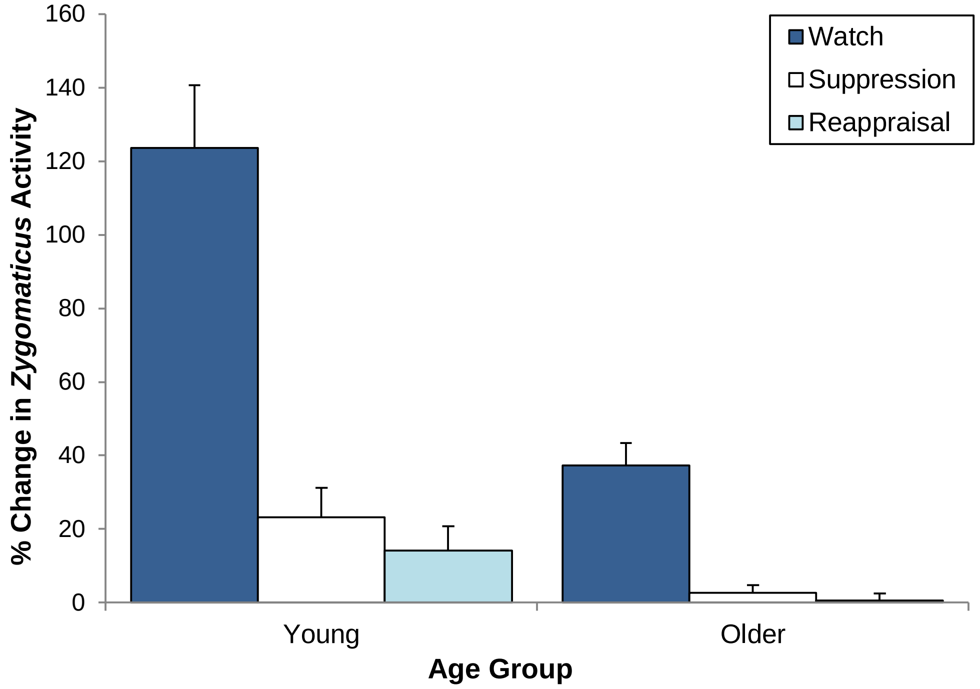
Analysis of facial expression. This analysis was designed to determine whether both age groups were able to reduce their emotional facial expression using the instructed regulation strategies. When assumptions of sphericity were violated, Greenhouse-Geisser corrected values are reported. The change in *zygomaticus* and *corrugator* muscle activity, representing positive and negative facial expression, respectively, is shown in Figure 3.1 as a function of age group (young, older) and instruction (watch, expressive suppression, detached reappraisal). These data were separately analyzed for activity in the *zygomaticus* and *corrugator* muscle regions with a 2 x 3 mixed ANOVA.[4] The between-subjects variable was age group and the within-subject variable was instruction.

For *zygomaticus* muscle responses to positive stimuli, there was a main effect of age group, $F(1, 66) = 16.89$, $p < .001$, $\eta_p^2 = .20$, and instruction, $F(1.29, 85.30) = 75.19$, $p < .001$, $\eta_p^2 = .53$, and an Age Group x Instruction interaction, $F(1.29, 85.30) = 17.59$, $p < .001$, $\eta_p^2 = .21$. Tests of simple effects to follow-up the interaction revealed simple main effects of age group for the watch condition, $F(1, 66) = 21.53$, $p < .001$, $\eta_p^2 = .25$, and expressive suppression condition, $F(1, 66) = 6.03$, $p = .017$, $\eta_p^2 = .08$, with young adults demonstrating greater *zygomaticus* activity than older adults in both conditions. There were no age differences for the detached reappraisal condition, $F(1, 66) = 3.43$, $p = .069$, $\eta_p^2 = .05$.

A further test of simple effects revealed a simple main effect of instruction for young adults, $F(2, 65) = 48.70$, $p < .001$, $\eta_p^2 = .60$, and older adults, $F(2, 65) = 5.52$, $p = .006$, $\eta_p^2 = .15$. Separate post hoc analyses for each age group revealed greater *zygomaticus* activity during the watch condition than expressive suppression (young: $p < .001$, $d = 1.29$; older: $p = .002$, $d = 1.35$) and detached reappraisal (young: $p < .001$, $d = 1.44$; older: $p = .002$, $d = 1.43$). The two regulation strategies did not differ significantly (young: $p = .065$; older: $p = .693$).

[4]Consideration was given to including baseline level of negative affect as a covariate in the ANOVA analyses, given the group differences in this variable at the beginning of the testing session. However, no significant correlations were found between negative affect and the outcome variables of EMG (*p*s > .171), self-report (*p*s > .051), or memory performance (*p*s > .158) with the exception of *zygomaticus*, $r = .41$, $p = .013$, and *corrugator* EMG activity, $r = .38$, $p = .023$, during the expressive suppression condition for young adults. Because of the general lack of associations, controlling for negative affect was not considered necessary (Tabachnik & Fidell, 2006).

(A) *Zygomaticus* Activity (Positive Expression)



(B) *Corrugator* Activity (Negative Expression)

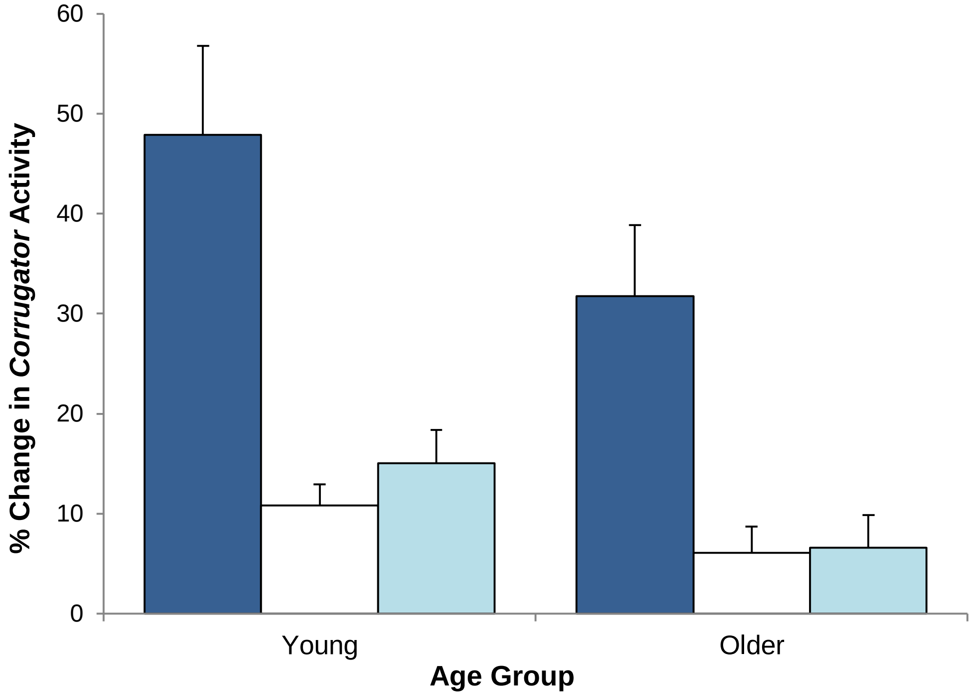


Figure 3.1. Change in (A) *zygomaticus* and (B) *corrugator* EMG activity from baseline when viewing (A) positive and (B) negative pictures. A higher percentage increase in activity indicates greater use of the specified muscle. Expressive suppression and detached reappraisal strategies required participants to reduce their emotional responses. Error Bars indicate standard error. A: *Zygomaticus* activity (positive expression). B: *Corrugator* activity (negative expression).

For *corrugator* muscle responses to negative stimuli, there was a main effect of age group, $F(1, 66) = 4.22$, $p = .044$, $\eta_p^2 = .06$, with young adults ($M = 24.59$, $SD = 36.94$) demonstrating greater *corrugator* activity than older adults ($M = 14.82$, $SD = 29.71$). There was a main effect of instruction, $F(1.25, 82.34) = 25.12$, $p < .001$, $\eta_p^2 = .28$, with post hoc analyses revealing that *corrugator* activity was greater for the watch condition ($M = 40.08$, $SD = 47.67$) than expressive suppression ($M = 8.51$, $SD = 14.05$, $p < .001$, $d = 0.90$) and detached reappraisal ($M = 10.95$, $SD = 19.65$, $p < .001$, $d = 0.80$). The two regulation strategies did not differ significantly ($p = .926$). There was no Age Group x Instruction interaction, $F(1.25, 82.34) = 0.69$, $p = .439$, $\eta_p^2 = .01$.

Summary of EMG data. Young and older adults both showed *zygomaticus* and *corrugator* facial activity during the watch condition and reduced this facial activity to baseline levels in both expressive suppression and detached reappraisal regulation conditions. However, of particular note, compared with young, older adults responded with significantly lower *zygomaticus* and *corrugator* activity in the watch condition. Thus, relative to young, older adults had less facial activity to reduce.

Self-reported Emotional Experience

Preliminary analyses. Preliminary checks of emotion ratings were first conducted. Within the watch condition, positive stimuli ($M = 7.42$, $SD = 1.18$) were rated as evoking greater happiness than negative stimuli ($M = 2.70$, $SD = 1.35$), $t(68) = 20.81$, $p < .001$, $d = 3.72$.

Analysis of self-reported emotion. Emotional experience was analyzed separately for positive and negative stimuli with a 2 (Age Group; young, older) x 3 (Instruction; watch, expressive suppression, detached reappraisal) mixed ANOVA (see Footnote 4). The dependent variable was the self-reported emotional rating of happiness in response to each picture set. Young and older adults' mean scores for self-reported experience in each condition are displayed in Figure 3.2.

For positive stimuli, there was a main effect of age group, $F(1, 66) = 4.78$, $p = .032$, $\eta_p^2 = .07$, with older adults ($M = 6.90$, $SD = 1.61$) reporting greater feelings of happiness than young adults ($M = 6.35$, $SD = 1.30$). There was a main effect of instruction, $F(2, 132) = 28.68$, $p < .001$, $\eta_p^2 = .30$, with post hoc analyses revealing that the watch condition ($M = 7.40$, $SD = 1.17$) was rated as eliciting greater happiness than expressive suppression ($M = 6.41$, $SD = 1.58$, $p < .001$, $d = 0.71$) and detached reappraisal ($M = 6.04$, $SD = 1.34$, $p < .001$, $d = 1.07$). The two regulation conditions did not differ significantly ($p = .188$). There was no Age Group x Instruction interaction, $F(2, 132) = 0.66$, $p = .521$, $\eta_p^2 = .01$.

For negative stimuli, there was no main effect of age group, $F(1, 66) = 3.35$, $p = .072$, $\eta_p^2 = .05$; however, there was a main effect of instruction, $F(2, 132) = 4.57$, $p = .012$, $\eta_p^2 = .07$. Post hoc analyses revealed that the watch condition ($M = 2.69$, $SD = 1.36$) was rated as eliciting greater unhappiness than detached reappraisal ($M = 3.29$, $SD = 1.54$, $p = .018$, $d = 0.41$), but not expressive suppression ($M = 3.00$, $SD = 1.45$, $p = .325$, $d = 0.22$). The two regulation conditions did not differ significantly from one another ($p = .410$). There was no Age Group x Instruction interaction, $F(2, 132) = 0.16$, $p = .849$, $\eta_p^2 < .01$.

Summary of self-report data. In response to positive stimuli, young and older adults self-reported reductions in happiness in both expressive suppression and detached reappraisal regulation conditions relative to the watch condition. For negative pictures, compared to the watch condition, both age groups reduced their unhappiness using detached reappraisal, but not expressive suppression. Ratings in the watch condition indicate that the self-perception of emotional response to stimuli was just as intense for older adults compared to young adults.

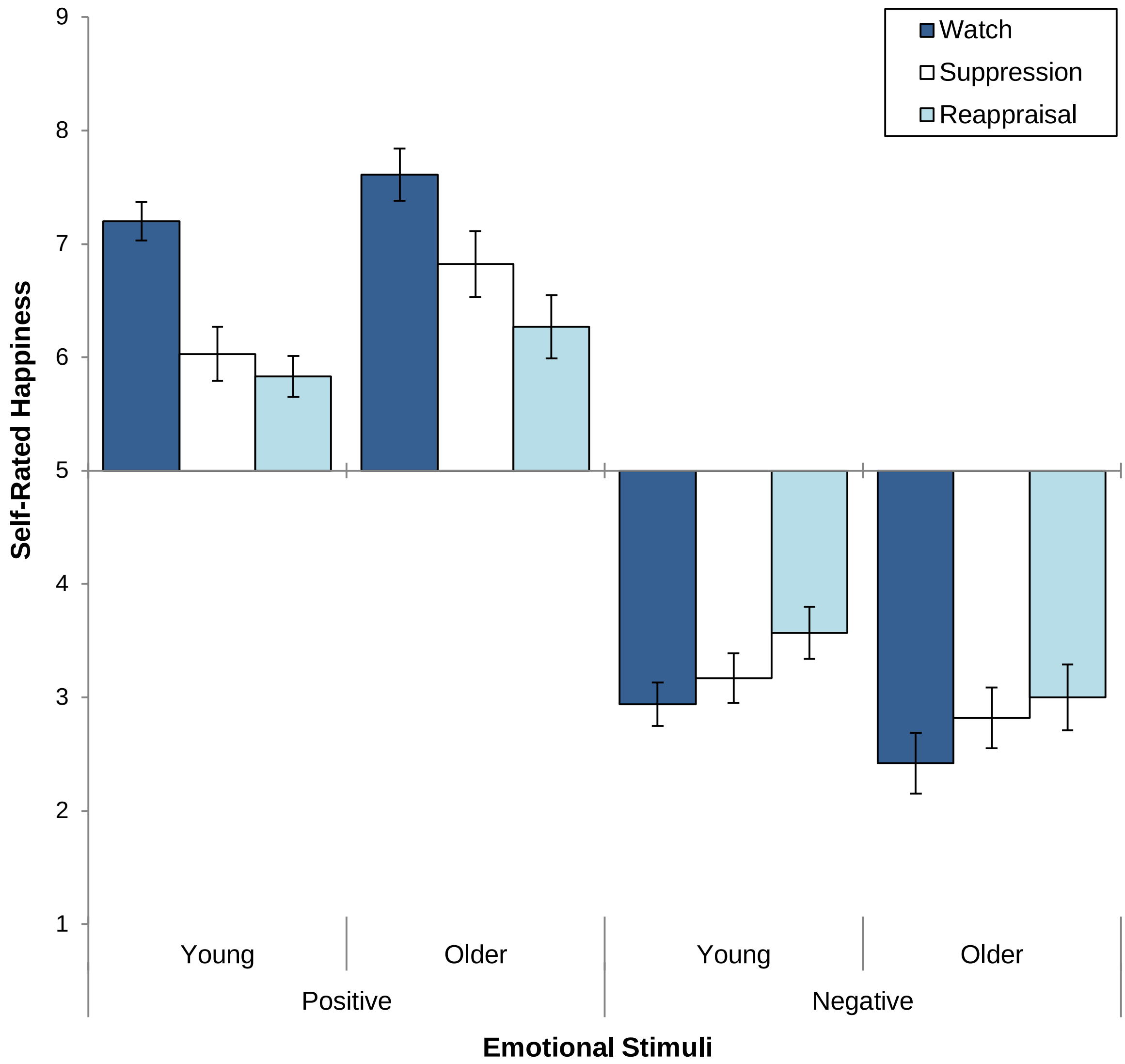


Figure 3.2. Mean scores of self-reported experience ratings for positive and negative stimuli for each instruction. A higher rating indicates a pleasant "happy" subjective experience. A lower rating indicates an unpleasant "unhappy" subjective experience. The *x*-axis crosses the *y*-axis indicating neutral subjective experience. Expressive suppression and detached reappraisal strategies required participants to reduce their emotional responses. Error bars indicate standard error.

Impact of Strategy Use on Memory Performance

Analysis of picture recall. The effect of strategy use on memory recall performance was analyzed separately for positive and negative stimuli with a 2 (Age Group; young, older) x 3 (Instruction; watch, expressive suppression, detached reappraisal) mixed ANOVA (see Footnote 4).[5] The dependent variable was the percentage of pictures correctly recalled.[6] Young and older adults' mean scores for picture recall in each condition are displayed in Figure 3.3.

For positive stimuli, there was a main effect of age group, $F(1, 66) = 19.80$, $p < .001$, $\eta_p^2 = .23$, with young adults ($M = 30.79$, $SD = 22.02$) recalling a greater percentage of stimuli than older adults ($M = 17.68$, $SD = 19.61$). There was no main effect of instruction, $F(2, 132) = 1.12$, $p = .331$, $\eta_p^2 = .02$, nor an Age Group x Instruction interaction, $F(2, 132) = 0.37$, $p = .694$, $\eta_p^2 = .01$. For negative stimuli, there was a main effect of age group, $F(1, 66) = 31.39$, $p < .001$, $\eta_p^2 = .32$, with young adults ($M = 35.71$, $SD = 20.60$) recalling a greater percentage of stimuli than older adults ($M = 19.87$, $SD = 18.08$). There was no main effect of instruction, $F(2, 132) = 0.15$, $p = .858$, $\eta_p^2 < .01$, or an Age Group x Instruction interaction, $F(2, 132) = 2.43$, $p = .092$, $\eta_p^2 = .04$.

Summary of recall across instruction conditions. For both age groups there were no differences between instruction conditions for the percentage of positive and negative stimuli recalled. Although there was a main effect of age group, the lack of main or interaction effects for instruction indicates there were also no effects on memory for young and older adults in either type of regulation condition across stimuli. Specifically, the absence of effects on memory is shown by the lack of difference between recall performance

[5] Given that the watch condition was not counterbalanced with the two regulation conditions, additional analyses were conducted to solely compare recall between expressive suppression and detached reappraisal strategies, whose order was counterbalanced. Positive and negative stimuli were analyzed separately with a 2 (Age Group) x 2 (Instruction) mixed ANOVA. For both age groups, there were no differences between regulation strategies for positive, $F(1,66) = 2.08$, $p = .154$, or negative stimuli recalled, $F(1, 66) = 0.15$, $p = .701$, suggesting no recall differences were observed between expressive suppression and detached reappraisal.

[6] There were 47 unmatched descriptions for young adults, and 34 for older adults. A comparison of mean scores for unmatched pictures, revealed no difference between young ($M = 1.34$, $SD = 1.21$) and older adults ($M = 1.03$, $SD = 1.21$), $t(66) = 1.06$, $p = .292$, $d = 0.26$.

on the two regulation instruction conditions compared to the control condition where participants were instructed only to watch.

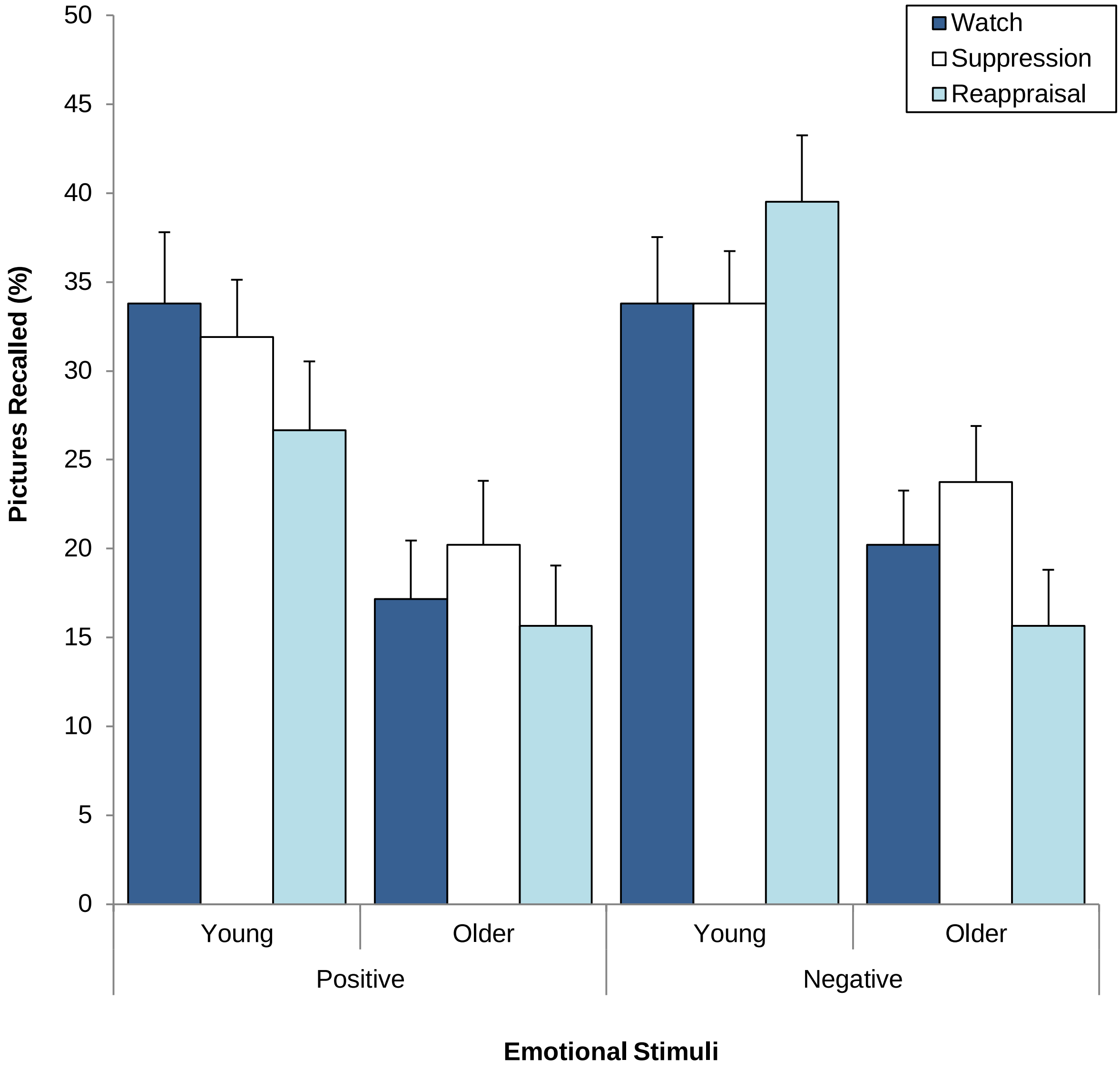


Figure 3.3. Mean scores of percentage recalled positive and negative stimuli for each instruction. Expressive suppression and detached reappraisal strategies required participants to reduce their emotional responses. Error bars indicate standard error.

3.4. Discussion

As anticipated, the first set of analyses confirmed that both young and older adults could regulate their facial expression (as indexed with EMG) and subjective experience of emotion (as indexed with self-report). More specifically, the findings showed that when responding to positive stimuli, young and older adults were equally able to reduce their facial expression and internal pleasant experience of emotion, regardless of which regulatory strategy was used. When it came to negative emotion, whilst both age groups were successful at minimizing their behavioral expression regardless of the strategy used, they were only able to reduce their internal unpleasant feelings using detached reappraisal and continued to report feeling just as unhappy when using expressive suppression. These findings of reduced emotional facial expression following implementation of regulation strategies are consistent with prior research using behavioral measures of facial expression (Emery & Hess, 2011; Kunzmann et al., 2005; Magai et al., 2006), as well as the one previous study that used EMG to index changes in facial expression (Lohani & Isaacowitz, 2014).

The current study therefore supports previous findings of no age differences in the ability to reduce negative expression across detached reappraisal and expressive suppression strategies (Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009) but extends them by showing that this pattern similarly applies to the ability to reduce positive expression. Furthermore, although the regulatory goal (i.e., to minimize emotional display) is only overtly specified for the expressive suppression condition, for both conditions effective strategy use led to a reduction in the strength of the emotional expression exhibited. The fact that the effective use of detached reappraisal not only impacted subjective experience, but also facial expressions of emotion in young and older adults is consistent with the view that detached reappraisal elicits its effects on emotion response tendencies relatively early in the emotion-generative process, leading to subsequently reduced outward displays of emotion (Gross, 1998a; Kim & Hamann, 2012; Lohani & Isaacowitz, 2014; Ray et al., 2010).

Explanations for Preserved Emotion Regulation Ability in Older Adults

The primary focus of the present study, however, was to explore possible explanations that contribute to understanding preserved capacity for emotion regulation in older adults. Two possible explanations were investigated: (a) utilization of less demanding emotion regulation strategies, and (b) age-related differences in facial expressivity.

To examine the first explanation, young and older adults were instructed to reduce their emotional responses using two distinct strategies of expressive suppression and cognitive ‘detached’ reappraisal. Their recall for the stimuli was also subsequently tested. As previously noted, both age groups were equally able to regulate their emotional expression and experience for both strategies. However, no support was found for the prediction that expressive suppression would result in decreased memory (i.e., reduced recall) relative to detached reappraisal and unregulated watching. In fact, for both young and older adults, the type of emotion regulation process engaged in made no difference to the number of stimuli recalled, with recall following both strategies similar to that in the watch condition. Indeed, alternative forms of cognitive reappraisal (e.g., positive reappraisal; Martins et al., 2015) may have improved memory due to involving even greater elaborative processing, attention, and orientation to the emotional stimuli than detached reappraisal (Nowlan et al., 2014; Shiota & Levenson, 2009). However, as there were no differences in memory costs associated with the two regulation strategies investigated, no clear evidence was provided in the current study to support the suggestion that older adults maintain emotion regulation ability via greater use of the more cognitively efficient strategy of detached reappraisal relative to expressive suppression.

To investigate the second explanation that older adults might naturally respond with lower levels of facial reactivity, potentially reducing the regulatory demands on subsequent cognitive processes, participants’ emotional expressions during an unregulated watch condition were recorded with facial EMG. Consistent with this suggestion, the findings showed that older adults responded with lower levels of smile and frown reactivity to emotional stimuli compared to young adults, which may have made it less difficult for them to achieve an equivalent level of regulatory success. These results showing age-related reduction in facial reactivity are similar to two past studies using *corrugator* EMG (Lohani & Isaacowitz, 2014; D. P. Smith et al., 2005), and another study using behavioral observations (Kunzmann et al., 2005) that also found lower negative facial responses in older adults.

The lack of memory costs associated with emotion regulation in older adults found in the current study and others (e.g., Emery & Hess, 2011) also fits with this second explanation. Specifically, it could be argued that for older adults lower intensity of facial responses reduces the amount of cognitive resources required to achieve levels of emotion similar to young adults. This leaves older adults with adequate resources to process, and in turn recall, the emotional stimuli presented. The reduced facial reactivity observed in older adults may be associated with age-related declines in autonomic nervous system function and cardiovascular reactivity (D. P. Smith et al., 2005), which are activated with emotional arousal (Urry & Gross, 2010). For example, in response to emotional stimuli older adults produce lower levels of event-related brain potentials, amygdala activation, heart rate, and sympathetic arousal, despite reporting higher levels of self-reported emotion and arousal (Levenson et al., 1991; Mather et al., 2004; D. P. Smith et al., 2005; Tsai et al., 2000; although see Kunzmann & Grühn, 2005). Overall then, it may be that with less physiological activation and emotional responsiveness in old age, emotions themselves may become easier to regulate (D. P. Smith et al., 2005).

Although reduced facial reactivity may be a possible contributor to the preserved emotion regulation ability of older adults in the current study, alternative interpretations of the findings should also be considered. This is particularly important in relation to the lack of memory costs associated with expressive suppression for young adults, which is in contrast to the findings of some other studies that did find decreased memory associated with this strategy (Bonanno et al., 2004; Emery & Hess, 2011; Richards & Gross, 1999). One possible explanation concerns the fact that the instruction for expressive suppression in the current study (as well as in a study by Ortner & de Koning, 2013, who also found no costs) asked participants to focus specifically on relaxing facial muscles, whereas studies where a cost was found simply asked participants to generally hide their emotional expression so others could not tell what they were feeling (e.g., Emery & Hess, 2011). It is possible that the form of expressive suppression used in the current study might be a less effortful strategy because participants can apply it prior to the onset of emotional responses (Gross, 1998a, 2002), and require less attentional resources to continuously reduce the emotional facial displays (Morgan & Scheibe, 2014), thus producing limited effects on memory performance. This explanation is, however, speculative and further investigation involving direct testing of different strategies for expressive suppression and their impact on stimulus encoding and retrieval is warranted.

Furthermore, it could be argued that the lack of costs associated with the regulation conditions relative to the watch condition for both young and older adults may be due to participants experiencing a recency effect, remembering more recently viewed than initially viewed items. This is because the watch condition was administered first to avoid any potential carry-over effects of the regulation instructions. Thus, items from the subsequently administered regulation conditions may have been better recalled simply due to having been viewed more recently. However, participants in the current study were presented with the surprise recall test following the removal of EMG electrodes, thereby providing opportunity for distraction and a short delay since viewing the stimuli, which has been shown to minimize recency effects (Bjork & Whitten, 1974; Davelaar, Goshen-Gottstein, Ashkenazi, Haarmann, & Usher, 2005).

In addition, it is possible that the lack of memory effects in the current study could have been due to the time participants had to encode the stimulus (i.e., 5 s during picture presentation, and 5 s following each stimulus). Participants may have been reflecting back on the prior picture during the 5 s following stimulus presentation, which could have reduced any regulation effects on memory. However, the current interstimulus interval was consistent (between 10 to 14 s) with previous studies that have found memory costs following expressive suppression (Bonanno et al., 2004; Richards & Gross, 1999), suggesting that the results are unlikely to be attributable to this aspect of the methodology.

Finally, it could also be suggested that the lack of memory effects in the expressive suppression condition may have been due to the blocked design whereby participants did not need to apply the strategy anew for every stimulus, but rather could just keep regulating throughout the block. However, previous studies using a similar blocked design (Bonanno et al., 2004; Emery & Hess, 2011) have reported memory effects thereby suggesting that this possibility is unlikely.

The current findings appear then to be most consistent with the explanation that reduced facial reactivity may contribute to older adults' ability to regulate as well as young adults as it is less demanding of cognitive resources, allowing maintenance of performance on other cognitive tasks such as memory. Indeed, given what is known about cognitive decline with age, it might be that young and older adults are somewhat equivalent in their ratio of facial reactivity and resource demands leading to equivalent emotion regulation performance in the two groups. That is, young adults have more facial reactivity but also more resources available to them to regulate, whereas older adults have reduced resources available to them but can perform the regulation task adequately because they have less reactivity to reduce. This offers a parsimonious explanation for the findings showing equivalent emotion regulation capacity without costs to memory in both age groups in the current study.

The claim that preserved regulation ability in older adults may be linked to lower expressive reactivity is further strengthened by the self-report data. Specifically, older adults' less expressive behavior was not due to reduced perception of positive or negative stimuli, as the self-rated emotional experience was just as intense for young and older adults. Thus, stimuli were effective in eliciting emotional responses in both age groups, with age differences only observed in facial reactivity, and not internal experience. Furthermore, it is unlikely that older adults were implicitly and automatically regulating their facial responses. This is because their smaller expressive responses in the watch condition were not limited to negative emotion but were also observed for positive emotion. Implicit regulation of positive emotion is particularly unlikely for older adults given they are known to strategically enhance positive emotional experiences and avoid negative ones (see SST; Carstensen & Mikels, 2005).

Limitations and Future Research

The current research relied on static pictures to elicit emotional responses so some caution needs to be applied when interpreting the findings. Although static pictures were effective in eliciting emotional experience and expression in the current study, the use of dynamic stimuli, such as films, would increase the intensity of responses (Gabert-Quillen, Bartolini, Abravanel, & Sanislow, 2014; Mauss & Robinson, 2010). Films are better able to elicit greater emotional responses, with higher degrees of ecological validity, allowing for a range of intensities in emotional responses across various discrete emotions (Fernández et al., 2012; Gross & Levenson, 1995). Use of emotional films would thus provide greater opportunity to further determine subtle age-related differences in emotional responding and emotion regulation (Gross & Levenson, 1995).

Additional research comparing the facial reactivity of young and older adults is also needed to clarify the conditions under which older adults may or may not have less expression to reduce relative to their younger counterparts. Future research should attempt to elicit equal levels of emotional facial expressions for both age groups to establish a common age baseline when comparing subsequent capacities for regulation, and the consequences of regulation on memory performance.

Conclusion

The current study showed that older adults can effectively regulate their facial expression and internal feelings of emotion and can do so without decreasing memory performance. No evidence was found to support the suggestion that differences in regulation strategy explain the preserved emotion regulation ability of older adults (Emery & Hess, 2011), as expressive suppression and detached reappraisal did not differentially impact the number of emotional stimuli recalled. The findings did, however, reveal that young and older adults respond to emotional stimuli differently, and support some previous research showing that older adults react with substantially less emotional expressivity as indicated by facial EMG. Older adults may therefore require fewer cognitive resources to achieve the same level of emotion regulation as young adults. Thus, despite an age-related reduction in cognitive resources, it appears that reduced emotional reactivity in older adults may contribute to maintained emotion regulation capacity due to having less facial expression to regulate. This provides a preliminary explanation for understanding how older adults can successfully reduce their displays of emotion without affecting memory performance. This novel set of findings using objective psychophysiological methodology provides insight into the aging process in relation to a core ability required for successful social interaction. Importantly, this is the first study to consider this explanation for maintenance of emotion regulation with age. The current findings therefore create an opening for a new stream of research in this field that is likely to contribute to a more comprehensive explanation for older adults' emotion regulation.

CHAPTER 4: Eliciting Amusement, Happiness, and Sadness in Young and Older Adults: Piloting of Film Stimuli (Study 2)

"A film is – or should be – more like music than like fiction. It should be a progression of moods and feelings. The theme, what's behind the emotion, the meaning, all that comes later."

– Stanley Kubrick (1989)

Overview of Chapter

The current study primarily provided pilot research in the development and norming of a battery of dynamic emotional films for testing young and older adults in Studies 3 and 4. That is, Study 3 aimed to evoke low and high levels of emotional reactivity (i.e., with amusing and sad films) to vary the effort required in emotion regulation for young and older adults. Study 4 aimed to evoke high levels of sadness and compare the effectiveness of instructed emotion regulation strategies in both age groups. The intention of the current study was not to examine emotion regulation or age differences in reactivity, but simply, to develop and pilot emotion-eliciting films for use as suitable stimuli in the subsequent studies of the thesis. Film databases currently available for researchers have been developed through testing young adults only, limiting the extendibility of such normative ratings to emotion research in older age. The current study is the first known research to establish a set of emotional films developed and normed with young *and* older adults.

The effectiveness of using films to elicit emotion is first discussed, including the advantages, the standardisation process, and review of the current film databases available. The need for a set of film databases tested with young and older adults is then discussed, including the importance of age relevant stimuli, emotional discreteness, arousal, and varying intensity levels.

The current study comprises of two pilot studies. Pilot Study A involved participants whom viewed a large selection of emotional and neutral films, with the aim of establishing amusing and sad films, which differed in levels of emotional intensity, as well as a set of neutral films. Pilot Study B involved participants whom viewed and rated their responses to emotional films, with the aim of establishing a set of happy films. Across both pilot studies, participants were instructed to self-report their emotional experience (according to discrete emotional states) and emotional arousal. The classification of film stimuli undertook specific norming criteria, such as ensuring each film elicits the target emotion and not found to be confusing.

Results are presented, detailing the most effective films in eliciting each target emotion and specified level of emotional intensity (i.e., low or high emotional arousal). In conclusion, the study presents a battery of emotional films developed and normed to elicit amusement, happiness, sadness, and neutral feelings in young and older adults.

4.1. Introduction

The study of emotion has received considerable attention over the last few decades, with increasing interest invested in examining such areas as individual differences or the effects of emotion on cognitive processes (Schaefer, Nils, Sanchez, & Philippot, 2010). Indeed, the requirement for reliable and efficient means of eliciting and assessing emotion and their effects is an important consideration in emotion research and subsequent conclusions. A range of emotion-elicitation procedures have been developed to examine emotion in laboratory settings, with some techniques more effective than others (Fernández et al., 2012). Among the number of procedures (e.g., pictures, music, memories), films are a desirable method due to higher ecological validity, dynamic nature of stimuli, inclusion of visual and auditory sensations, and sustained exposure of maintaining subjective, behavioural, and physiological responses over longer periods of time (Carvalho, Leite, Galdo-Álvarez, & Gonçalves, 2012; Gross & Levenson, 1995). Whilst sets of film stimuli are currently widely available for young adults (e.g., Gabert-Quillen et al., 2014; Rottenberg, Ray, & Gross, 2007; Schaefer et al., 2010), a set of emotional films has not yet been established that are normed for older adults.

Additionally, emotion research examining older adults would benefit from a set of stimuli that provides the option for eliciting differing experiences of discrete emotions with varying emotional intensities (Schaefer et al., 2010). In order to assess the wide array of emotional life, a battery of films ought to include both positive and negative discrete emotions (e.g., amusement and sadness). Preferences within the emotion literature has tended to focus on negative emotions (Schaefer et al., 2010), however, positive emotions also contribute to the spectrum of emotional experience, particularly when understanding emotional ageing (e.g., positivity effect; Isaacowitz, Wadlinger, Goren, & Wilson, 2006; Van Reekum et al., 2011). Furthermore, eliciting varying degrees of emotional responses (e.g., low vs. high arousal) in laboratory settings would provide future researchers with greater experimental manipulation and flexibility in specific questions related to emotional intensity. In summary, researchers examining emotion processes in older adults would benefit from a set of standardised film stimuli that elicit discrete emotions with varying levels of intensity.

Using Films to Elicit Emotion

The use of films to elicit emotional experience and responses has grown to be a reliable and widely accepted standard for laboratory based experimental research into emotion (Gross & Levenson, 1995; Rottenberg et al., 2007; Schaefer et al., 2010). In comparison, a number of other emotion-eliciting techniques include exposure to pictures (e.g., Bradley & Lang, 2007b), music and sounds (e.g., Hagemann, Levenson, & Gross, 2006), autobiographical recollections (e.g., Holland & Kensinger, 2010), mental imagery (e.g., Schaefer et al., 2003), and scripted or unscripted social interactions (e.g., Harmon-Jones, Amodio, & Zinner, 2007). Compared to these procedures, the use of films has several advantages. Evidence indicates that films are a simple yet powerful technique when evoking emotion in a laboratory setting (Gross & Levenson, 1995; Schaefer et al., 2010), and also hold the ability to elicit strong subjective and physiological responses (Robinson & Demaree, 2009; Tsai et al., 2000). Additionally, films benefit from being dynamic rather than static in nature (Gross & Levenson, 1995), eliciting discrete emotions (Carvalho et al., 2012), the ability to be standardised, allowing for improved validity and reliability in subsequent studies (Fernández et al., 2012; Rottenberg et al., 2007), and the lack of practical or ethical concerns associated with real-life scenarios to elicit emotion (Schaefer et al., 2010). Indeed, importantly to the current thesis, such film qualities assist in enhancing ecological validity (Gross & Levenson, 1995) and through the recreation of dynamic situations and levels of engagement that closely models reality (Fernández et al., 2012; Schaefer et al., 2010).

As a method to elicit emotional responses, films particularly benefit from being dynamic in nature, compared to static stimuli, such as pictures. Film clips are frequently acquired from feature length movies, television programs, or even YouTube, as short video segments depicting an evolving scene (Gabert-Quillen et al., 2014; Rottenberg et al., 2007). Such scenes involve exposure to multiple sensations and elements, such as visual events, movement, dialogue, music, and other sounds. Additionally, compared to static pictures, dynamic films provide exposure to ongoing and changing stimuli over longer periods of time, which allows for sustained emotional activation and reactions (Carvalho et al., 2012; Dan-Glauser & Gross, 2011; Koval, Butler, Hollenstein, Lanteigne, & Kuppens, 2014). Emotionally arousing film are therefore an effective method of eliciting changes in subjective feelings, behavioural responses, and physiological levels over time (Carvalho et al., 2012) for young and older adults (e.g., Henry et al., 2009; Lohani & Isaacowitz, 2014; Phillips et al., 2008).

As stated previously, an advantage of using films is the possibility of standardising a set of stimuli that is both reliable and valid (Gross & Levenson, 1995). However, despite the frequent use of films in emotion research, fewer studies have actually provided empirical ratings for such film sets (Gabert-Quillen et al., 2014). For instance, scenes intended to elicit desired emotions may be identified with intuition and without undergoing the standardisation process to reliably determine the emotion such scenes may elicit (Gabert-Quillen et al., 2014; Gross & Levenson, 1995; Hewig et al., 2005). One method of standardising emotional stimuli is assessing participants self-reported feelings following each film (Rosenthal et al., 2008). Subjective accounts of emotional experience provide information on the internal component of emotional responses. Such methodology also allows for convenience and simplicity in administration.

Five key studies have undertaken efforts in standardising films and have since published film databases with normative ratings (Carvalho et al., 2012; Gabert-Quillen et al., 2014; Gross & Levenson, 1995; Rottenberg et al., 2007; Schaefer et al., 2010). Such studies include stimuli developed to elicit discrete emotional states (e.g., amusement, anger, disgust, fear, sadness, and neutral states) that also differ in levels of valence and arousal (Carvalho et al., 2012). However, these recently established film databases have solely utilised younger adults (often recruited through undergraduate university samples) during the norming process (although see Henry et al., 2009, whom recruited only older adults to pilot a small set of amusing films for a larger study). Given the reliance on young adults, the available normative ratings are likely to be specific to that age cohort, with possible age-related differences in stimuli effectiveness if applied to older adults without validation. Importantly, the current study is the first to include a sample with equal numbers of young and older adults to provide normative ratings in standardising a battery of emotional films sets.

Emotional Films for Young *and* Older Adults

Given age differences in emotional perception and processing (Mather & Carstensen, 2005; Ruffman et al., 2008; St. Jacques et al., 2010), it would be inappropriate to assume that the currently available emotional film databases (validated with young adults) would be suitable in evoking similar emotional responses in older adults (Beaudreau et al., 2009). In particular, evidence has emerged in the ageing literature, highlighting the importance of using age-relevant stimuli when assessing older adults' emotional responses (Kunzmann & Grühn, 2005; Kunzmann & Richter, 2009; Lohani & Isaacowitz, 2014). Studies have shown that when emotional stimuli is relevant and meaningful to older adults, the stimuli will evoke greater subjective experience and physiological reactivity than when stimuli is not age-relevant (Kunzmann & Grühn, 2005). For instance, due to the higher prevalence of health-related and social losses in old age, emotional arousing scenes of the loss of loved ones, death, illness, among others, may be particularly relevant for older adults (Kunzmann & Grühn, 2005; Skinner, Berg, & Uchino, 2014). Age-relevant stimuli are more likely to trigger similar autobiographical memories and experiences, which theoretically, may enhance emotional responses (Stanley & Isaacowitz, 2014). In sum, it is evident that individuals, as explained with older adults, respond best to emotional stimuli that are currently relevant to themselves or which may be encountered during their current stage in life (Rottenberg et al., 2007; Stanley & Isaacowitz, 2014).

Indeed, as the purpose of the current study is to develop and test film stimuli for young *and* older adults, and given the importance of age-relevant stimuli in eliciting emotional responses, the current study will ensure a selection of diverse films that contain themes that are meaningful and memorable for both age groups. Furthermore, ensuring that selected films were released across varying decades and involve actors of varying age groups and genders (Phillips et al., 2008; Rottenberg et al., 2007) will also be accounted for in the current study. Stanley and Isaacowitz (2014) emphasise that stimulus relevance, such as school and work contexts for young adults, or retirement and family contexts for older adults, promotes motivational drives for participants to process the emotional information portrayed in each scene and respond accordingly. The current study extends from previous stimulus norming studies (e.g., Schaefer et al., 2010), in focusing on emotion-eliciting films relevant for both young and older adults, and utilising both age groups for participation.

Whilst the importance of age-relevant films requires consideration when developing a new set of stimuli, the selection of which emotion or emotions to be evoked must also be carefully considered. Stimuli should offer a range of emotional experiences across positive and negative states. As stated, negative emotions often receive more attention and examination in emotion research than positive emotions (Blanchard-Fields & Coats, 2008; Gross et al., 1997; Kliegel et al., 2007; Kunzmann & Grühn, 2005). This is partly due to the 'basic emotions' framework (e.g., Ekman, 1993), where negative emotional states are more easily differentiated from each other (e.g., anger vs. sadness) than positive states (e.g., happiness). That is, positive emotions are often classified under a general label of happiness, whereas, basic negative emotion categories include anger, disgust, fear, and sadness (Herring et al., 2011; Schaefer et al., 2010). To circumvent this issue in the literature, the current study aims to test emotional films intended to elicit separate discrete positive feelings of happiness *and* amusement, as well as negative films eliciting sadness. Furthermore, variations in research needs and questions, a selection of emotional stimuli ideally should include a choice of films developed to elicit an array of emotional experiences and responses (i.e., across both positive and negative emotions).

Establishing a set of films that induce discrete positive and negative emotions allows for greater analysis and understanding into the fundamental differences between core emotions across the life span (Fernández et al., 2012). First, discrete emotions are evoked by different stimuli and events, such as humorous scenes eliciting amusement (Herring et al., 2011), feel good pleasant scenes eliciting happiness, and scenes of loss eliciting sadness (Haase et al., 2012). Second, discrete emotions activate different patterns of emotional systems in the perceiver, such as subjective experiences, facial expression, and physiological arousal (Stanley & Isaacowitz, 2014). For instance, along the valence dimension, amusement is subjectively rated with high levels of pleasantness, and sadness with high levels of unpleasantness (Gross & Levenson, 1995). According to approach-avoidance related dimensions, amusement is associated with greater approach related behaviours, whereas sadness is associated with greater withdrawal related behaviours (Christie & Friedman, 2004; Kreibig, 2010).

Regarding facial expressivity, happiness is expressed with smiles, involving elevation of lips, narrowing and wrinkles in outer corner of eyes, and lowering of eyebrows (Dimberg, Thunberg, & Elmehed, 2000; Martin, 2001; Slessor et al., 2010), whereas, amusement is expressed with greater positive facial displays, smiling, laughter, and exhilaration (Herring et al., 2011). Sadness is expressed with upward movement of the inner eyebrows, lowering of mouth corners, and with or without tears (Ekman & Friesen, 1978; Gross, Fredrickson, & Levenson, 1994; Seider et al., 2011).

Physiological activity recorded during emotional films also demonstrates how amusement, happiness, and sadness differ. Amusement is characterised by increased electrodermal (e.g., skin conductance) and respiratory activity (e.g., respiration rate), and decreased sympathetic cardiac activity (Gross & Levenson, 1997; Ritz, Steptoe, DeWilde, & Costa, 2000; Tsai et al., 2000). Happiness shares a similar physiological pattern with amusement, however, change in responses are more variable, with possibilities of decreases, increases, or no change in physiological activity (Gruber, Johnson, Oveis, & Keltner, 2008; Kreibig, 2010). On the other hand, sadness (and specifically non-crying sadness) elicited during films is characterised by sympathetic withdrawal, such as decreased cardiovascular (e.g., heart rate) and electrodermal activity, but increased respiratory activity (Gross et al., 1994; Robinson & Demaree, 2009; Tsai et al., 2000). Given the distinctions between discrete basic emotions, a database of emotional films for young and older adults should include stimuli that offer a range of specific emotional experiences across discrete positive and negative states.

Whilst emotion-eliciting film databases have traditionally relied on discrete emotional states to differentiate and classify stimuli (Gross & Levenson, 1995; Rottenberg et al., 2007), the importance of using dimensional approaches of emotion classification (e.g., arousal) has often been overlooked until recently (Carvalho et al., 2012; Schaefer et al., 2010). Arousal refers to the degree of emotional activation during exposure to the stimuli (Bradley, Codispoti, Cuthbert, & Lang, 2001; Bradley & Lang, 2007a). Mapping emotional stimuli against discrete emotional states, as well as arousal levels, provides a much more robust classification of stimuli and provides more accessibility in the broad array of possible research questions for subsequent studies (Carvalho et al., 2012). For instance, future studies using such normed stimuli could explore research questions examining the effects of emotional intensity, and thereby requiring the differentiation of emotional arousal levels (e.g., low vs. high arousal).

To date, no known database of emotional films has differentiated stimuli into separate categories of intensity, such as low or high emotional arousal. Having such distinct stimuli normed on diverse intensity criteria would be beneficial in allowing new studies the capacity to elicit differing levels of emotional responses. For instance, the third study of the current thesis will utilise such stimuli to evoke low and high levels of emotional reactivity so as to vary the effort required for emotion regulation, such as with expressive suppression. That is, higher emotional arousing stimuli may lead to a breakdown of cognitive-affective systems (particularly in ageing; Skinner et al., 2014) and result in poorer emotion regulation due to emotional reactivity exceeding the availability of resources needed for effortful regulation (see dynamic integration theory; Labouvie-Vief, 2008). Moreover, emotional states not only differ in terms of the discreteness of the emotion experienced, but also in their intensity (Reisenzein, 1994). People may describe their emotional experience as feeling somewhat amused or a little sad, or extremely amused or very sad (Reisenzein, 1994). Therefore, allowing experimental manipulation of such self-described emotional intensities provides researchers with the ability to investigate specific questions that resemble the multiple facets of emotional life.

Furthermore, as research into emotional reactivity in old age is still unfolding, current findings are relatively inconsistent (Beaudreau et al., 2009). Variations in young and older adults' intensity of emotional experiences and responses may reflect differences in the type of stimuli utilised (Kunzmann & Grühn, 2005; Levenson et al., 1991; Reynaud, El-Khoury-Malhame, Blin, & Khalfa, 2012; Tsai et al., 2000). That is, for older adults the degree of self-reported feelings, as well as behavioural and physiological reactivity, may be specific to the nature of the stimuli, and dependent on the level of emotional content portrayed in the scene (Kunzmann & Grühn, 2005). Relatedly, in the emotion regulation literature, older adults may demonstrate greater difficulty in managing more intense or enduring negative emotions due to biological systems potentially becoming more inflexible with age (see strength and vulnerability integration model, SAVI; Charles & Piazza, 2009). A database of emotion films that varies in emotional intensity, and normed by young and older adults, provides researchers with an essential tool to examine emotional responses across adulthood. The current study will differentiate low and high levels of emotional intensity based on participants self-reported level of target emotion (e.g., amusement, happiness, sadness), and perceived level of emotional arousal. This will be the first study to include older adults, along with young adults, in the development and norming processes in establishing a set of emotion-eliciting films.

The Current Study

The main aim of the present study was to establish a set of empirically tested emotion-eliciting films that could be used in emotion research with young and older adults. For the purpose of the current research thesis, this study was designed as a pilot for the subsequent studies in developing a set of dynamic stimuli that would evoke greater emotional responses (and potentially placing more demand on emotion regulation efforts) than the pictures previously used in Study 1 (Pedder et al., 2016). Of note, the aim of the current study was not to investigate age differences, or mechanisms of emotion regulation, but instead to provide a battery of emotion-eliciting films that could be used for both age groups. Therefore, the first objective of the current study was to develop and test a set of amusing films that represent emotionally arousing dynamic stimuli, and differ in low and high levels of emotional intensity (i.e., amusement and arousal ratings). Similarly, the second objective was to develop and test a set of sad films that represent emotionally arousing dynamic stimuli, and differ in low and high levels of emotional intensity (i.e., sadness and arousal ratings). The third objective was to develop and test a set of neutral films that elicit minimal levels of emotion and arousal. The fourth objective was to develop and test a set of happy films for Study 3, to provide an intervening step of emotional arousal between pleasant static pictures (viewed in Study 1) and amusing dynamic films (to be viewed in Study 3).

In addition to the broader objectives of the current study, specific objectives were established around the *conditions* of the selected films. The first condition was to ensure that the stimuli content was relevant for young and older adults, and was effective in eliciting emotional responses in both age groups. The second condition was to ensure selected films discretely elicit the intended emotion (e.g., amusement, sadness, happiness), with minimal levels of unrelated emotions (e.g., anger, disgust, fear, surprise). The third condition was to ensure that for both age groups, the stimuli could be comprehended and viewed as standalone segments without prior knowledge (i.e., based on minimal confusion ratings). The final condition was to test a selection of films to provide greater choice of dynamic emotion-eliciting stimuli in the research literature on ageing.

For the current study, participants were instructed to view a large selection of emotion-eliciting films and self-report their emotional experience for each film. Self-report techniques have been used as an effective method of stimulus norming across other emotional databases (e.g., Carvalho et al., 2012; Schaefer et al., 2010). Due to the variability across different types of positive and negative emotional responses, two discrete emotions of amusement and sadness were chosen to represent differential ends along the valence continuum. Because of the evolving nature in this thesis, an initial pilot study (Pilot Study A) tested amusing, sad, and neutral films, whereas, an additional pilot study (Pilot Study B) separately tested happy films. Young and older adult participants were recruited to ensure the final selected film sets evoked the intended emotional response for both age groups, which is essential for subsequent studies.

4.2. Pilot Study A

The primary goal of this first pilot study was to develop and norm separate sets of amusing and sad films that elicit self-reported low and high levels of emotional intensity in young and older adults. The purpose was to establish a selection of dynamic stimuli with varying intensities to examine the effect of intensity on emotion regulation in Study 3. Additionally, the secondary purpose of this pilot was to establish a set of highly arousing sad films that could be used to compare emotion regulation strategies in Study 4.

4.2.1 Method

Participants

Sixteen young (*M* = 27.19 years, *SD* = 2.11; range 22–32; 10 women) and 15 older adults (*M* = 72.53, *SD* = 6.03; range 63–88; 8 women) participated in the present study. Participants were reimbursed $30 for their time and were recruited through posters and word of mouth. Exclusion criteria for older adults included scores of 84 or below on Addenbrooke's Cognitive Examination-Revised (ACE-R), which is a brief cognitive screening measure assessing orientation, attention, general memory, verbal fluency, language, and spatial memory (Mathuranath et al., 2000).

Age-related scores on background measures are shown in Table 4.1. Young and older adults performed the same on a measure of verbal intelligence, as indexed by the National Adult Reading Test (NART; Nelson & Willison, 1991). However, compared with young, older adults performed worse with task switching and processing speed (Trail Making Test; trail B - trail A; Reitan, 1992). There were no age differences in self-reported levels of anxiety or depression over the past week (Hospital Anxiety and Depression Scale, HADS; Zigmond & Snaith, 1983). At the start of testing, there were no age differences in self-reported positive or negative affect on the Positive and Negative Affect Schedule (PANAS, state version; D. Watson et al., 1988). Compared to older adults, young adults reported better overall health for the last month on a self-rated 5-point scale (1 = *poor*, 5 = *excellent*).

Table 4.1

Performances on Background Measures for Young and Older Adults

	Young Adults $n = 16$		Older Adults $n = 15$		t test[c] ($df = 29$)		
Characteristic	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
NART: FSIQ	114.02	4.98	113.10	5.87	3.24	.641	0.17
Trail Making (B - A)	21.03	8.68	40.86	22.77	3.24	.003	1.15
Anxiety[a]	5.69	4.19	4.47	3.34	0.89	.379	0.32
Depression[a]	2.13	2.06	2.33	1.54	0.32	.754	0.11
Positive Affect[b]	34.56	9.33	37.73	5.47	1.14	.262	0.41
Negative Affect[b]	12.69	2.41	12.27	4.33	0.34	.739	0.12
Health last Month	4.31	0.79	3.53	0.74	2.82	.009	1.02

Note. NART = National Adult Reading Test; FSIQ = Full Scale Intelligent Quotient.
[a]Anxiety and Depression scales from the Hospital Anxiety and Depression Scale. [b]Positive and negative affect scale from the Positive and Negative Affect Schedule. [c]Independent *t* test applied, with Cohen's *d* = effect size.

Procedure and Materials

Emotion rating task. This task involved participants viewing a total of 40 short films and rating their emotional experience to each film. Participants viewed a block of 16 amusing and a separate block of 16 sad films, which were counterbalanced in order between participants. Films within each block were randomised in order, with participants viewing one of eight neutral films following each fourth film to reduce the carryover effect of emotional experience. Additionally, participants completed background measures and had opportunities for breaks following each eighth film.

Participants were instructed to “watch each scene carefully, and following each video, please rate the emotional experience *you* felt whilst watching it”. Participants manually pressed the spacebar when they were ready to proceed to the next film. Participants completed an initial practice of one neutral video to familiarise themselves with the task. Task instructions and stimuli were presented with PowerPoint (Microsoft Office for Mac, 2011) on an Apple MacBook Pro laptop computer with a 32-inch LCD screen. Participants wore over-ear Bose audio headphones and were able to adjust volume as required.

Self-report scales. For a subjective measure of emotional intensity, participants recorded their emotional experience immediately following each film. Participants rated how much of a range of emotions they felt whilst watching each video on a series of nine-point *Likert* scales, ranging from 1 (not at all) to 9 (extremely). Specified emotions, each with their own nine-point scale, included: amusement, anger, disgust, fear, sadness, surprise, and confusion. Additionally, participants rated the arousal level of their emotional experience on a nine-point *Likert* scale, from 1 (calm/dull) to 9 (intense).

Stimuli. Films were obtained from movies, television shows, and YouTube. Criteria for films selected, included content requiring no background information or explanation, and appropriate for both young and older adult age groups, based on the relevance of the content, decade of original film release, and age range of the characters in the film (Kunzmann & Grühn, 2005). Guidance on films were also acquired from previously published studies using films to elicit amusement or sadness (Carvalho et al., 2012; Gabert-Quillen et al., 2014; Gross & Levenson, 1995; Henry et al., 2009; Lohani & Isaacowitz, 2014; Schaefer et al., 2010), and also popular online databases, magazines, and forums listing the top movie scenes eliciting the targeted emotion (e.g., International Movie Database, Rolling Stone website, YouTube). Neutral films were selected to elicit minimal emotional arousal, and depicted scenes of nature, cooking pasta, watering tomatoes, and information on a castle, as shown in Table 4.2. Prior to the selected films being included in the current study, the films were initially piloted with several peers, who provided feedback on the effectiveness and appropriateness of each film. Based on this feedback, several films were replaced, and finalised to the set tested in the current study.

Of the 16 films targeting amusement, eight were selected with the intention of eliciting low levels of amusement, and another eight for eliciting high levels of amusement, as shown in Table 4.2. Also, of the 16 films targeting sadness, eight were selected with the intention of eliciting low levels of sadness, and another eight for eliciting high levels of sadness, as shown in Table 4.2. All films aimed to primarily elicit the targeted emotion, with minimal additional emotional states, such as anger, fear, or disgust. Films ranged from 69 to 141 s in duration, with an average of 109.19 s in duration.

Table 4.2

Films Selected to Elicit Amusement, Sadness, and Neutral Feelings

Film – Scene	Date	Source	Length (s)
Amusing Films (Low-Intensity)			
Some Mothers Do Ave'Em – Roller-skating	1973	TV show	107
Just for Laughs – Horrible makeup prank	2011	TV show	101
Caddyshack – Boat causing chaos in harbour	1980	Movie	120
Mad TV – Airplane service skit	2007	TV show	108
Just for Laughs – Waterpark urinate prank	2011	TV show	72
Austin Powers – Three point turn in a hallway	1997	Movie	69
Cat Cleans Kitchen – Cat rides vacuum cleaner	2013	YouTube	105
Just for Laughs – News prank, told to duck	2011	TV show	120
Amusing Films (High-Intensity)			
I Love Lucy – Chocolate factory mishap	1952	TV show	122
Just for Laughs – Police in underwear prank	2011	TV show	131
Baby Laughing – Watching paper being torn	2011	YouTube	103
Walk on the Wild Side - Animals talking	2009	TV show	104
Mr Bean – Naked and locked out of hotel room	1993	TV show	87

Table 4.2 Continued

Film – Scene	Date	Source	Length (s)
Japanese Show – Dinosaur scare prank	2013	TV show	88
The Naked Gun – Car chase with learner driver	1988	Movie	95
Just for Laughs – British Guard photo prank	2011	TV show	79
Sad Films (Low-Intensity)			
My Dog Skip – Dog with arthritis misses owner	2000	Movie	118
Fresh Prince of Bel-Air – Drug use confession	1993	TV show	69
Rabbit Hole – Crying in car about memory	2010	Movie	99
Dangerous Minds - News of student shooting	1995	Movie	126
E.T. – Alien says goodbye to family	1982	Movie	140
Midnight Cowboy – Man dies during bus ride	1969	Movie	102
Dear John – Relationship breakup	2010	Movie	112
Seven Pounds – Ezra and Emily meet	2008	Movie	78
Sad Films (High-Intensity)			
Sophie's Choice – Can't choose which child	1982	Movie	132
The Champ – Boy crying over boxer's death	1979	Movie	139
Click – Father dying in the street	2006	Movie	120
My Girl – Best friend's funeral	1991	Movie	141
The Green Mile – Execution	1999	Movie	141
The NeverEnding Story – Artax sinks in swamp	1984	Movie	120
Remember Me – 9/11 World Trade Centre	2010	Movie	120
The Impossible – Family reunion after disaster	2012	Movie	126
Neutral Films			
Mountain Goats – Information on goats	2010	Documentary	43
Mountain Villagers – Information on villagers	2010	Documentary	35
Lyre Bird Mimicking – Mimics sounds	2013	YouTube	71
Flowers in a Valley – Scenes of flowers	2010	Documentary	53
Castle History – Information on a castle	2010	Documentary	40
Cooking Pasta – Watching pasta boil	2010	TV Show	79
Knitting Demonstration – Viewing hands knit	2012	YouTube	64
Watering Tomatoes – Gardening instructions	2012	YouTube	62

4.2.2 Results

The aim of the following analyses was to test and establish a battery of amusing and sad films. Amusing and sad films were examined separately, and each involved several steps of analysis to select the four films that elicited the lowest levels of the targeted emotion, and the four films that elicited the highest levels of that emotion. In the primary analysis, films were checked to ensure they elicited the intended target emotion (i.e., greater amusement or sadness mean scores), and minimal comparable levels of non-target discrete emotions (e.g., anger, disgust, fear, surprise; Gross & Levenson, 1995). Films were also checked for confusion to ensure participants were able to comprehend each film as a standalone scene. For the current study, films receiving confusion scores of $M = 3.00$ or above were deemed unsuitable stimuli and removed from subsequent steps. In the secondary analysis, remaining films were ranked based on their target emotion mean score (e.g., amusement or sadness), and the four lowest and four highest films were assigned to respective low- and high-intensity sets. Lastly, obtained low- and high-intensity sets were analysed to ensure differences exist *between* intensity sets (based on self-rated target emotion and arousal levels), and that no differences exist *within* intensity sets (i.e., emotion and arousal ratings did not differ between films of each independent intensity set). Analyses where assumptions of sphericity were violated, Greenhouse-Geisser corrected values were reported.

Films Eliciting Amusement

Emotional discreteness. Each amusing film was checked for the intensity of self-reported emotional experience, and whether amusement differed significantly from non-targeted discrete emotions. Emotion ratings for each film were analysed with one-way repeated measures analysis of variance (ANOVA). The within-subjects variable was self-reported emotion (amusement, anger, disgust, fear, sadness, surprise, confusion). For each film, there was a main effect of emotion (ps < .001), and according to post hoc analyses, all films were rated with greater amusement than anger, disgust, fear, sadness, surprise, and confusion. The mean self-rated emotion scores for all amusing films are shown in Table 4.3.

Clarity of film content. Films were then double checked for self-reported confusion. According to the previous analyses (see Table 4.3), no mean scores of confusion were above *M* = 3.00. Therefore, no films were excluded from subsequent steps.

Assigning films to intensity sets. Based on the previous steps, the films eliciting the lowest scores of amusement were assigned to the low-intensity set, which included: *Cat Cleans Kitchen*, *Austin Powers*, *Caddyshack*, and *News Prank*. The films eliciting the highest scores of amusement were assigned to the high-intensity set, which included: *I Love Lucy*, *Mr Bean*, *Police Prank*, and *Baby Laughing*.

Table 4.3

Mean Self-Reported Emotion Scores for Films Intended to Elicit Feelings of Amusement

Amusing Films	*F*	*p*	η_p^2	**Amusement**	Anger	Disgust	Fear	Sadness	Surprise	Confusion
I Love Lucy	102.67	<.001	.77	**6.97 (1.89)**	1.16 (0.73)	1.16 (0.73)	1.13 (0.72)	1.03 (0.18)	2.35 (2.00)	1.65 (1.58)
Mr Bean	129.40	<.001	.81	**6.65 (1.80)**	1.06 (0.36)	1.10 (0.40)	1.19 (0.75)	1.29 (1.01)	2.13 (1.63)	1.16 (0.73)
Police Prank	64.42	<.001	.68	**6.35 (2.39)**	1.10 (0.54)	1.48 (1.09)	1.00 (0.00)	1.03 (0.18)	3.94 (2.66)	1.52 (1.36)
Baby Laughing	117.21	<.001	.75	**6.29 (1.66)**	1.03 (0.18)	1.06 (0.36)	1.00 (0.00)	1.00 (0.00)	2.23 (2.25)	1.35 (1.08)
Dinosaur Prank	39.37	<.001	.57	**6.06 (2.08)**	1.13 (0.50)	1.35 (1.02)	2.00 (1.91)	1.03 (0.18)	2.77 (2.20)	1.94 (1.97)
Walk on Wild Side	124.39	<.001	.81	**6.06 (1.65)**	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	2.26 (1.86)	1.16 (0.45)
The Naked Gun	62.34	<.001	.68	**6.00 (1.90)**	1.00 (0.00)	1.06 (0.36)	1.94 (1.55)	1.00 (0.00)	2.45 (1.95)	1.74 (1.65)
Guard Prank	94.09	<.001	.76	**5.77 (2.00)**	1.00 (0.00)	1.10 (0.40)	1.00 (0.00)	1.00 (0.00)	2.39 (1.82)	1.10 (0.40)
Some Mothers..	49.48	<.001	.62	**5.71 (2.45)**	1.13 (0.43)	1.13 (0.43)	1.61 (1.28)	1.00 (0.00)	2.65 (2.24)	1.52 (1.26)
Makeup Prank	72.06	<.001	.71	**5.71 (2.07)**	1.06 (0.36)	1.26 (0.63)	1.06 (0.36)	1.06 (0.36)	2.77 (2.00)	1.35 (0.91)
Waterpark Prank	28.41	<.001	.49	**5.55 (2.68)**	1.29 (0.69)	2.23 (1.82)	1.23 (0.80)	1.29 (0.86)	3.26 (2.65)	1.48 (1.29)
Mad TV Flight	68.37	<.001	.70	**5.52 (2.03)**	1.23 (0.80)	1.10 (0.40)	1.06 (0.36)	1.06 (0.36)	2.10 (1.97)	1.29 (0.86)
Cat Cleans Kitchen	45.80	<.001	.60	**5.16 (2.35)**	1.03 (0.18)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	2.26 (1.63)	1.87 (1.84)
Austin Powers	48.55	<.001	.62	**5.03 (1.96)**	1.32 (1.14)	1.13 (0.72)	1.00 (0.00)	1.03 (0.18)	1.52 (1.21)	1.90 (1.76)
Caddyshack	32.07	<.001	.52	**4.58 (2.01)**	1.29 (0.59)	1.16 (0.45)	1.19 (0.65)	1.03 (0.18)	1.93 (1.50)	2.13 (2.29)
News Prank	41.55	<.001	.58	**4.32 (1.89)**	1.13 (0.56)	1.06 (0.25)	1.03 (0.18)	1.06 (0.25)	1.48 (1.12)	1.81 (1.62)

Note. Emotion rating scales ranged from 1 (not at all) to 9 (extremely). Each film was analysed using separate repeated measures ANOVAs (*df* = 6, *df error* = 180). All post hoc comparisons between the target emotion (amusement) and each discrete emotion differed significantly (*p*s < .05).

Similarities within each intensity set. The selected films were checked for amusement and arousal differences[7] within each low- and high-intensity set, as shown in Table 4.4. Amusement and arousal ratings were analysed with separate one-way repeated measures ANOVAs for low- and high-intensity sets. The within-subjects variables were respective low-intensity films (*Cat Cleans Kitchen*, *Austin Powers*, *Caddyshack*, *News Prank*) and high-intensity films (*I Love Lucy*, *Mr Bean*, *Police Prank*, *Baby Laughing*). For amusement ratings, there was no main effect of film within the low-intensity set, $F(2.34, 70.29) = 2.02$, $p = .133$, $\eta_p^2 = .06$, or within the high-intensity set, $F(3, 90) = 1.02$, $p = .386$, $\eta_p^2 = .03$. For arousal ratings, there was no main effect of film within the low-intensity set, $F(3, 90) = 2.38$, $p = .075$, $\eta_p^2 = .07$, or within the high-intensity set, $F(3, 90) = 1.48$, $p = .224$, $\eta_p^2 = .05$.

Differences between intensity sets. In order to determine whether the intended low- and high-intensity amusing film sets differed significantly, averaged self-reported amusement and arousal scores were first calculated for each participant. Thus, separate amusement and arousal ratings were averaged for the four lowest intensity films (C*at Cleans Kitchen*, *Austin Powers*, *Caddyshack*, *News Prank*) and the four highest intensity films (*I Love Lucy*, *Mr Bean*, *Police Prank*, *Baby Laughing*). Averaged low- and high-intensity set scores were then compared using paired *t* tests. The high-intensity set ($M = 6.56$, $SD = 1.28$) was rated as eliciting greater feelings of amusement than the low-intensity set ($M = 4.77$, $SD = 1.58$), $t(30) = 6.59$, $p < .001$, $d = 1.24$). The high-intensity set ($M = 6.06$, $SD = 1.48$) was

[7] Additional *t*-test analyses were conducted to determine whether age differences exist in amusement and arousal ratings for each film. *Mr Bean* received age differences across amusement (young: $M = 5.75$, $SD = 1.92$; older: $M = 7.60$, $SD = 1.06$), $t(29) = 3.30$, $p = .003$, $d = 1.19$, and arousal ratings (young: $M = 5.00$, $SD = 1.97$; older: $M = 6.53$, $SD = 1.19$), $t(29) = 2.61$, $p = .014$, $d = 0.94$. *Caddyshack* received age differences in arousal ratings (young: $M = 3.88$, $SD = 1.93$; older: $M = 5.73$, $SD = 1.87$), $t(29) = 2.72$, $p = .011$, $d = 0.97$. *News Prank* received age differences in amusement ratings (young: $M = 3.50$, $SD = 1.59$; older: $M = 5.20$, $SD = 1.82$), $t(29) = 2.77$, $p = .010$, $d = 0.99$. There were no further age differences across remaining amusing films (*p*s > .052).

also rated as eliciting greater arousal than the low-intensity set (*M* = 4.76, *SD* = 1.53), $t(30) = 6.26$, $p < .001$, $d = 0.86$).

Table 4.4

Amusement and Arousal Ratings for Selected Low- and High-Intensity Amusing Films

	Amusement Rating		Arousal Rating	
Amusing Films	*M*	*SD*	*M*	*SD*
Low-Intensity Set				
Cat Cleans Kitchen	5.16	2.35	5.26	1.91
Austin Powers	5.03	1.96	4.35	1.78
Caddyshack	4.58	2.01	4.77	2.09
News Prank	4.32	1.89	4.65	1.92
High-Intensity Set				
I Love Lucy	6.97	1.89	6.48	1.81
Mr Bean	6.65	1.80	5.74	1.79
Police Prank	6.35	2.39	5.97	2.27
Baby Laughing	6.29	1.66	6.03	1.78

Note. Self-reported amusement rating scales ranged from 1 (not at all amusing) to 9 (extremely amusing), and arousal rating scales ranged from 1 (calm/dull) to 9 (intense).

Films Eliciting Sadness

Emotional discreteness. Each sad film was checked for the intensity of self-reported emotional experience, and whether sadness differed significantly from non-targeted discrete emotions. Emotion ratings for each film were analysed with one-way repeated measures ANOVAs. The within-subjects variable was self-reported emotion (amusement, anger, disgust, fear, sadness, surprise, confusion). For each film, there was a main effect of emotion (*p*s < .001), and according to post hoc analyses, majority of films were rated with greater sadness than amusement, anger, disgust, fear, surprise, and confusion. For two films, sadness did not differ significantly from surprise (*The Impossible*, *p* = .167; *Seven Pounds*, *p* = 1.00), and were consequently removed from subsequent steps. Confusion was also found to not differ significantly from sadness in five films (*Rabbit Hole*, *p* = 1.00; *Midnight Cowboy*, *p* =.577; *The Impossible*, *p* = .891; *Dear John*, *p* = 1.00; *Seven Pounds*, *p* = .324), and thus examined further in the next step. The mean self-rated emotion scores for all sad films are shown in Table 4.5.

Clarity of film content. Films were then double checked for self-reported confusion. According to the previous analyses (see Table 4.5), mean scores of confusion were above *M* = 3.00 for *Rabbit Hole*, *Dear John*, and *Seven Pounds*, and were excluded for subsequent steps. All other remaining films did not meet the cut off criteria on confusion (including *Midnight Cowboy*), and remained for subsequent steps.

Assigning films to intensity sets. Of the remaining stimuli, the four films eliciting the lowest scores of sadness were assigned to the low-intensity set, which included: *Dangerous Minds*, *Fresh Prince of Bel Air*, *My Dog Skip*, and *Midnight Cowboy*. The four films eliciting the highest scores of sadness were assigned to the high-intensity set, which included: *Sophie's Choice*, *NeverEnding Story*, *My Girl*, and *The Champ*.

Table 4.5

Mean Self-Reported Emotion Scores for Films Intended to Elicit Feelings of Sadness

Sad Films	*F*	*p*	η_p^2	**Sadness**	Amusement	Anger	Disgust	Fear	Surprise	Confusion
Sophie's Choice	48.94	<.001	.62	**7.19 (1.72)**	1.00 (0.00)	4.71 (2.44)	5.03 (2.56)	3.03 (2.33)	2.13 (1.88)	1.84 (1.57)
NeverEnding Story	50.75	<.001	.63	**7.00 (1.77)**	1.13 (0.43)	2.32 (2.20)	1.42 (1.12)	3.55 (2.69)	2.00 (1.67)	2.06 (1.77)
My Girl	87.75	<.001	.75	**6.77 (1.98)**	1.13 (0.43)	1.26 (1.09)	1.39 (1.09)	1.55 (1.69)	1.77 (1.41)	1.77 (1.36)
The Champ	42.23	<.001	.59	**6.45 (2.20)**	1.13 (0.43)	1.97 (1.66)	1.74 (1.55)	2.19 (1.85)	1.97 (1.70)	2.45 (2.11)
The Green Mile	32.28	<.001	.52	**6.42 (2.01)**	1.00 (0.00)	3.06 (2.59)	3.74 (2.90)	2.19 (2.18)	2.10 (1.97)	2.29 (2.08)
Remember Me	18.14	<.001	.38	**5.29 (2.52)**	1.06 (0.25)	2.03 (1.78)	1.90 (1.81)	2.71 (1.90)	2.29 (2.19)	2.90 (2.48)
Click	24.75	<.001	.45	**5.10 (2.18)**	2.19 (1.49)	1.26 (0.93)	1.23 (0.92)	1.84 (1.68)	1.84 (1.57)	2.84 (2.24)
Dangerous Minds	35.90	<.001	.55	**4.77 (1.86)**	1.42 (0.99)	1.32 (1.01)	1.42 (1.03)	1.48 (1.31)	1.84 (1.46)	2.81 (1.76)
E.T.	17.61	<.001	.37	**4.45 (2.74)**	1.61 (1.20)	1.16 (0.73)	1.26 (0.82)	1.77 (1.65)	1.87 (1.43)	1.94 (1.53)
Fresh Prince of Bel..	21.48	<.001	.42	**4.42 (2.33)**	1.10 (0.40)	1.48 (1.29)	1.68 (1.35)	1.84 (1.90)	2.26 (2.03)	1.81 (1.66)
My Dog Skip	30.29	<.001	.50	**4.39 (2.30)**	1.26 (0.96)	1.00 (0.00)	1.06 (0.56)	1.13 (0.56)	1.52 (1.12)	2.10 (1.87)
Rabbit Hole	38.08	<.001	.56	**4.03 (1.78)**	1.29 (1.44)	1.13 (0.43)	1.10 (0.30)	1.19 (0.54)	1.68 (1.25)	4.39 (2.26)*
Midnight Cowboy	10.46	<.001	.26	**4.00 (2.41)**	1.45 (1.03)	1.58 (1.48)	1.84 (1.51)	1.77 (1.86)	2.42 (1.95)	2.68 (2.09)*
The Impossible	15.48	<.001	.34	**3.97 (2.26)**	1.26 (0.58)	1.23 (0.76)	1.39 (1.02)	2.29 (1.85)	2.61 (2.14)*	2.77 (1.96)*
Dear John	22.40	<.001	.43	**3.77 (1.82)**	1.23 (0.80)	1.29 (0.82)	1.29 (0.90)	1.23 (0.67)	1.71 (1.47)	3.77 (2.74)*
Seven Pounds	26.02	<.001	.47	**2.74 (1.69)**	1.16 (0.45)	1.13 (0.50)	1.00 (0.00)	1.00 (0.00)	2.16 (1.66)*	3.94 (2.41)*

Note. Emotion rating scales ranged from 1 (not at all) to 9 (extremely). Each film was analysed using separate repeated measures ANOVAs (*df* = 6, *df error* = 180).

*Represents non-significant post hoc comparisons between sadness and discrete emotion. All other comparisons with sadness were significant (*p*s < .05).

Similarities within each intensity set. Selected films were checked for sadness and arousal differences[8] within each low- and high-intensity set, as shown in Table 4.6. Sadness and arousal ratings were analysed with separate one-way repeated measures ANOVAs for low- and high-intensity sets. The within-subjects variables were respective low-intensity films (*Dangerous Minds*, *Fresh Prince of Bel Air*, *My Dog Skip*, *Midnight Cowboy*) and high-intensity films (*Sophie's Choice*, *NeverEnding Story*, *My Girl*, *The Champ*). For sadness ratings, there was no main effect of film within the low-intensity set, $F(3, 90) = 1.26$, $p = .293$, $\eta_p^2 = .04$, or within the high-intensity set, $F(3, 90) = 1.31$, $p = .275$, $\eta_p^2 = .04$. For arousal ratings, there was no main effect of film within the low-intensity set, $F(3, 90) = 1.60$, $p = .195$, $\eta_p^2 = .05$, or within the high-intensity set, $F(2.36, 70.67) = 2.00$, $p = .136$, $\eta_p^2 = .06$.

Differences between intensity sets. In order to determine whether the intended low- and high-intensity sad film sets differed significantly, averaged self-reported sadness and arousal scores were first calculated for each participant. Thus, separate sadness and arousal ratings were averaged for the four lowest intensity films (*Dangerous Minds*, *Fresh Prince of Bel Air*, *My Dog Skip*, *Midnight Cowboy*) and the four highest intensity films (*Sophie's Choice*, *NeverEnding Story*, *My Girl*, *The Champ*). Averaged low- and high-intensity set scores were then compared using paired *t* tests. The high-intensity set ($M = 6.85$, $SD = 1.38$) was rated as eliciting greater feelings of sadness than the low-intensity set ($M = 4.39$, $SD = 1.78$), $t(30) = 10.76$, $p < .001$, $d = 1.54$). The high-intensity set ($M = 6.99$, $SD = 1.26$) was

[8]Additional *t*-test analyses were conducted to determine whether age differences exist in sadness and arousal ratings for each film. *NeverEnding Story* received age differences in sadness ratings (young: $M = 6.38$, $SD = 1.89$; older: $M = 7.67$, $SD = 1.40$), $t(29) = 2.15$, $p = .040$, $d = 0.78$. *The Champ* received age differences in arousal ratings (young: $M = 6.31$, $SD = 1.82$; older: $M = 7.60$, $SD = 1.40$), $t(29) = 2.20$, $p = .036$, $d = 0.79$. *Fresh Prince* received age differences in sadness ratings (young: $M = 3.44$, $SD = 1.97$; older: $M = 5.47$, $SD = 2.30$), $t(29) = 2.65$, $p = .013$, $d = 0.95$. *Midnight Cowboy* received age differences in sadness ratings (young: $M = 3.00$, $SD = 1.46$; older: $M = 5.07$, $SD = 2.79$), $t(29) = 2.61$, $p = .014$, $d = 0.93$. There were no further age differences across remaining sad films (*p*s > .050).

also rated as eliciting greater arousal than the low-intensity set (*M* = 5.02, *SD* = 1.33), $t(30) = 9.28$, $p < .001$, $d = 1.52$).

Table 4.6

Sadness and Arousal Ratings for Selected Low- and High-Intensity Sad Films

	Sadness Rating		Arousal Rating	
Sad Films	*M*	*SD*	*M*	*SD*
Low-Intensity Set				
Dangerous Minds	4.77	1.86	4.81	1.60
Fresh Prince of Bel Air	4.42	2.33	5.45	1.95
My Dog Skip	4.39	2.30	5.16	2.00
Midnight Cowboy	4.00	2.41	4.65	2.09
High-Intensity Set				
Sophie's Choice	7.19	1.72	7.23	1.89
NeverEnding Story	7.00	1.77	7.26	1.50
My Girl	6.77	1.98	6.55	1.61
The Champ	6.45	2.20	6.94	6.94

Note. Self-reported sadness rating scales ranged from 1 (not at all sad) to 9 (extremely sad), and arousal rating scales ranged from 1 (calm/dull) to 9 (intense).

Neutral Films

Ratings of emotion. To ensure neutral films did not elicit unwanted emotion, each film was checked for the intensity of self-reported emotional experience. Descriptive statistics were used to analyse the emotion ratings (amusement, anger, disgust, fear, sadness, surprise) for each film. For each film, any mean emotion rating above *M* = 2.00 was used as a cut off, with only one film (*Lyre Bird Mimicking*), meeting this exclusion criteria (amusement, *M* = 2.68; surprise, *M* = 2.52) and excluded from subsequent analysis. The mean self-rated emotion scores for all neutral films are shown in Table 4.7.

Clarity of film content. Films were then double checked for self-reported confusion. According to descriptive statistics (shown in Table 4.7), no mean scores of confusion were above $M = 3.00$. Therefore, no films were excluded for subsequent steps.

Assigning films to the neutral set. Remaining films were checked for levels of self-reported arousal ratings, as displayed in Table 4.7. The four films eliciting the lowest arousal scores were assigned to the neutral film set, which included *Mountain Goats*, *Cooking Pasta*, *Knitting Demonstration*, and *Watering Tomatoes*.

Differences within the neutral set. The selected films were checked for any arousal differences[9] within the neutral set. Arousal ratings were analysed with a one-way repeated measures ANOVA. The within-subjects variable was the neutral films (*Mountain Goats*, *Cooking Pasta*, *Knitting Demonstration*, *Watering* T*omatoes*). For arousal ratings, there was no main effect of film, $F(3, 90) = 0.42$, $p = .742$, $\eta_p^2 = .01$.

[9]Additional *t*-test analyses were conducted to determine whether age differences exist in amusement, sadness, and arousal ratings for each neutral film. *Knitting Demonstration* received age differences in arousal ratings (young: $M = 1.94$, $SD = 1.29$; older: $M = 3.47$, $SD = 2.26$), $t(29) = 2.33$, $p = .027$, $d = 0.83$. *Watering Tomatoes* received age differences across amusement (young: $M = 2.56$, $SD = 2.63$; older: $M = 1.00$, $SD < 0.01$), $t(29) = 2.30$, $p = .029$, $d = 0.84$, and arousal ratings (young: $M = 1.88$, $SD = 1.36$; older: $M = 3.93$, $SD = 2.22$), $t(29) = 3.14$, $p = .004$, $d = 1.11$. There were no further age differences across remaining neutral films (*p*s > .067).

Table 4.7

Mean Self-Reported Emotion and Arousal Scores for Films Intended to Elicit Neutral Feelings

Neutral Films	Amusement	Anger	Disgust	Fear	Sadness	Surprise	Confusion	Arousal
Mountain Goats	1.13 (0.72)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.29 (0.69)	1.22 (0.62)	3.13 (2.38)
Maintain Villagers	1.03 (0.18)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.03 (0.18)	1.23 (0.80)	1.13 (0.56)	3.52 (2.26)
Lyre Bird Mimicking	2.68 (2.47)	1.00 (0.00)	1.00 (0.00)	1.13 (0.72)	1.23 (0.92)	2.52 (2.10)	1.35 (0.95)	4.13 (2.68)
Valley Flowers	1.10 (0.54)	1.06 (0.36)	1.00 (0.00)	1.00 (0.00)	1.06 (0.36)	1.87 (1.63)	1.06 (0.36)	3.42 (2.05)
Castle History	1.19 (0.75)	1.03 (0.18)	1.00 (0.00)	1.00 (0.00)	1.06 (0.36)	1.06 (0.25)	1.13 (0.50)	3.19 (2.10)
Cooking Pasta	1.45 (1.52)	1.13 (0.72)	1.00 (0.00)	1.00 (0.00)	1.03 (0.18)	1.16 (0.52)	1.45 (1.46)	2.87 (2.05)
Knitting Demonstration	1.13 (0.34)	1.13 (0.72)	1.00 (0.00)	1.00 (0.00)	1.03 (0.18)	1.58 (1.41)	1.81 (1.68)	2.68 (1.96)
Watering Tomatoes	1.81 (2.02)	1.06 (0.36)	1.06 (0.36)	1.00 (0.00)	1.03 (0.18)	1.55 (1.48)	1.74 (1.44)	2.87 (2.08)

Note. Self-reported emotion rating scales ranged from 1 (not at all) to 9 (extremely), and arousal rating scales ranged from 1 (calm/dull) to 9 (intense).

Differences between neutral and emotion sets. In order to determine whether the neutral film set differed significantly from the amusing and sad film sets (of low- and high-intensity), averaged self-reported emotion and arousal scores were first calculated for each participant. Thus, separate amusement, sadness, and arousal ratings were averaged for the four selected neutral films (*Mountain Goats*, *Cooking Pasta*, *Knitting Demonstration*, *Watering* T*omatoes*) and compared with the averaged amusing and sad film set scores using paired *t* tests.

For comparisons with the low-intensity amusing film set, the neutral film set was rated as eliciting less feelings of amusement, $t(30) = 10.22$, $p < .001$, $d = 2.61$, and less arousal, $t(30) = 8.19$, $p < .001$, $d = 1.19$. For comparisons with the high-intensity amusing film set, the neutral film set was rated as eliciting less feelings of amusement ($M = 1.39$, $SD = 0.94$), $t(30) = 17.98$, $p < .001$, $d = 4.61$, and less arousal ($M = 2.89$, $SD = 1.60$), $t(30) = 13.61$, $p < .001$, $d = 2.06$. For comparisons with the low-intensity sad film set, the neutral film set was rated as eliciting less feelings of sadness, $t(30) = 10.41$, $p < .001$, $d = 2.68$, and less arousal, $t(30) = 7.31$, $p < .001$, $d = 1.45$. For comparisons with the high-intensity sad film set, the neutral film set was rated as eliciting less feelings of sadness ($M = 1.02$, $SD = 0.13$), $t(30) = 22.46$, $p < .001$, $d = 5.95$, and less arousal, $t(30) = 14.11$, $p < .001$, $d = 2.85$.

Pilot Study A Summary

In the current pilot study, young and older adults self-reported their emotional experience to a wide selection of dynamic emotion-eliciting stimuli. Through the development and norming process, eight amusing films were identified, with four being assigned to the low-intensity set (*Cat Cleans Kitchen*, *Austin Powers*, *Caddyshack*, *News Prank*) and four assigned to the high-intensity set (*I Love Lucy*, *Mr Bean*, *Police Prank*, *Baby Laughing*). Eight sad films were also identified, with four being assigned to the low-intensity set (*Dangerous Minds*, *Fresh Prince of Bel Air*, *My Dog Skip*, *Midnight Cowboy*) and four assigned to the high-intensity set (*Sophie's Choice*, *NeverEnding Story*, *My Girl*, *The Champ*). Selected films were found to elicit the target emotion (e.g., amusement or sadness), with minimal levels of unrelated emotions (e.g., anger, disgust, fear, surprise) or confusion. Additionally, sets of high emotionally intense amusing and sad films were rated with greater emotion and arousal than sets of low emotionally intense amusing and sad films. Within each identified set, films did not differ on target emotion or arousal ratings. Furthermore, four neutral films were selected and normed (*Mountain Goats*, *Cooking Pasta*, *Knitting Demonstration*, *Watering Tomatoes*). Neutral films did not differ on arousal ratings, and were also rated with lower emotion and arousal than each of the amusing and sad film sets.

4.3. Pilot Study B

The primary goal of the second pilot study was to develop and norm a set of pleasant film stimuli intended to elicit self-reported feelings of happiness for young and older adults and could be used in Study 3. The purpose was to establish a set of dynamic stimuli that were more emotionally arousing than the static pleasant pictures used in Study 1, yet less emotionally arousing than the dynamic amusing films tested in Pilot Study A. It was anticipated that given amusing stimuli are likely to evoke laughter (i.e., markedly increased levels of *zygomaticus* muscle activity), then a set of happy stimuli developed to evoke smiles (i.e., subtle increases in *zygomaticus* muscle activity) could provide an intervening step between the lower arousing static pleasant pictures and the higher arousing dynamic amusing films. Because of *corrugator* muscle activity (i.e., frowning to index negative facial expression) being less reactive than *zygomaticus* muscle activity in response to emotional stimuli, a similar pattern was not repeated for sad stimuli.

4.3.1 Method

Participants

The second (and current) pilot study consisted of 20 young (*M* = 27.05 years, *SD* = 3.66; range 20–34; 12 women) and 22 older adults (*M* = 69.23, *SD* = 6.08; range 60–86; 17 women), who did not participate in the first pilot study. Participants were recruited through word of mouth or participation in an additional research project of the Cognition and Emotion Research Centre. Exclusion criteria for older adults included scores of 84 or below on the ACE-R (Mathuranath et al., 2000).

Age-related scores on background measures are displayed in Table 4.8. There were no age differences in self-reported levels of anxiety or depression over the past week (HADS; Zigmond & Snaith, 1983). At the start of testing there were no age differences in self-reported positive or negative affect on the PANAS (state version; D. Watson et al., 1988). There were no age differences on reported overall health for the past month on a self-rated 5-point scale (1 = *poor*, 5 = *excellent*).

Table 4.8

Performances on Background Measures for Young and Older Adults

	Young Adults n = 20		Older Adults n = 22		t test[c] (df = 40)		
Characteristic	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Anxiety[a]	4.75	3.88	5.27	2.37	0.53	.597	0.16
Depression[a]	1.75	2.61	2.32	1.91	0.81	.423	0.25
Positive Affect[b]	30.10	9.79	33.14	4.78	1.30	.203	0.39
Negative Affect[b]	12.30	3.23	11.05	1.33	1.68	.102	0.51
Health last Month	4.25	0.72	4.09	0.61	0.78	.442	0.24

[a]Anxiety and Depression scales from the Hospital Anxiety and Depression Scale. [b]Positive and negative affect scale from the Positive and Negative Affect Schedule. [c]Independent *t* test applied, with Cohen's *d* = effect size.

Procedure and Materials

Emotion rating task. This task followed the same protocol with the emotion rating task in Pilot Study A of the current study. This involved participants viewing four short films and rating their emotional experience to each. Films were randomised in order. Participants were instructed to "watch each scene carefully, and following each video, please rate the emotional experience *you* felt whilst watching it". Participants manually pressed the spacebar when they were ready to proceed to the next film. Task instructions and stimuli were presented with PowerPoint (Microsoft Office for Mac, 2011) on an Apple MacBook Pro laptop computer with a 32-inch LCD screen. Participants wore over-ear Bose audio headphones and were able to adjust volume as required.

Self-report scales. For a subjective measure of emotional intensity, participants recorded their emotional experience immediately following each film. Participants rated how much of a range of emotions they felt whilst watching each film on a series of nine-point *Likert* scales, ranging from 1 (not at all) to 9 (extremely). Specified emotions, each with their own nine-point scale, included: happiness, anger, disgust, fear, sadness, surprise, and confusion. Additionally, participants rated the arousal level of their emotional experience on a nine-point *Likert* scale, from 1 (calm/dull) to 9 (intense).

Stimuli. Films were obtained from movies and television shows. Criteria for films selected, included content requiring no background information or explanation, and appropriate for both young and older adult age groups (Kunzmann & Grühn, 2005). Guidance on film selection was acquired from popular online databases and forums listing the top movie scenes to elicit happiness (e.g., International Movie Database, YouTube). Prior to the selected films being included in the current study, the films were initially piloted with several peers, who provided feedback on the effectiveness and appropriateness of each film. Based on this feedback, several films were replaced, and finalised to the set of four films tested in the current part of this study.

As shown in Table 4.9, the four films were selected with the intention of eliciting feelings of happiness (i.e., feel good pleasant scenes). All films aimed to primarily elicit the targeted emotion, with minimal additional emotional states, such as anger, fear, sadness, or disgust. Films ranged from 77 to 118 s in duration, with an average of 104.25 s in duration.

Table 4.9

Films Selected to Elicit Feelings of Happiness

Film – Scene	Date	Source	Length (s)
Happy Films			
Love Actually – Airport arrival before credits	2003	Movie	114
10 Things I Hate About You – Singing to girl in stadium	1999	Movie	118
Kicking and Screaming – Scoring winning goal	2005	Movie	77
500 Days of Summer – Dancing in the street	2009	Movie	108

4.3.2 Results

The aim of the following analyses was to establish a set of happy films. First, films were first checked to ensure they elicited the intended target emotion (i.e., greater happiness scores), and minimal comparable levels of non-target discrete emotions (e.g., anger, disgust, fear, sadness, surprise; Gross & Levenson, 1995). Second, films were checked for confusion and clarity of film content, to ensure participants were able to comprehend each film as a standalone scene. For the current study, films receiving confusion scale scores of M = 3.00 or above are deemed ineffective stimuli and removed from subsequent steps.

Films Eliciting Happiness

Emotional discreteness. Each film was checked for the intensity of self-reported emotional experience, and whether happiness differed significantly from non-targeted discrete emotions. Emotion ratings for each film were analysed with one-way repeated measures ANOVAs. The within-subjects variable was self-reported emotion (happiness, anger, confusion, disgust, fear, sadness, surprise). For each film, there was a main effect of emotion (*p*s < .001), and according to post hoc analyses, all films were rated with greater happiness than anger, disgust, fear, sadness, surprise, and confusion. The mean self-rated emotion scores for all happy films are shown in Table 4.10.

Clarity of film content. Films were then double checked for self-reported confusion. According to the previous analyses (see Table 4.10), no mean scores of confusion were above $M = 3.00$ cut off.

Similarities between films. Films were also checked for happiness and arousal differences[10] between each other. Happiness and arousal ratings were analysed with separate one-way repeated measures ANOVAs. For happiness ratings, there was no main effect of film, $F(2.53, 96.48) = 2.49$, $p = .079$, $\eta_p^2 = .06$. For arousal ratings, there was no main effect of film, $F(2.24, 91.98) = 0.22$, $p = .826$, $\eta_p^2 < .01$. The mean happiness and arousal scores are displayed in Table 4.11.

[10] Additional *t*-test analyses were conducted to determine whether age differences exist in happiness and arousal ratings for each happy film. There were no age differences across *Love Actually, 10 Things I Hate About You, Kicking and Screaming*, or *500 Days of Summer* films (*p*s > .138).

Table 4.10

Mean Self-Reported Emotion Scores for Films Intended to Elicit Feelings of Happiness

Happy Films	*F*	*p*	η_p^2	**Happiness**	Anger	Disgust	Fear	Sadness	Surprise	Confusion
Love Actually	120.54	<.001	.75	**7.29 (1.11)**	1.69 (1.52)	1.45 (1.38)	1.26 (1.25)	1.95 (1.51)	2.86 (2.04)	1.88 (1.37)
10 Things I Hate About..	132.17	<.001	.76	**7.12 (1.21)**	1.26 (0.99)	1.36 (1.34)	1.26 (1.13)	1.55 (1.19)	2.95 (2.27)	1.69 (1.49)
Kicking and Screaming	123.73	<.001	.75	**6.76 (1.39)**	1.26 (0.91)	1.19 (0.94)	1.24 (0.96)	1.64 (1.45)	2.43 (1.99)	1.64 (1.74)
500 Days of Summer	120.05	<.001	.75	**6.81 (1.52)**	1.29 (1.18)	1.31 (1.18)	1.26 (1.13)	1.26 (1.11)	2.55 (2.16)	1.98 (1.88)

Note. Emotion rating scales ranged from 1 (not at all) to 9 (extremely). Each film was analysed using separate repeated measures ANOVAs (df = 6, df $error$ = 246). All post hoc comparisons between the target emotion (happiness) and each discrete emotion differed significantly (ps < .05).

Table 4.11

Happiness and Arousal Ratings for Selected Happy Films

	Happiness Rating		Arousal Rating	
Happy Films	*M*	*SD*	*M*	*SD*
Love Actually	7.29	1.11	5.52	1.97
10 Things I Hate About You	7.12	1.21	5.71	1.78
Kicking and Screaming	6.76	1.39	5.48	2.00
500 Days of Summer	6.81	1.52	5.64	2.07

Note. Self-report happiness rating scales ranged from 1 (not at all happy) to 9 (extremely happy), and arousal rating scales ranged from 1 (calm/dull) to 9 (intense).

Pilot Study B Summary

In the second pilot study, additional young and older adults self-reported their emotional experience to a selection of dynamic stimuli intended to elicit feelings of happiness. Four films (*Love Actually*, *10 Things I Hate About You*, *Kicking and Screaming, 500 Days of Summer*) were tested to ensure they elicited the target emotion (e.g., happiness), with minimal levels of unrelated emotions (e.g., anger, disgust, fear, sadness, surprise) or confusion. All four films did not differ on mean happiness and arousal ratings.

4.4. Discussion

The main aim of the present study was to develop and empirically test a selection of emotion-eliciting films, with the purpose of establishing a set of dynamic stimuli for subsequent studies of the current research thesis. The current study comprised of two sub-studies that together, were used to pilot sets of amusing, happy, sad, and neutral films. Young and older adults were instructed to provide self-reported ratings whilst watching a large collection of short segments taken from movies, television shows, and YouTube. The specific objectives regarding the selection of film stimuli were supported. Sets of amusing and sad films that differ in low and high emotional intensity, as well as sets of happy and neutral films, were developed with normative ratings presented. The specific objectives regarding the conditions of the selected films were also supported. Stimuli were effective in eliciting emotion for young and older adults, and films were confirmed to discretely elicit each target emotion (with minimal unrelated emotion) without confusion. Lastly, the normed films expand the choice of standardised emotion-eliciting stimuli available in the research literature.

Films Eliciting Amusement, Happiness, and Sadness

The current study presents the development and norming of a new battery of films found to elicit discrete emotional states in young and older adults. Two prominent theoretical models of emotion were considered during the testing process (Gross & Levenson, 1995; Schaefer et al., 2010), with findings demonstrating support for the use of a mixed discrete and dimensional approach (Christie & Friedman, 2004). That is, together a basic emotion categorical approach (i.e., discrete emotion) and a dimensional approach (i.e., arousal level) were used to test a final selection of 24 short emotional film clips. Analyses demonstrated that the selected films were effective as an emotion induction technique in eliciting discrete subjective emotional experiences with differing self-reported levels of arousal, consistent with previous film norming studies (Carvalho et al., 2012; Christie & Friedman, 2004; Gross & Levenson, 1995; Schaefer et al., 2010).

Accordingly, against criteria to elicit basic emotional states, eight films demonstrated the capacity to discretely elicit amusement, eight to elicit sadness, four to elicit happiness, and four to elicit emotional neutrality. Each emotional film was found to distinctively evoke subjective feelings of the intended emotion (e.g., sadness), with minimal levels of unrelated emotions (e.g., amusement, anger, disgust, fear, surprise). Normative data was provided for such emotion ratings, detailing the extent to which each film elicited the target emotion. The inclusion of two positive emotions, amusement and happiness, contributes to expanding the availability of stimuli to evoke a range of positive emotional states, which is often overlooked due to a research bias towards examining negative emotions. The neutral films were also rated against emotion criteria, receiving minimal emotional (and arousal) ratings, and thereby suitable in emotion research as a comparable baseline stimulus (Rottenberg et al., 2007). The current films add to the pool of available film databases standardised through English-speaking populations (Gabert-Quillen et al., 2014; Gross & Levenson, 1995; Rottenberg et al., 2007), with the addition of being tested with young and older adults, and for establishing distinct low and high emotionally intensive categories.

As stated, the inclusion of an affective dimension approach (e.g., arousal) in combination with the discrete emotion approach, provides emotional films with more concise standardisation data (Gabert-Quillen et al., 2014). In establishing sets of amusing, happy, sad, and neutral films, the current study also measured participants' subjective ratings of affective arousal. As arousal ratings provide a subjective index of emotional intensity, such scores are beneficial in determining potential degrees of emotional reactivity along other channels, such emotional expression or behaviour (Carvalho et al., 2012). Importantly, emotional films were rated with greater arousal than neutral films, highlighting the activation tendencies associated with emotional states (Greenberg & Paivio, 2003). Based on self-reported emotional discreteness and arousal, taken together, the current films provide suitable stimuli for eliciting desired affective states during laboratory experiments.

One of the most prominent advantages of the current study is the classification of amusing and sad films according to criteria of low and high emotional intensity, which no known film databases have previously undertaken. Thus, this is the first film database to include analyses that provide subsets of emotional films according to two groups of affective intensity. Moreover, while past standardisation studies (e.g., Gabert-Quillen et al., 2014) have found overlapping of emotions for films with low-moderate intensity ratings, the current films discretely elicit the subjective experience of each target emotion. Validity criteria for such intensity subsets were based on films rated with the lowest and highest levels of target emotion (maintaining emotional discreteness) and subjective emotional arousal. Therefore, the newly developed amusing films now include a set of low amusing stimuli (low amusement, low arousal) and high amusing stimuli (high amusement, high arousal). Similarly, the newly developed and piloted sad films now include a set of low sad stimuli (low sadness, low arousal) and high sad stimuli (high sadness, high arousal). The current films are therefore sensitive to the degrees of emotional intensities, and expand previous film databases in now allowing greater flexibility and precision in future research designs by providing stimuli that activate low and high emotional states.

Emotional Films for Young *and* Older Adults

A second prominent advantage of the current study, and key to the current thesis, is the inclusion of young and older adults during stimulus testing. This is the first database of emotional films to include both age groups during the development and norming process, and therefore, holds importance in the use of such stimuli in ageing research. As noted, previous pilot research by Henry et al. (2009) tested three amusing films for research with older adults. However, the authors did not include young adults during this process, therefore the current study has addressed this methodological gap in the emotion ageing literature. Findings confirm that the selected film clips are an effective emotion-elicitation technique for older adults, and could be used as a source of experimental material in future studies involving participants of older age.

An area of caution with the current study is that stimuli receiving age differences were not removed from the final selection of films. Additional analysis found that compared with young adults, older adults self-reported greater emotional responses (i.e., discrete emotion or arousal) across seven films (e.g., *Mr Bean*, *Caddyshack*, *News Prank*, *NeverEnding Story*, *The Champ*, *Midnight Cowboy*, and *Fresh Prince of Bel Air*). Findings are, however, consistent with previous research demonstrating older adults tend to report higher levels of subjective emotional experience than their younger counterparts (Haase et al., 2012; Kunzmann & Grühn, 2005; Lohani & Isaacowitz, 2014). The current study focused on initially selecting films that would likely be relevant across differing generations (e.g., released over differing decades, age of actors), and by targeting themes applicable to both age groups (e.g., scenes involving family, relationships, pet animals). Though, films reported as confusing were removed from the final selection of suitable stimuli. Importantly, both young and older adults' ratings were emotionally similar for the majority of films. Thus, the overall lack of age differences suggests that these films remain suitable for research involving both age groups.

A larger sample size, with an increase in power, would allow for the reliable comparison of young and older adults, to ensure that final selected films were rated comparably between both age groups (i.e., no age differences). That is, to ensure both ages experience matched levels of emotional arousal. Caution in this process would also have to be considered, in being careful not to create two separate film sets per age group. This would reduce the flexibility in using such films to answer additional age-related research questions. For instance, Studies 3 and 4 of the current research thesis require participants to recall content viewed in each film. In this example, age comparisons in recall performance would be limited due to young and older adults viewing separate sets of films that could differ in their degree of difficulty for accurate memory recall.

Limitations and Future Directions

The most prominent limitation with the current study is the completion of Pilot Studies A and B with different participants. Some caution should be considered with the generalisability of findings as not all participants saw all films in the same testing session.

That is, participants in Pilot Study A viewed amusing, sad, and neutral films, but not happy films, and vice versa for participants who completed Pilot Study B. It is possible that happy films may have been rated with greater emotional intensity and arousal, given they were viewed in isolation without comparability with amusing films. It could be argued that if the same participants viewed happy and amusing films, then happy films may have been rated with lower emotion and arousal when compared with amusing films. Thus, results from the overall study restrict the comparability of using all film sets in later research (Fernández et al., 2012). Ensuring participants view all stimuli sets would allow for greater accuracy and reliability for providing normative emotion and arousal ratings in standardising sets of emotion-eliciting films.

Relatedly, during the selection of happy films in Pilot Study B, amusement ratings were not collected in combination with happiness ratings. In this thesis, amusement was introduced as a more intense form of positive emotion and as such only one rating scale was used to rate positive emotion. Future research should consider the possibility that both positive emotions could be conceptually distinct (see Herring et al., 2011, for a review) and thus use two positive emotion scales of amusement and happiness during the validation of film stimuli.

Furthermore, due to the limitations in sample size (Pilot Study A: $N = 31$; Pilot Study B: $N = 42$), the current study is restricted in the extent it can be considered a database of validated films for use in the greater literature. A larger sample to test the selected films will improve and enhance the validity and reliability of current normative ratings (Carvalho et al., 2012). Indeed, prior pilot studies have used samples of less than 20 participants when validating emotion stimuli for the primary study (e.g., Reynaud et al., 2012).

A consideration with the current study is the reliance on self-report. Whilst other emotional databases have also relied on subjective responses for film validation (Gabert-Quillen et al., 2014; Gross & Levenson, 1995; Schaefer et al., 2010), there are limits to such approaches (Fernández et al., 2012). Notably, such methodologies rely on the capacity for film stimuli to evoke noticeable subjective emotional responses. Emotional reactions may also go unnoticed by participants, requiring conscious awareness and an ability to accurately describe such feelings (Rosenthal et al., 2008). Additionally, emotions are also not simply limited to internal feelings, but regarded as a multifaceted response system, which also involves changes to facial expression, behaviour, and physiological and brain activity (Mauss & Robinson, 2010; Tsai et al., 2000). Future research would benefit from a multimethod assessment with the use of expressive and psychophysiological indicators of emotional responding, in combination with subjective accounts, to thoroughly standardise the current set of films (Schaefer et al., 2010).

The use of objective criteria would extend the use of the currently tested films in other research projects. Of particular interest, is the use of objective psychophysiological methods to assess behavioural and physiological changes in response to emotional stimuli, such as through muscular, electrodermal, cardiovascular, and respiratory systems (Carvalho et al., 2012). Facial electromyography (EMG, indexing emotional expressions) would assist in mapping positive and negative valence, and skin conductance or heart rate (indexing activation of the sympathetic nervous system) would assist in differentiating between low and high levels of arousal (Carvalho et al., 2012; Fernández et al., 2012; Kreibig, 2010). Knowing how the currently established set of films induce emotional changes to such objective measures in combination with subjective feelings, would provide a more complete picture of stimulus effects on young and older adults’ emotional states (Fernández et al., 2012).

Conclusion

In conclusion, the current study developed and piloted a new battery of emotion-eliciting films for use in future research involving young and older adults. The established films provide an important tool for eliciting discrete emotional states (e.g., amusement, happiness, sadness, neutral) of varying arousal levels in a laboratory setting. Specifically, amusing and sad films assigned to subsets of films eliciting low or high levels of subjective emotional intensity allow for flexible manipulation of emotion criteria. Moreover, this was the first study to include young and older adults during the testing of a large selection of emotional films. Increased sample size, as well as objective psychophysiological techniques (e.g., EMG, skin conductance, heart rate) in combination with self-report measures, would assist in enhancing the extendibility in using these films in the wider research literature. Importantly and finally, the piloted films provide suitable dynamic stimuli (of varying emotional intensities) for testing specific age-related research questions in the subsequent studies of the current research thesis.

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CHAPTER 5: Ageing is associated with successful regulation of positive but not negative facial expressions in response to emotionally arousing films (Study 3)

"Wrinkles should merely indicate where smiles have been."

– Mark Twain (1897)

Overview of Chapter

The current study extended Study 1 (Pedder et al., 2016) by investigating age differences in facial reactivity as a contributor to preserved emotion regulation in old age, as well as the *limitations* to older adults' ability to regulate emotional responses effectively. Specifically, Study 1 concluded that emotion regulation might become less effortful and require less cognitive resources for older adults due to having reduced emotional reactivity compared to young adults. It could therefore be proposed that heightened emotional reactivity in older adults may place greater demands on those resources and thereby resulting in emotion regulation becoming more difficult to achieve. The current study examined a component of the dynamic integration theory (Labouvie-Vief, 2008) by investigating whether older adults remained successful at regulating their overt facial expressions to more emotionally evocative dynamic stimuli (extending from the static stimuli used in Study 1).

In the current study, young and older adults viewed amusing, happy, and sad emotion-eliciting films of varying intensities (which were piloted in Study 2 to evoke low and high levels of emotional reactivity). Participants were instructed to watch the films naturally or to regulate their facial muscles using expressive suppression. Emotion regulation and emotion reactivity was measured according to changes in *zygomaticus* (i.e., smiles and laughter) and *corrugator* (i.e., frowns) electromyography (facial EMG) muscle activity, as well as changes in autonomic activity (using skin conductance to index physiological arousal) and subjective experience (self-report). Following the emotion regulation task, memory performance in the accuracy of film content recalled was also measured to index the cognitive demands utilised during expressive suppression.

Results first confirmed that during the watch condition across emotional films, older adults responded with lower levels of emotional facial EMG activity and physiological arousal compared with young adults, possibly making emotion regulation less effortful in old age. Both age groups reduced their positive facial expression when viewing amusing films of high-intensity, however, not to baseline levels (i.e., a neutral facial expression), suggesting greater emotion regulation challenges associated with dynamic emotional stimuli than the static pictures used in Study 1.

Young adults, but not older adults, reduced their negative facial expression when viewing sad films. Therefore, support was found for Labouvie-Vief’s (2008) dynamic integration theory, suggesting that older adults experience greater difficulty when attempting to regulate heightened negative emotional reactivity, potentially due to increased effort and resource demands needed to effectively obtain emotion regulation goals.

The findings contribute to a more comprehensive understanding of emotion regulation capacity in old age, including the limits of regulating negative facial expressions and the consequences for social interactions. Theoretical and methodological implications of the findings are discussed, as well as considerations for research leading into Study 4.

5.1. Introduction

Emotion regulation of facial responses is an adaptive skill for social situations where outward signs of emotion may be detrimental to interpersonal relationships and daily functioning (Gross & John, 2003; Kalokerinos et al., 2014). Thus, the regulation of emotional responses remains important across the life span and is important for social situations, including challenging interactions with co-workers, conflict with family members, and anxiety during a speech (Coats & Blanchard-Fields, 2008; Diamond & Aspinwall, 2003). In line with socioemotional selectivity theory (SST; Carstensen, 1992), emotion regulation is a particularly crucial skill for older adults, with greater priority given to maintaining socially meaningful relationships and positive experiences (Charles & Piazza, 2009; English & Carstensen, 2014; Riediger et al., 2009). SST suggests that there are motivational shifts in later life, where increased effort and resources are given to regulating emotional behaviour to manage social interactions (Birditt, 2014; Birditt et al., 2005) and to improve emotional wellbeing and mental health (Carstensen et al., 2003; Löckenhoff & Carstensen, 2004).

A number of studies have investigated older adults' capacity to regulate their overt facial displays of emotion using expressive suppression as an emotion regulation strategy (e.g., Henry et al., 2009). Expressive suppression involves the direct inhibition of overt facial displays of emotion, such as through controlling facial muscles to conceal the emotional state seen by others (Gross et al., 2006). Evidence from experimental research indicates that both young and older adults are effective at regulating their positive (Emery & Hess, 2011; Pedder et al., 2016) and negative facial expressions (Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Magai et al., 2006; Phillips et al., 2008; Shiota & Levenson, 2009). Moreover, for young adults, but not older adults, regulation of emotional expression has been found to impair memory performance (Emery & Hess, 2011; Scheibe & Blanchard-Fields, 2009), likely because young adults rely on greater cognitive demands and resources to implement the response-focused strategy (Mather, 2012; Robinson & Demaree, 2009). Despite the growing interest in the effects of ageing on emotion regulation, little is known about *how* older adults maintain successful regulation of facial expressions into later life, and whether there are any *limits* to their emotion regulation capacity.

The mechanisms underlying older adults' ability to effectively regulate facial expressions are only beginning to be examined (Morgan & Scheibe, 2014). The selection, optimisation, and compensation with emotion regulation (SOC-ER) framework suggests that age-related declines in cognitive functioning may consequently permit older adults to implement more efficient and less demanding strategies to achieve emotional goals (Opitz, Gross, et al., 2012; Urry & Gross, 2010). In investigating possible strategy effects, Study 1 found that cognitive 'detached' reappraisal and expressive suppression strategies were equally effective at reducing facial expressions in young and older adults (and with no costs to memory performance). This evidence suggested that differences in strategy demands did not contribute to explaining successful regulation of facial expressions in old age, therefore additional explanations were also considered.

In line with age-related biological changes (Arking, 2006; Cacioppo et al., 1997) and consisted with prior research (e.g., Lohani & Isaacowitz, 2014; D. P. Smith et al., 2005; although see Reminger et al., 2000), Study 1 revealed that older adults produced significantly lower levels of facial reactivity in response to static pictures of emotional scenes. It was suggested that due to lower levels of emotional reactivity in old age, that regulation of facial expressions might become less effortful for older adults compared with young adults (Pedder et al., 2016). Indeed, emotion regulation is regarded as cognitively demanding and requires ongoing effortful processes throughout the emotional event (Kryla-Lighthall & Mather, 2008; Richards & Gross, 2006). In particular, expressive suppression is suggested to strongly rely on multiple executive functions, such as self-monitoring, behavioural inhibition, and working memory (Gross, 2002; Richards, 2004). Therefore, due to already lower emotional reactivity, expressive suppression may become easier to accomplish for older adults, requiring less cognitive resources and effort to regulate compared to young adults (Morgan & Scheibe, 2014).

Thus, depending on the degree of emotional reactivity, facial expressions may be more or less effortful to regulate efficiently (Phillips et al., 2008). A premise of cognitive-emotional integration (i.e., dynamic integration theory) suggests that higher levels of emotional arousal place increased demands on self-regulatory resources to achieve emotion regulation goals (Labouvie-Vief, 2008). As such, due to diminishing resources, older adults are likely to experience greater difficulty in regulating emotional expressions that are of particularly heightened levels of emotional arousal and activation (Uchino et al., 2010). This is relevant to older adults, given the age-related cognitive declines in functions that are involved in regulation (e.g., cognitive control; Hedden & Gabrieli, 2004; Ochsner & Gross, 2005). Similarly, the strength and vulnerability integration model (SAVI; Charles & Piazza, 2009) predicts that older adults experience greater difficulty in regulating heightened emotional arousal due to physiological vulnerabilities associated with ageing. Whilst older adults may demonstrate emotion regulation success in situations of low emotional arousal, high levels of distress or excitement in social interactions may result in poorer regulation of facial expressions for older compared to young adults (Charles & Luong, 2013).

Consequently, older adults demonstrate preferences for low-intensive and less arousing emotional activation (for a review, see Labouvie-Vief et al., 2014). For example, using an experience-sampling technique, older adults demonstrated strong preferences for low- than high-arousing positive states (e.g., peaceful, relaxed vs. excited, proud), whereas young adults valued both levels of positive emotions equally (Scheibe, English, Tsai, & Carstensen, 2013). Evidence from other studies has also indicated that older adults perceive highly arousing positive and negative stimuli as more aversive than young adults, and thus older adults are more vulnerable to the subsequent effects on emotional equilibrium (Grühn

& Scheibe, 2008; Keil & Freund, 2009). Labouvie-Vief et al. (2014) suggested that older adults may become more easily overwhelmed in dealing with highly arousing emotional events, and thereby demonstrate reduced emotion regulation capacities. For instance, using an emotional stroop task, older adults were found to be more sensitive to arousal level compared with young adults, and experienced increased difficulties in inhibition, an important cognitive function in expressive suppression, with high emotionally arousing stimuli (Wurm, Labouvie-Vief, Aycock, Rebucal, & Koch, 2004).

It is therefore possible that certain emotion regulation processes, such as behavioural inhibition used in expressive suppression, are likely to be disrupted for older adults as they experience more intense emotions that extend beyond their thresholds of emotional arousal (Labouvie-Vief et al., 2010). Further research is needed to investigate the predictions of dynamic integration theory in older adults so as to better understand the limits and constraints of successful emotion regulation in later life (Uchino et al., 2010). The current study utilises dynamic stimuli (i.e., films) to elicit longer lasting and high emotionally arousing responses by extending on from Study 1, which used static stimuli of positive and negative pictures. Indeed the use of films, in contrast to pictures, are effective in eliciting a range of emotion responses due to the dynamic, visual, and auditory nature of the stimuli and the ability to evoke emotional physiological responses to longer lasting stimuli (Gomez, Zimmermann, Guttormsen-Schär, & Danuser, 2005; Rottenberg et al., 2007; Sato, Fujimura, & Suzuki, 2008). Furthermore, the current study intends to manipulate the extent of emotional activation in young and older adults, by examining whether expressive suppression becomes more challenging for older adults when experiencing heightened levels of emotional physiological arousal.

The Current Study

The primary aim of the current study was to examine the dynamic integration theory (Labouvie-Vief, 2008) by investigating whether older adults remained successful at regulating their facial expressions to dynamic stimuli of heightened emotional intensity. Previous findings suggest that reduced emotional reactivity in older adults may contribute to maintained emotion regulation capacity due to requiring less effort and cognitive demands than young adults (e.g., see conclusions of Study 1). Therefore, increased emotional reactivity in older adults may rely on greater cognitive resources resulting in greater difficulty in regulating emotional responses effectively. For the current study, young and older adults were instructed to regulate their overt facial responses when viewing dynamic stimuli of varying emotional intensities (extending from the use of low arousing static stimuli in Study 1). Thus, participants viewed positive (amusing, happy) and negative (sad) films, which were piloted in Study 2, to elicit low and high levels of emotional reactivity. The aims were three-fold.

First, age differences in emotion regulation were investigated by comparing the effectiveness of reducing *zygomaticus major* (i.e., smiles and laughter) and *corrugator supercilii* (i.e., frowns) facial electromyography (EMG) muscle activity during the *expressive suppression* condition compared with the watch condition. Based on previous evidence (Emery & Hess, 2011; Kunzmann et al., 2005) and in accordance with the dynamic integration theory (Labouvie-Vief, 2008), it was predicted that both age groups would reduce their overt positive and negative facial expression (as indexed by EMG) to low-intensity films, but only young adults, and not older adults, would effectively reduce their responses to high-intensity films. Based on prior research demonstrating mixed consequences of expressive suppression on physiological arousal and subjective experience (Dan-Glauser & Gross, 2011; Gross & Levenson, 1997; Lohani & Isaacowitz, 2014), it was anticipated that emotion regulation would not alter skin conductance level (SCL; indexing activity in the sympathetic nervous system, SNS) or subjective experience (self-report) indices compared to the watch condition for both age groups.

Second, age differences in emotional reactivity during the *watch* condition were investigated by measuring spontaneous facial muscle expressivity, physiological arousal, and subjective experience. Based on psychophysiological evidence (Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Pedder et al., 2016; D. P. Smith et al., 2005), it was predicted that across low- and high-intensity films, older adults would produce lower levels of *zygomaticus* and *corrugator* EMG activity, as well as lower levels of SCL (i.e., physiological arousal) relative to young adults. It was also predicted that higher intensity films would result in increased levels of EMG and SCL activity compared to lower intensity films across both age groups. In relation to previous mixed self-report evidence (Emery & Hess, 2011; Tsai et al., 2000), it was anticipated that there would be no age differences in subjective accounts of positive and negative films.

Third, previous researchers (Emery & Hess, 2011) have called for additional investigation into the ageing and emotion regulation effects on memory, with more evocative dynamic stimuli (e.g., emotional films). As an index of the cognitive demands during emotion regulation, the current study also investigated whether expressive suppression impaired memory performance (i.e., accuracy in recall of film content) to films of varying emotional intensities (Morgan & Scheibe, 2014). Based on prior evidence that memory performance is preserved in older adults following regulation (Emery & Hess, 2011; Scheibe & Blanchard-Fields, 2009) and in line with the current prediction that older adults would produce lower emotional reactivity during the watch condition, it was expected that expressive suppression would reduce memory performance during the lower intensity emotional films in young adults but not in older adults. However, for higher intensity emotional films, it was expected that due to higher facial reactivity requiring regulation resulting in increased effort and cognitive demands, that expressive suppression would reduce memory performance in young *and* older adults.

5.2. Method

Participants

Forty young adults (aged 18–33; *M* = 22.00 years, *SD* = 3.96; 24 women) and 40 older adults (range 60–85; *M* = 71.33 years, *SD* = 5.35; 21 women) participated in the current study. Data from this study was collected during the same testing session as Study 4, during which the effects of detached reappraisal and focused-breathing were also examined whilst viewing sad films. This study, however, only examined data from the instruction conditions of watch and expressive suppression. Young adults were recruited through the university undergraduate pool, and older adults were recruited through the community and an established database of participants. Participants received course credit or were reimbursed $30 for their time and travel expenses. Exclusion criteria for older adults included scores of 84 or below on Addenbrooke's Cognitive Examination-Revised (ACE-R), which is a brief cognitive screening measure assessing orientation/attention, general memory, verbal fluency, language, and spatial memory (Mathuranath et al., 2000).

The age-related patterns of performance on background measures are shown in Table 5.1. Older adults performed better than young adults on verbal intelligence, as indexed by the National Adult Reading Test (NART; Nelson & Willison, 1991). Compared with young, older adults performed worse with task switching and processing speed on the Trail Making Test (TMT; trail B - trail A; Reitan, 1992). Compared with young, older adults recalled fewer words in a test of delayed recall (Short Word Test of Screening Examination for Cognitive Impairment; Beatty et al., 1995).

Table 5.1

Performances on Background Measures for Young and Older Adults

	Young Adults n = 40		Older Adults n = 40		t test[d] (df = 78)		
Characteristic	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
NART: FSIQ	110.61	4.95	118.73	4.93	7.35	< .001	1.64
Trail Making (B - A)	29.54	15.93	41.34	23.10	2.66	.010	0.59
Memory Recall[a]	7.73	1.62	6.90	1.84	2.13	.036	0.48
Anxiety[b]	7.23	3.53	4.53	2.67	3.86	< .001	0.86
Depression[b]	3.28	2.55	2.40	1.97	1.72	.090	0.39
Positive Affect[c]	31.88	7.09	36.45	6.92	2.92	.005	0.65
Negative Affect[c]	12.95	4.47	10.83	1.53	2.85	.006	0.63
Health last Month	3.85	0.70	3.98	0.92	0.68	.496	0.16

Note. NART = National Adult Reading Test; FSIQ = Full Scale Intelligent Quotient.
[a]Delayed Memory Recall test from the Short Word Test of the SEFCI. [b]Anxiety and Depression scales from the Hospital Anxiety and Depression Scale. [c]Positive and negative affect scale from the Positive and Negative Affect Schedule. [d]Independent *t* test applied, with Cohen's *d* = effect size.

There were no age differences in self-reported depression, however, young adults reported greater levels of anxiety than older adults, over the past week on the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). At the start of the testing session older adults self-reported greater positive affect than young adults, whereas, young adults reported greater levels of negative affect than older adults on the Positive and Negative Affect Schedule (PANAS; state version; D. Watson et al., 1988). There were no age differences on reported overall health for the past month on a self-rated 5-point scale (1 = *poor*, 5 = *excellent*).

Procedure and Materials

Emotion regulation task. The emotion regulation task asked participants to suppress their facial expressions whilst viewing emotional film clips. Participants viewed a neutral film as initial practice, followed by separate blocks of amusing and sad films, which were counterbalanced in order between participants. The amusing and sad film blocks contained two instruction conditions: (1) watch naturally, and (2) expressive suppression.[11] Each instruction consisted of a pair of low-intensity films and a separate pair of high-intensity films. All videos within each amusing and sad blocks were randomised across conditions. Both instructions stated to "please view the following videos carefully without looking away from the screen". In the watch condition, participants were instructed to "simply WATCH the video as you naturally would". In the expressive suppression condition, participants were instructed to "try to SUPPRESS any emotion that may arise so that if someone was watching, they could not tell what you were feeling". Task instructions and stimuli were presented with E-Prime 2.0 Professional (Psychology Software Tools, Inc., Sharpsburg, PA) on a Microsoft Windows desktop computer and LCD screen. Participants wore over-ear Bose audio headphones and were able to adjust volume as suited. Stimuli onset and offset digital event markers were sent from E-Prime to physiology recording software.

Stimuli. Eight amusing and eight sad films were selected from an initial pilot study (see Pilot Study A of Study 2) involving a combined 32 films. Films were obtained from movies, television shows, and YouTube, and averaged 112.75 s in duration. Sixteen young (eight women) and 15 older adults (eight women) completed pilot testing. Participants completed the ACE-R, NART, HADS, TMT, and PANAS to ensure participants were representative of the target population. From the pilot study, the four films that elicited the lowest of each intended emotion were selected for the low-intensity conditions, and the four films that elicited the highest levels of each intended emotion were selected for the high-intensity conditions. Films were only included if they elicited minimal levels of unrelated emotions (e.g., anger, disgust, fear, or surprise) and were not reported as confusing. The self-

[11]Whilst viewing high-intensity sad films, participants also completed two additional strategies of detached reappraisal and focused-breathing. The data from these strategies were analysed as part of Study 4, which involved different research questions from the current study.

rated scores for each selected film from the pilot study are shown in Table 5.2. Low- and high-intensity sets differed significantly for amusing films (low: $M = 4.77$, $SD = 1.58$; high: $M = 6.56$, $SD = 1.28$), $t(30) = 6.59$, $p < .001$, $d = 1.24$, and sad films (low: $M = 4.39$, $SD = 1.78$; high: $M = 6.85$, $SD = 1.38$), $t(30) = 10.76$, $p < .001$, $d = 1.54$.[12] Two additional neutral films (*Knitting Demonstration*, *Mountain Goats*), also piloted, were viewed separately as practice prior to respective blocks of amusing and sad films.

Table 5.2

Mean Self-Reported Amusement and Sadness Ratings for Emotional Films Piloted in Study 2

Amusing Films	Length (s)	*M*	*SD*	Sad Films	Length (s)	*M*	*SD*
Low-Intensity				Low-Intensity			
Cat in Kitchen	105	5.16	2.35	*Dangerous Minds*	126	4.77	1.86
Austin Powers	69	5.03	1.96	*Fresh Prince…*	69	4.42	2.33
Caddyshack	120	4.58	2.01	*My Dog Skip*	118	4.39	2.30
News Prank	120	4.32	1.89	*Midnight Cowboy*	102	4.00	2.41
High-Intensity				High-Intensity			
I Love Lucy	122	6.97	1.89	*Sophie's Choice*	132	7.19	1.72
Mr Bean	87	6.65	1.80	*NeverEnding Story*	120	7.00	1.77
Police Prank	131	6.35	2.39	*My Girl*	141	6.77	1.98
Baby Laughing	103	6.29	1.66	*The Champ*	139	6.45	2.20

Note. $N = 31$ (16 young adults, 15 older adults). Amusement rating scales ranged from 1 (not at all amusing) to 9 (extremely amusing). Sadness rating scales ranged from 1 (not at all sad) to 9 (extremely sad).

[12]Low- and high-intensity sets also differed on ratings of arousal for amusing films (low: $M = 4.76$, $SD = 1.53$; high: $M = 6.06$, $SD = 1.48$), $t(30) = 6.26$, $p < .001$, $d = 0.86$, and sad films (low: $M = 5.02$, $SD = 1.33$; high: $M = 6.99$, $SD = 1.26$), $t(30) = 9.28$, $p < .001$, $d = 1.52$. Additionally, no main effects of target emotion (amusement or sadness) or arousal were found within each of the low or high intensity sets (*p*s > .075), indicating that amusing and sad films did not differ in emotional ratings or arousal levels within each low- and high-intensity set.

An additional four happy films were included under the amusement condition in the current study to provide a set of dynamic pleasant stimuli that contrasts with the static pleasant pictures used in Study 1 (i.e., pictures of pleasant 'happy' scenes). The happy films were also intended to provide a considerably lower intensity level of positive emotional reactions than the amusing films. Therefore, the happy films provide an intervening step in the transition from pleasant static pictures (with less emotional arousal) to amusing dynamic films (with greater emotional arousal). It was anticipated that participants would respond with laughter towards low-intensity amusing films, and especially high-intensity amusing films, producing substantial *zygomaticus* cheek muscle activity. Therefore, with the inclusion of four films intended to elicit feelings of happiness, it was anticipated that participants would respond with smiles, rather than laughter (as with amusing films). These additional films were selected from movies, averaged 104.25 s in duration, and piloted for self-reported ratings of happiness (see Pilot Study B of Study 2). Films only elicited minimal levels of unrelated emotions (e.g., anger, disgust, fear, sadness, or surprise) and were not reported as confusing.[13] The self-rated scores for happy films are shown in Table 5.3.

Table 5.3

Mean Self-Reported Happiness Ratings for Happy Films Piloted in Study 2

Happy Films	Length (s)	*M*	*SD*
Love Actually	114	7.29	1.11
10 Things I Hate About You	118	7.12	1.21
Kicking and Screaming	77	6.76	1.39
500 Days of Summer	108	6.81	1.52

Note. $N = 42$ (20 young adults, 22 older adults). Happiness rating scales ranged from 1 (not at all happy) to 9 (extremely happy).

[13]Additionally, no main effects of target emotion (happiness) or arousal were found between films ($ps > .079$), indicating that happy films did not differ in emotional ratings or arousal levels.

In summary, for the current experiment, participants viewed a total of six films during the amusement condition (2 x happy, 2 x low-intensity amusing, 2 x high-intensity amusing). Participants also viewed a total of four films during the sadness condition (2 x low-intensity sad, 2 x high-intensity sad). For each intensity level, participants viewed two films randomly taken from the pool of four films available.

Facial EMG. Surface EMG was used to record subtle facial muscle activity. Pairs of 4 mm Ag-Ag CI shielded fixed-wire electrodes containing conductance electrode gel were placed over the *zygomaticus major* (to index amusement/happiness with positive affect) and *corrugator supercilii* (to index sadness with negative affect) muscle regions on the left side of the face (Driscoll et al., 2009; Fridlund & Cacioppo, 1986; Lohani & Isaacowitz, 2014; Tassinary et al., 2007). Muscle sites were first prepared using skin abrasive pads and Nu Prep skin preparation gel before using adhesive washers to attach electrodes to skin surface with an inter-electrode distance of 1 cm. An impedance checker was used to ensure impedance level was below 20 kΩ during signal recording (Tassinary et al., 2007). Activity was recorded using biopotential amplifiers at a sampling rate of 1,000 Hz with an integrated MP150 system and Acq*Knowledge* 4.2 software package (Biopac Systems, Inc., Goleta, CA). A 50 Hz notch interference filter, along with a 500 Hz low-pass and 10 Hz high-pass filter were applied.

Post data acquisition, raw signals were checked for noise and interference using analysis of power spectral density. For the data, a 25 Hz high-pass and a 425 Hz low-pass digital filter were applied to reduce noise (Lohani & Isaacowitz, 2014). A Logitech digital webcam recorded participant’s visual facial responses to facilitate the removal of artifacts and non-task specific activity from the EMG signal. Root mean square (RMS) transformations were applied to normalise the distribution of values (De Luca, 2006).

Each film trial consisted of a black screen (5 s), followed by a fixation cross and an orienting acoustic "bop" (0.5 s) before viewing the film stimulus (> 69 s). The initial 9 s of each film were omitted from data analysis to allow for participants' orientation to the stimuli and to begin experiencing the target emotion (Etzel, Johnsen, Dickerson, Tranel, & Adolphs, 2006). The following 60 s of EMG recording was extracted for statistical analysis, as this was the maximum allowable duration of stimulus activity for all films. The percentage change in stimulus activity was compared with baseline activity recorded 2 s immediately prior to the onset of the orienting sound; a standardisation metric which better accounts for variance across conditions and magnitude of EMG responses between groups (van Boxtel, 2010). This is consistent with previous research examining emotion (e.g., Bailey & Henry, 2009; Dan-Glauser & Gross, 2011; Kreibig et al., 2007; Kret, Stekelenburg, Roelofs, & de Gelder, 2013; Slessor et al., 2014) and is particularly suitable for ageing research given the age differences in the intensity of EMG responses (Lohani & Isaacowitz, 2014; D. P. Smith et al., 2005). The final score comprised of the average RMS change in activity for 60 s of stimulus exposure, thereby providing an indication of participants' subtle positive and negative facial muscle responses to the emotional stimuli.

Skin conductance. Increase in sweat gland activity, which is controlled by the sympathetic nervous system (SNS), provides a physiological indicator of emotional arousal (Busch et al., 2012; Carvalho et al., 2012; Kunzmann & Grühn, 2005). Two 6 mm Ag-Ag CI shielded fixed-wire electrodes containing conductance electrode gel were placed on the distal phalanges of the index and middle fingers of the participant's non-dominant hand (Boucsein et al., 2012; Dawson, Schell, & Fillion, 1990). Skin abrasive pads were first applied to fingertip surface before using adhesive washers and Velcro straps to attach electrodes to fingers. Exosomatic activity was continuously recorded using direct current during baseline and stimuli periods of the expressive regulation task through a Biopac Galvanic Skin Response (GSR) amplifier with a sampling rate of 1,000 Hz and a gain of 5 µmho/V (Biopac Systems, Inc., Goleta, CA).

For post SCL data acquisition, a similar protocol was followed as with the EMG data. However, due to skin conductance being a relatively slow signal, a latency window of 2 s was applied when extracting the 60 s of SCL data for statistical analysis (Boucsein et al., 2012). This resulted in the initial 11 s of each film omitted from data extraction (compared with the 9 s for EMG data). The maximum tonic SCL was compared with baseline levels recorded during viewing of neutral films (Lohani & Isaacowitz, 2014; Rottenberg et al., 2007). This allowed for longer baseline periods than EMG to reflect the differential amplitude time courses of physiological responses systems and for participants' arousal levels to subside (Boucsein et al., 2012; Kreibig, 2010). The final score comprised of the change in microSiemans (μS) activity for 60 s of stimulus exposure, thereby providing an indication of participants' emotional arousal whilst viewing the amusing and sad films.

Self-report. As stimuli were chosen to elicit targeted feelings of amusement and sadness, participants rated the intensity of each on nine-point *Likert* scales. The scales ranged from 1 (not at all amused) to 9 (extremely amused), and from 1 (not at all sad) to 9 (extremely sad). Participants completed the self-report scales immediately following each film.

Memory questionnaire. On completion of the emotion regulation task, participants were given a surprise memory test relating to the content observed in each film.[14] Consistent with previous emotional memory tests (Robinson & Demaree, 2007, 2009), the current study developed a similar six-item free response test for each film. This test provided a sensitive measure of memory performance to index any costs associated with expressive suppression. Test items were determined by selecting appropriate individual pieces of information in the films, ranging in difficulty of required details. Obscure and obvious items were avoided to

[14] An additional copy of the same surprise recall test was provided to participants 24 hours following the initial testing session to examine the subsequent effects of expressive suppression on stimulus consolidation. However, data from this test was not included in the current analyses due to the likely influence of practice effects and rehearsal on memory performance.

minimise floor or ceiling effects with the content of the questions. Example questions included “what was the name of the women’s friend?” and “how many people were the targets of the prank?”. This provided reminder cues to participant’s memory retrieval processes, however, required accurate recall of exact detail. A scoring grid was developed (see Appendix E.11), involving up to two points for accurate answers per question, with a maximum of 12 points to be obtained for each film. Total scores for each film were then related back to the respective watch or expressive suppression instruction conditions.

5.3. Results

Emotional Expression as Indexed by EMG

Preliminary analyses. Low- and high-intensity amusing and sad films were first checked for correctly associated increases in *zygomaticus* or *corrugator* muscle activity during the watch condition (Dan-Glauser & Gross, 2011), which was confirmed with paired sample t tests. For the low-intensity films, increased *zygomaticus* activity was greater when viewing amusing (M = 244.01, SD = 424.12) than sad films (M = 1.69, SD = 47.88), $t(79)$ = 5.09, $p < .001$, d = 0.80, and increased *corrugator* activity was greater when viewing sad (M = 45.64, SD = 60.77) than amusing films (M = 21.36, SD = 74.02), $t(79)$ = 2.48, p = .015, d = 0.36. For the high-intensity films, increased *zygomaticus* activity was greater when viewing amusing (M = 524.05, SD = 688.35) than sad films (M = -2.31, SD = 44.58), $t(79)$ = 6.84, $p < .001$, d = 1.08, and increased *corrugator* activity was greater when viewing sad (M = 96.72, SD = 93.37) than amusing films (M = 13.56, SD = 69.24), $t(79)$ = 6.60, $p < .001$, d = 1.01.

Additionally, baseline scores during the watch condition were checked for any age differences that could interfere with the calculation of percentage muscle change. For *zygomaticus* activity, there were age differences in baseline scores for the watch condition in happy films (young: M = 0.16, SD = 0.12; older: M = 0.24, SD = 0.12), $t(78)$ = 2.99, p =

.004, *d* = 0.67, in low-intensity amusing films (young: *M* = 0.15, *SD* = 0.10; older: *M* = 0.21, *SD* = 0.12), *t*(78) = 2.18, *p* = .032, *d* = 0.54, and in high-intensity amusing films (young: *M* = 0.12, *SD* = 0.07; older: *M* = 0.25, *SD* = 0.18), *t*(78) = 4.06, *p* < .001, *d* = 0.95. For *corrugator* activity, there were no age differences in baseline scores for the watch condition in low-intensity sad films (young: *M* = 0.38, *SD* = 0.28; older: *M* = 0.33, *SD* = 0.17), *t*(78) = 0.99, *p* = .325, *d* = 0.22, or in high-intensity sad films (young: *M* = 0.32, *SD* = 0.25; older: *M* = 0.33, *SD* = 0.19), *t*(78) = 0.21, *p* = .831, *d* = 0.05. In summary, caution should be applied when interpreting age differences in the intensity of *zygomaticus* activation for amusing stimuli, but not for *corrugator* activity for sad stimuli.

Analyses of facial expression. Facial responses to amusing and sad films were analysed separately using changes in respective *zygomaticus* and *corrugator* EMG activity. This set of analysis was designed to determine whether both age groups were successful in using expressive suppression to inhibit their facial expression to dynamic stimuli of varying levels of emotionally intensity. Analyses where assumptions of sphericity were violated, Greenhouse-Geisser corrected values were reported.

Amusement. For amusing films, activity in the *zygomaticus* muscle region was analysed with a 2 x 2 x 3 mixed analysis of variance (ANOVA). The between-subjects variable was age group (young, older) and the within-subject variables were instruction (watch, expressive suppression) and intensity (happiness, low amusement, high amusement). The dependent variable was percentage change in *zygomaticus* muscle activity from baseline, representing positive facial expression. There was a main effect of age group, $F(1, 78) = 12.58$, $p = .001$, $\eta_p^2 = .14$, instruction, $F(1, 78) = 13.75$, $p < .001$, $\eta_p^2 = .15$, and intensity, $F(1.53, 119.06) = 39.10$, $p < .001$, $\eta_p^2 = .33$. There was also interactions for Age Group x Instruction, $F(1, 78) = 4.17$, $p = .044$, $\eta_p^2 = .05$, Age Group x Intensity, $F(1.53, 119.06) = 7.12$, $p = .003$, $\eta_p^2 = .08$, Instruction x Intensity, $F(2, 156) = 7.20$, $p = .001$, $\eta_p^2 = .09$, and Age Group x Instruction x Intensity, $F(2, 156) = 3.22$, $p = .042$, $\eta_p^2 = .04$.

The three-way interaction overrides all other two-way interactions and main effects, and is shown in Figure 5.1. Deconstructing the Age Group x Instruction x Intensity interaction for age group effects, revealed that during the watch condition young adults produced greater *zygomaticus* activity than older adults in response to low-intensity amusing films ($p < .002$, $d = .72$), and high-intensity amusing films ($p = .003$, $d = .68$), but no age differences for happy films ($p = .567$, $d = .13$). Regarding regulation effects, for young adults, there was lower *zygomaticus* activity during the expressive suppression than the watch condition for happy films ($p = .020$, $d = .56$) and high-intensity amusing films ($p = .002$, $d = .67$), but not low-intensity amusing films ($p = .161$, $d = .33$). For older adults, there was lower *zygomaticus* activity during the expressive suppression than the watch condition for high-intensity amusing films ($p = .018$, $d = .38$), and a trend for happy films ($p = .063$, $d = .40$), but not low-intensity amusing films ($p = .168$, $d = .28$). Regarding intensity effects during the watch condition, for young adults there was greater *zygomaticus* activity during the high-intensity amusing films than low-intensity amusing films ($p < .001$, $d = 0.34$) and happy films ($p < .001$, $d = 0.90$), and greater activity during the low-intensity amusing films than the happy films ($p < .001$, $d = 0.70$). Regarding intensity effects during the watch condition, for older adults there was greater *zygomaticus* activity during the high-intensity amusing films than low-intensity amusing films ($p = .005$, $d = 0.67$) and happy films ($p = .003$, $d = 0.30$), but no difference between the low-intensity amusing films than the happy films ($p = .305$, $d = 0.30$).

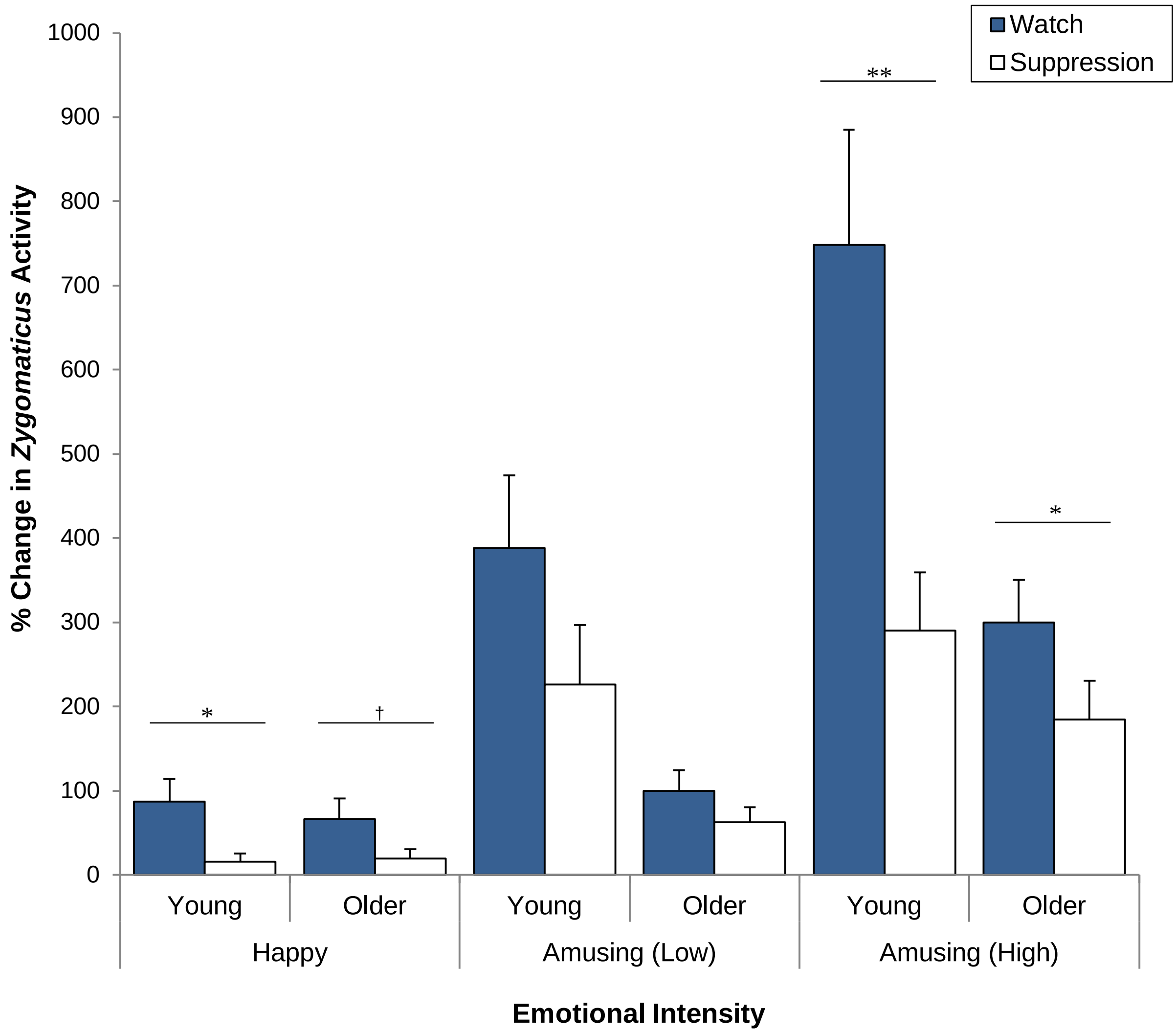

Figure 5.1. Change in *zygomaticus* activity from baseline when viewing amusing films at low and high emotional intensity, and of happy films. A higher percentage increase in activity indicates greater muscle use. Expressive suppression required participants to inhibit their emotional facial responses. Error bars indicate standard errors. Brackets indicate differences between instruction conditions for young and older adults.
$*p < .05$. $**p < .01$. $^{\dagger}p = .063$.

Additionally, one-sample *t* tests were conducted comparing the emotion regulation condition to baseline to determine whether the use of expressive suppression could return the percentage change in *zygomaticus* facial muscle activity back to baseline levels (i.e., a neutral facial expression). As shown in Table 5.4, the one-sample *t* test analysed whether a statistically significant difference existed between the percetange change in *zygomaticus* activity from a baseline score of 0 and an expressive suppression mean score (i.e., testing if facial activity mean scores differed from zero). For happy films, young and older adults' mean percentage change in *zygomaticus* activity during the expressive suppression condition was not significantly different to baseline, suggesting emotion regulation was effective in reducing smile responses to a neutral facial expression. However, for amusing films of low- and high-intensity, young and older adults' mean percentage change in *zygomaticus* activity during the expressive suppression condition were significantly different from baseline, indicating emotion regulation efforts did not return smile and laughter responses to a neutral facial expression.

Table 5.4

Differences between a Baseline Score of 0 and an Expressive Suppression Mean Score for the Percentage change in Zygomaticus Activity, as a Function of Age Group and Intensity

	Expressive Suppression		One Sample t test[a] (df = 39)		
Intensity	M	SD	t	p	d[b]
Young Adults					
Happiness	15.74	62.67	1.59	.120	0.25
Amusement (low)	226.50	443.07	3.23	.002	0.51
Amusement (high)	289.80	437.80	4.19	<.001	0.66
Older Adults					
Happy	19.53	71.14	1.74	.090	0.27
Amusement (low)	62.48	113.69	3.48	.001	0.55
Amusement (high)	184.26	291.78	3.99	.001	0.63

Note. Mean scores refer to percentage change in *zygomaticus* 'cheek' EMG activity from baseline.
[a]One-sample t test applied to determine if mean scores in facial activity differed from zero. [b]Cohen's d = effect size.

Sadness. For sad films, activity in the *corrugator* muscle region was analysed with a 2 x 2 x 2 mixed ANOVA. The between-subjects variable was age group (young, older) and the within-subject variables were instruction (watch, expressive suppression) and intensity (low sadness, high sadness). The dependent variable was percentage change in *corrugator* muscle activity from baseline, representing sad facial expression. There was a main effect of age group, $F(1, 78) = 15.17$, $p < .001$, $\eta_p^2 = .16$, instruction, $F(1, 78) = 14.27$, $p < .001$, $\eta_p^2 = .16$, and intensity, $F(1, 78) = 22.35$, $p < .001$, $\eta_p^2 = .22$. There was also interactions for Age Group x Instruction, $F(1, 78) = 5.88$, $p = .018$, $\eta_p^2 = .07$, Age Group x Intensity, $F(1, 78) = 6.84$, $p = .011$, $\eta_p^2 = .08$, and Instruction x Intensity, $F(1, 78) = 12.16$, $p = .001$, $\eta_p^2 = .14$. There was no Age Group x Instruction x Intensity interaction, $F(1, 78) = 0.08$, $p = .774$, $\eta_p^2 < .01$.

The Age Group x Instruction interaction is shown in Figure 5.2 and this is the interaction of primary interest as it shows that the young adults, but not older adults, reduced their *corrugator* activity during expressive suppression compared to the watch condition. This was confirmed with a simple main effect of instruction for young adults, $F(1, 78) = 19.24$, $p < .001$, $\eta_p^2 = .20$, with lower *corrugator* activity during expressive suppression than the watch condition. There was no simple main effect of instruction for older adults, $F(1, 78) = 0.91$, $p = .342$, $\eta_p^2 = .01$. Further tests revealed a simple main effect of age group for the watch condition, $F(1, 78) = 19.46$, $p < .001$, $\eta_p^2 = .20$, and expressive suppression, $F(1, 78) = 5.72$, $p = .019$, $\eta_p^2 = .07$, with young adults demonstrating greater *corrugator* activity than older adults in both conditions.

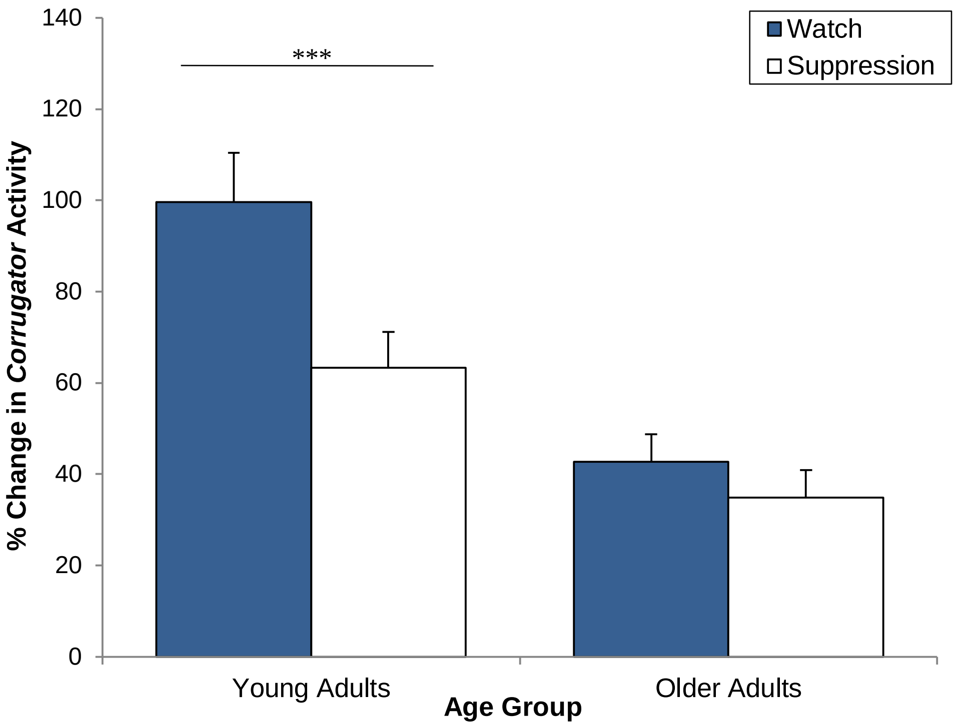

Figure 5.2. Age Group x Instruction interaction illustrating the change in *corrugator* activity from baseline when viewing sad films. A higher percentage increase in activity indicates greater muscle use. Expressive suppression required participants to inhibit their emotional facial responses. Error bars indicate standard errors. Brackets indicate differences between instruction conditions for young and older adults.
***$p < .001$.

The Age Group x Intensity interaction is shown in Figure 5.3 and tests of simple effects revealed a simple main effect of age group for low-intensity sad films, $F(1, 78) = 4.93$, $p = .029$, $\eta_p^2 = .06$, and high-intensity sad films, $F(1, 78) = 18.04$, $p < .001$, $\eta_p^2 = .19$, with young adults demonstrating greater *corrugator* activity than older adults in both conditions. A further test of simple effects revealed a simple main effect of intensity for young adults, $F(1, 78) = 26.95$, $p < .001$, $\eta_p^2 = .26$, with greater *corrugator* activity during the high-intensity than low-intensity sad films. There was no simple main effect of intensity for older adults, $F(1, 78) = 2.23$, $p = .139$, $\eta_p^2 = .03$.

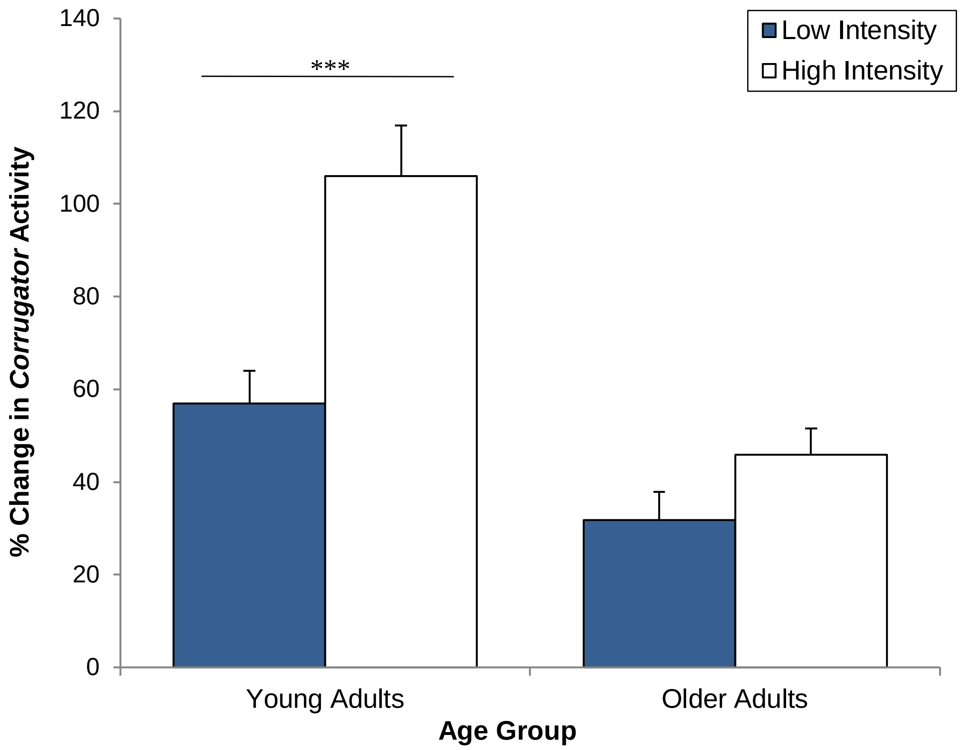

Figure 5.3. Age Group x Intensity interaction illustrating change in *corrugator* activity from baseline when viewing sad films at low and high levels of emotional intensity. A higher percentage increase in activity indicates greater muscle use. Error bars indicate standard errors. Brackets indicate differences between intensity conditions for young and older adults. ***$p < .001$.

The Instruction x Intensity interaction is shown in Figure 5.4 and was followed up with tests of simple effects, but was of secondary interest to the interactions involving age group. There was a simple main effect of instruction for high-intensity sad films, $F(1, 78) = 20.62$, $p < .001$, $\eta_p^2 = .21$, with participants demonstrating lower *corrugator* activity in the expressive suppression compared with the watch condition. There was no simple main effect of instruction for low-intensity sad films, $F(1, 78) = 0.14$, $p = .709$, $\eta_p^2 < .01$. A further test of simple effects revealed a simple main effect of intensity for the watch condition, $F(1, 78) = 25.58$, $p < .001$, $\eta_p^2 = .25$, with greater *corrugator* activity during the high-intensity than low-intensity sad films. There was no simple main effect of intensity for the expressive suppression condition, $F(1, 78) = 2.93$, $p = .091$, $\eta_p^2 = .04$.

Figure 5.4. Instruction x Intensity interaction illustrating change in *corrugator* activity from baseline when viewing sad films at low and high levels of emotional intensity. A higher percentage increase in activity indicates greater muscle use. Expressive suppression required participants to inhibit their facial responses. Error bars indicate standard errors. Brackets indicate differences between instruction conditions for low and high intensity levels. ***$p < .001$.

Additionally, one-sample *t* tests were conducted comparing the emotion regulation condition to baseline to determine whether the use of expressive suppression could return the percentage change in *corrugator* facial muscle activity back to baseline levels (i.e., a neutral facial expression). As shown in Table 5.5, the one-sample *t* test analysed whether a statistically significant difference existed between the percetange change in *corrugator* activity from a baseline score of 0 and an expressive suppression mean score (i.e., testing if facial activity mean scores differed from zero). For sad films of low- and high-intensity, young and older adults' mean percentage change in *corrugator* activity during the expressive suppression condition were significantly different from baseline, indicating that emotion regulation efforts did not return frown responses to a neutral facial expression.

Table 5.5

Differences between a Baseline Score of 0 and an Expressive Suppression Mean Score for the Percentage change in Corrugator Activity, as a Function of Age Group and Intensity

	Expressive Suppression		One Sample *t* test[a] (df = 39)		
Intensity	*M*	*SD*	*t*	*p*	*d*[b]
Young Adults					
Sadness (low)	49.40	58.92	5.30	<.001	0.84
Sadness (high)	77.34	76.89	6.36	<.001	1.01
Older Adults					
Sadness (low)	36.75	62.03	3.75	.001	0.59
Sadness (high)	32.97	46.18	4.52	<.001	0.71

Note. Mean scores refer to percentage change in *corrugator* 'brow' EMG activity from baseline.
[a]One-sample *t* test applied to determine if mean scores in facial activity differed from zero. [b]Cohen's *d* = effect size.

Summary of EMG data. Young and older adults demonstrated emotional facial muscle reactivity when viewing happy, amusing, and sad films. Under expressive suppression compared to watch instructions, young adults were able to reduce *zygomaticus* activity during happy and high-intensity amusing films, and reduce *corrugator* activity during high-intensity sad films. Under expressive suppression compared to watch instructions, older adults were able to reduce *zygomaticus* activity during high-intensity amusing films, but older adults could not reduce *corrugator* activity during sad films. However, participants' use of expressive suppression did not return *zygomaticus* or *corrugator* facial muscle activity back to baseline levels during amusing and sad films, and continued to demonstrate muscle activity, albeit lower levels compared to the watch condition.

During the watch condition, young adults responded with greater facial reactivity when viewing amusing and sad films of low- and high-intensity than older adults. Thus, relative to young, older adults had less facial muscle activity to regulate at both levels of emotionally intensive amusing and sad films. There were, however, no age differences in muscle activity when viewing happy films.

Furthermore, young and older adults produced greater *zygomaticus* activity during high- compared to low-intensity amusing films and happy films, however, only young adults demonstrated greater activity in the low-intensity amusing than happy films. Young adults produced greater *corrugator* activity in high- compared with low-intensity sad films, however, there were no differences between intensity conditions for older adults.

Physiological Arousal as Indexed by SCL

Preliminary analyses. Change in skin conductance was calculated by the increase in SCL from baseline scores when responding to neutral films, with SCL scores when responding to emotional films. Baseline SCL scores during neutral films were checked for any age differences that could interfere with calculating the change in skin conductance. For the *Knitting* neutral film (acting as baseline for amusing films), older adults (M = 0.01, SD < 0.01) produced greater SCL scores than young adults (M = 0.009, SD < 0.01), $t(78) = 2.36$, $p = .021$, $d = 0.10$, however, the effect size suggested a relative small statistical difference (Cohen, 1988, defines effect sizes near 0.2 as small). For the *Mountain Goats* neutral film (acting as baseline for sad films), there were no age differences in SCL scores (young adults:

M = 0.01, *SD* < 0.01; older adults, *M* = 0.01, *SD* < 0.01), *t*(78) = 1.00, *p* = .320, *d* < 0.01. Additionally, no differences in SCL scores were found between responses to the *Knitting* film (*M* = 0.01, *SD* < 0.01) and the *Mountain Goats* film (*M* = 0.01, *SD* < 0.01), *t*(79) = 1.65, *p* = .103, *d* < 0.01.

Analyses of skin conductance. Skin conductance responses to amusing and sad films were analysed separately. This analysis was designed to determine whether both age groups were able to reduce physiological arousal when regulating emotional responses to stimuli of varying emotional intensities.

Amusement. For amusing films, SCL was analysed with a 2 (Age Group; young, older) x 2 (Instruction; watch, expressive suppression) x 3 (Intensity; happiness, low amusement, high amusement). The dependent variable was change in μS from baseline, representing physiological activation. There was a main effect of age group, *F*(1, 78) = 22.72, *p* < .001, η_p^2 = .23, with young adults (*M* = 0.19, *SD* = 0.19) producing greater SCL than older adults (*M* = 0.07, *SD* = 0.09). There was a main effect of intensity, *F*(1.53, 119.06) = 39.10, *p* < .001, η_p^2 = .33, with high-intensity amusing films (*M* = 0.18, *SD* = 0.19) producing greater SCL than low-intensity amusing films (*M* = 0.11, *SD* = 0.12, *d* = 0.44) and happy films (*M* = 0.11, *SD* = 0.15, *d* = 0.41). There were no differences between low-intensity amusing and happy films. There was no main effect of instruction, *F*(1, 78) = 0.19, *p* = .662, η_p^2 < .01, or interactions for Age Group x Instruction, *F*(1, 78) = 1.76, *p* = .189, η_p^2 = .02, Age Group x Intensity, *F*(1.79, 139.45) = 2.05, *p* = .138, η_p^2 = .03, Instruction x Intensity, *F*(1.86, 144.66) = 0.132, *p* = .861, η_p^2 < .01, or Age Group x Instruction x Intensity, *F*(1.86, 144.66) = 0.01, *p* = .992, η_p^2 < .01.

Sadness. For sad films, SCL was analysed with a 2 (Age Group; young, older) x 2 (Instruction; watch, expressive suppression) x 2 (Intensity; low sadness, high sadness) mixed ANOVA. The dependent variable was change in μS from baseline, representing physiological activation. There was a main effect of age group, *F*(1, 78) = 17.95, *p* < .001,

$\eta_p^2 = .19$, with young adults ($M = 0.14$, $SD = 0.16$) producing greater SCL than older adults ($M = 0.05$, $SD = 0.07$). There was no main effect of instruction, $F(1, 78) = 1.57$, $p = .213$, $\eta_p^2 = .02$, or intensity, $F(1, 78) = 2.01$, $p = .161$, $\eta_p^2 = .03$, and no interactions for Age Group x Instruction, $F(1, 78) = 2.05$, $p = .156$, $\eta_p^2 = .03$, Age Group x Intensity, $F(1, 78) = 1.60$, $p = .209$, $\eta_p^2 = .02$, Instruction x Intensity, $F(1, 78) = 0.01$, $p = .955$, $\eta_p^2 < .01$, or Age Group x Instruction x Intensity, $F(1, 78) = 0.38$, $p = .537$, $\eta_p^2 = .01$.

Summary of SCL data. Young and older adults responded with greater levels of skin conductance whilst viewing amusing, happy, and sad films, when compared with responses to neutral films. Compared to watching films naturally, there were no changes in SCL scores when instructed to regulate expression to low and high emotionally intense stimuli. Additionally, in both low and high intensive stimuli, compared with young, older adults responded with significantly lower skin conductance activity. Thus, relative to young, older adults had less physiological arousal in response to emotional films.

Self-Reported Emotional Experience

Preliminary analyses. Checks of emotion ratings were first conducted on low- and high-intensity films. For the low-intensity watch conditions, amusing films were rated as evoking greater feelings of amusement ($M = 5.54$, $SD = 2.07$) than sadness ($M = 1.41$, $SD = 1.33$), $t(79) = 13.80$, $p < .001$, $d = 2.37$, and sad films were rated as evoking greater feelings of sadness ($M = 5.25$, $SD = 2.21$) than amusement ($M = 2.45$, $SD = 1.90$), $t(79) = 7.94$, $p < .001$, $d = 1.36$. For the high-intensity watch conditions, amusing films were rated as evoking greater feelings of amusement ($M = 7.38$, $SD = 1.59$) than sadness ($M = 1.20$, $SD = 0.75$), $t(79) = 27.64$, $p < .001$, $d = 4.97$, and sad films were rated as evoking greater feelings of sadness ($M = 6.75$, $SD = 2.25$) than amusement ($M = 1.64$, $SD = 1.32$), $t(79) = 16.32$, $p < .001$, $d = 2.77$. For the happy watch condition, happy films were rated as evoking greater feelings of amusement (M = 5.54, SD = 2.09) than sadness (M = 1.73, SD = 1.58), $t(79)$ = 13.34, p < .001, d = 2.06.

Analyses of self-reported emotion. Emotional experience to amusing and sad films was analysed separately using ratings on respective amusement and sadness self-report scales. The analysis was designed to determine whether both age groups were successful in using expressive suppression to reduce their emotional experience to varying levels of emotionally intensive stimuli.

Amusement. For amusing films, subjective experience of amusement was analysed with a 2 (Age Group; young, older) x 2 (Instruction; watch, expressive suppression) x 3 (Intensity; happiness, low amusement, high amusement) mixed ANOVA. The dependent variable was the self-reported emotional rating of amusement. There was no main effect of age group, $F(1, 78) = 0.15$, $p = .702$, $\eta_p^2 < .01$, or instruction, $F(1, 78) = 0.48$, $p = .492$, $\eta_p^2 = .01$, however, there was a main effect of intensity, $F(2, 156) = 41.31$, $p < .001$, $\eta_p^2 = .35$. There was an Age Group x Intensity interaction, $F(2, 156) = 30.52$, $p < .001$, $\eta_p^2 = .01$, but no interactions for Age Group x Instruction, $F(1, 78) = 2.78$, $p = .100$, $\eta_p^2 = .03$, Instruction x Intensity, $F(2, 156) = 0.73$, $p = .483$, $\eta_p^2 = .01$, or Age Group x Instruction x Intensity, $F(2, 156) = 0.59$, $p = .554$, $\eta_p^2 = .01$.

The Age Group x Intensity interaction is shown in Figure 5.5 and tests of simple effects revealed a simple main effect of age group for low-intensity films, $F(1, 78) = 4.99$, $p = .028$, $\eta_p^2 = .06$, with young adults rating greater feelings of amusement than older adults. There was a simple main effect of age group for high-intensity films, $F(1, 78) = 6.09$, $p = .016$, $\eta_p^2 = .07$, with older adults rating greater feelings of amusement than young adults. There were no age group differences for happy films, $F(1, 78) = 0.33$, $p = .567$, $\eta_p^2 < .01$. A further test of simple effects revealed a simple main effect of intensity for young adults, $F(2, 77) = 8.68$, $p < .001$, $\eta_p^2 = .18$, with post hoc analyses revealing greater amusement ratings for high-intensity than low-intensity amusing (p = .005, d = 0.43) and happy films (p < .001, *d* = 0.61). Ratings on low-intensity amusing and happy films did not differ (p = .266, d = 0.20). There was also a simple main effect of intensity for older adults, $F(2, 77) = 52.05$, $p < .001$, $\eta_p^2 = .58$, with post hoc analyses revealing greater amusement ratings for high-intensity than low-intensity amusing ($p < .001$, d = 1.23) and happy films ($p < .001$, d = 1.11). Ratings on low-intensity amusing and happy films did not differ (p = .283, d = 0.15).

Sadness. For sad films, subjective experience of sadness was analysed with a 2 (Age Group; young, older) x 2 (Instruction; watch, expressive suppression) x 2 (Intensity; low sadness, high sadness) mixed ANOVA. The dependent variable was the self-reported emotional rating of sadness. There was a main effect of age group, $F(1, 78) = 15.51$, $p < .001$, $\eta_p^2 = .17$, with older adults (M = 6.83, SD = 2.10) rating greater feelings of sadness than young adults (M = 5.38, SD = 2.28). There was a main effect of intensity, $F(1, 78) = 62.34$, $p < .001$, $\eta_p^2 = .44$, with high-intensity films (M = 6.87, SD = 2.15) receiving a greater rating of sadness than low-intensity films (M = 5.34, SD = 2.21). There was no main effect of instruction, $F(1, 78) = 2.24$, $p = .139$, $\eta_p^2 = .03$, and no interactions for Age Group x Instruction, $F(1, 78) = 0.10$, $p = .752$, $\eta_p^2 < .01$, Age Group x Intensity, $F(1, 78) = 0.65$, $p = .423$, $\eta_p^2 = .01$, Instruction x Intensity, $F(1, 78) = 0.05$, $p = .829$, $\eta_p^2 < .01$, or Age Group x Instruction x Intensity, $F(1, 78) = 1.81$, $p = .182$, $\eta_p^2 = .02$.

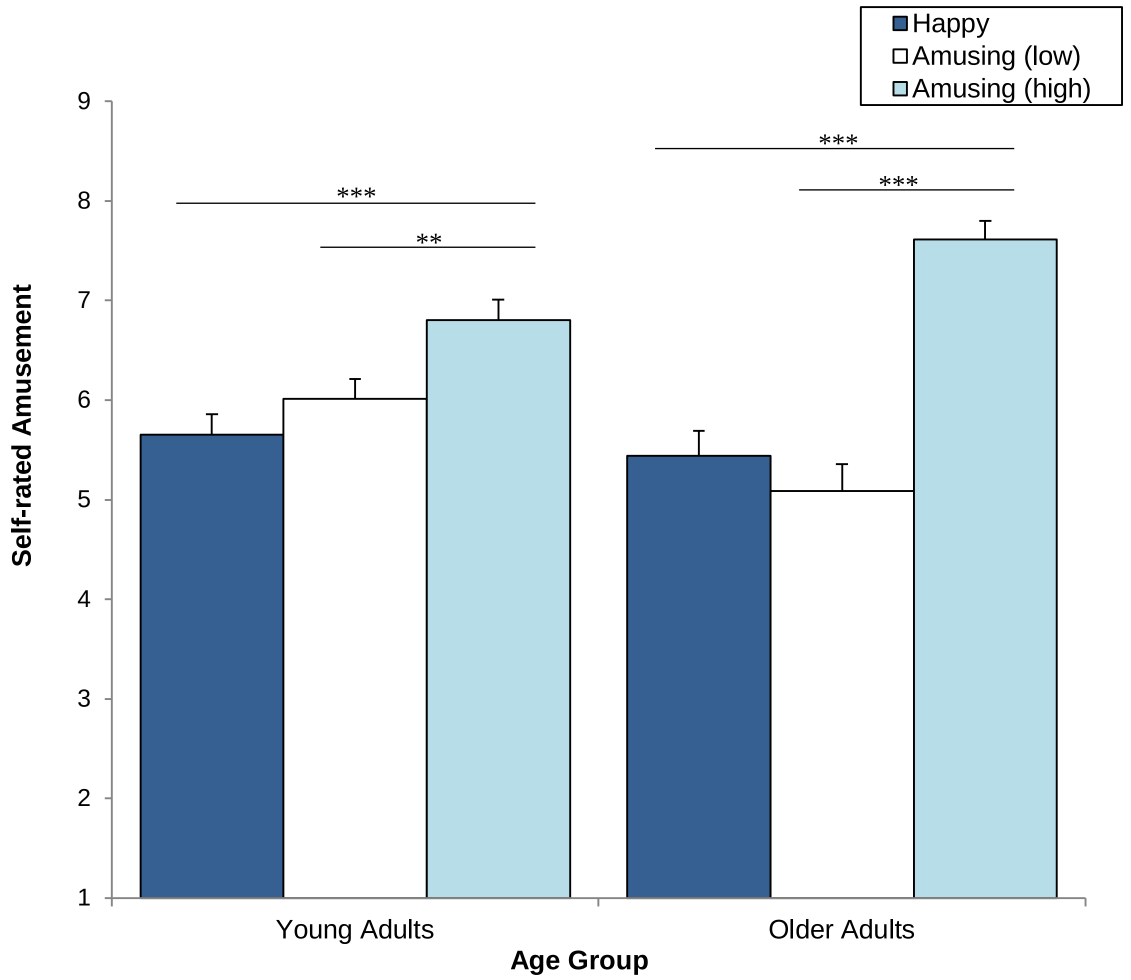

Figure 5.5. Age Group x Intensity interaction illustrating mean scores of self-reported amusement for happy and amusing (low, high-intensity) films. A higher rating indicates an "extremely amusing" subjective experience, whereas, a lower rating indicates "not at all amusing". Error bars indicate standard errors. Brackets indicate differences between intensity conditions for young and older adults.
**p < .01. ***p < .001.

Summary of self-report data. Compared with watching naturally, the use of expressive suppression did not change participants' subjective feelings of amusement or sadness, with participants continuing to feel just as amused or sad when told to regulate. In response to amusing films, both age groups rated high-intensity films with greater amusement than low-intensity and happy films. For low intensive films only, young adults rated greater amusement than older adults, whereas, for high intensive films only, older adult rated greater amusement than young adults. In response to sad films, older adults rated greater feelings of sadness than young adults, and high-intensity films were rated with greater sadness than low-intensity films.

Impact of Emotion Regulation on Memory Performance

Analysis of memory recall. Memory performances for amusing and sad conditions are analysed separately with the correctly recalled information of respective amusement and sadness films. The analysis was designed to determine whether the use of expressive suppression leads to changes in memory recall for varying levels of emotionally intensive stimuli.

Amusement. Memory performance of amusing films was analysed with a 2 (Age Group; young, older) x 2 (Instruction; watch, expressive suppression) x 3 (Intensity; happiness, low amusement, high amusement) mixed ANOVA. The dependent variable was the percentage of film information correctly recalled. There was a main effect of age group, $F(1, 78) = 28.15$, $p < .001$, $\eta_p^2 = .27$, and intensity, $F(2, 156) = 28.84$, $p < .001$, $\eta_p^2 = .27$, but no main effect of instruction, $F(1, 78) = 0.65$, $p = .424$, $\eta_p^2 = .01$. There was an Age Group x Intensity interaction, $F(2, 156) = 9.21$, $p < .001$, $\eta_p^2 = .11$, but no interactions Age Group x Instruction, $F(1, 78) = 0.01$, $p = .936$, $\eta_p^2 < .01$, Instruction x Intensity, $F(2, 156) = 0.42$, $p = .661$, $\eta_p^2 = .01$, or Age Group x Instruction x Intensity, $F(2, 156) = 1.93$, $p = .149$, $\eta_p^2 = .02$.

The Age Group x Intensity interaction is shown in Figure 5.6 and tests of simple effects revealed a simple main effect of age group for happy films, $F(1, 78) = 38.42$, $p < .001$, $\eta_p^2 = .33$, and low-intensity, $F(1, 78) = 13.59$, $p < .001$, $\eta_p^2 = .15$, with young adults recalling a greater percentage of film information for each level of intensity than older adults. There was no simple main effect of age group for high-intensity films, $F(1, 78) =$

3.87, $p = .053$, $\eta_p^2 = .05$. A further test of simple effects revealed a simple main effect of intensity for older adults, $F(2, 77) = 29.50$, $p < .001$, $\eta_p^2 = .43$, with post hoc analyses revealing greater recall from the high-intensity than low-intensity ($p = .002$, $d = 0.42$) and happy films ($p < .001$, $d = 1.14$). There was also greater recall from the low-intensity than happy films ($p < .001$, $d = 0.75$). There was no simple main effect of intensity for young adults, $F(2, 77) = 2.28$, $p = .109$, $\eta_p^2 = .06$.

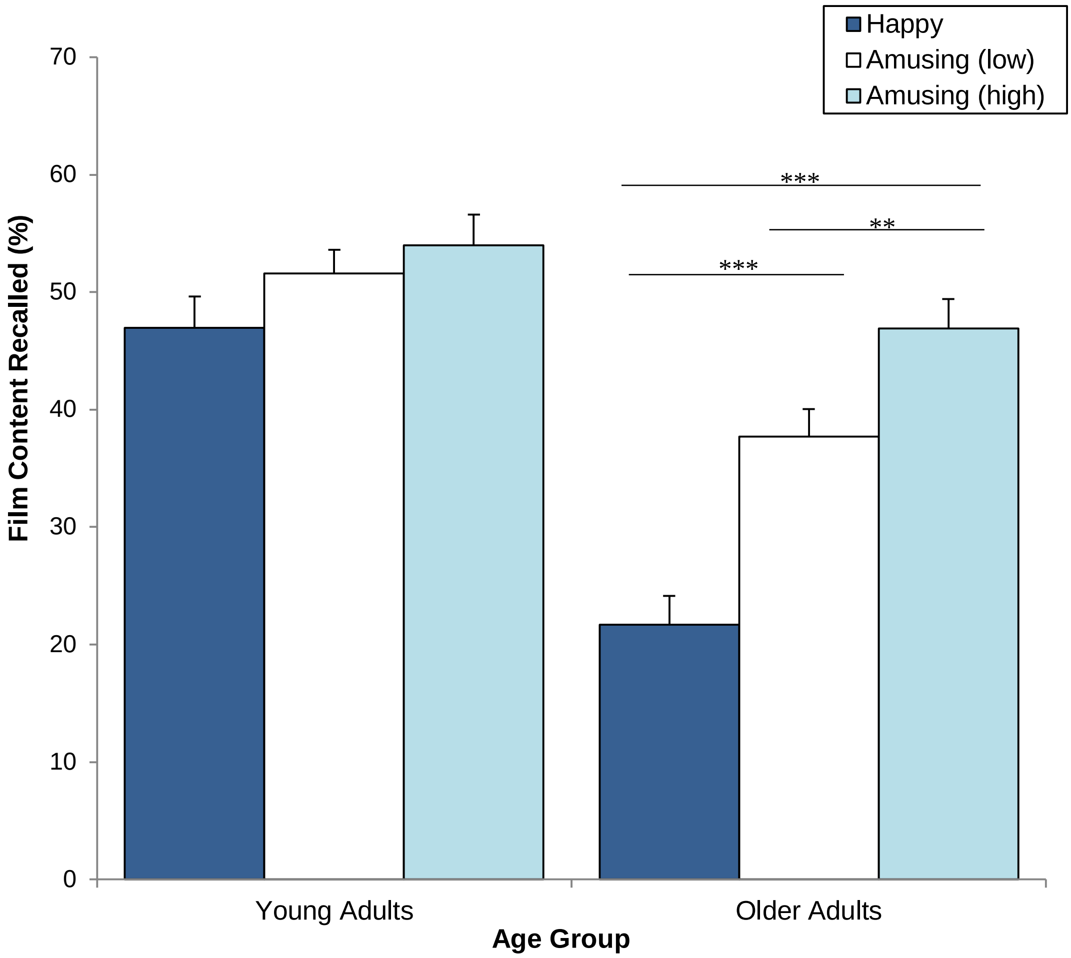

Figure 5.6. Age Group x Intensity interaction illustrating the percentage of content accurately recalled from happy and amusing (low, high-intensity) films. Error bars indicate standard errors. Brackets indicate differences between intensity conditions for young and older adults.

***p* < .01. ****p* < .001.

Sadness. Memory performance of sad films was analysed with a 2 (Age Group; young, older) x 2 (Instruction; watch, expressive suppression) x 2 (Intensity; low sadness, high sadness) mixed ANOVA. The dependent variable was the percentage of film information correctly recalled. There was a main effect of age group, $F(1, 78) = 12.25$, $p = .001$, $\eta_p^2 = .14$, with young adults ($M = 48.75$, $SD = 18.41$) recalling a greater percentage of film information than older adults ($M = 39.95$, $SD = 19.02$). There was a main effect of intensity, $F(1, 78) = 24.06$, $p < .001$, $\eta_p^2 = .24$, with a greater percentage of film information correctly recalled from the high-intensity sad films ($M = 47.87$, $SD = 17.29$) than the low-intensity sad films ($M = 40.83$, $SD = 20.40$). There was no main effect of instruction, $F(1, 78) = 2.14$, $p = .148$, $\eta_p^2 = .03$, and no interactions for Age Group x Instruction, $F(1, 78) = 0.27$, $p = .604$, $\eta_p^2 < .01$, Age Group x Intensity, $F(1, 78) = 0.07$, $p = .800$, $\eta_p^2 < .01$, Instruction x Intensity, $F(1, 78) < 0.01$, $p = .980$, $\eta_p^2 < .01$, or Age Group x Instruction x Intensity, $F(1, 78) = 0.05$, $p = .822$, $\eta_p^2 < .01$.

Summary of recall across instruction conditions. For both age groups there were no differences between instruction conditions for the percentage of film information correctly recalled. The lack of main or interaction effects for instruction indicates there was also no memory costs for young or older adults in using expressive suppression as an emotion regulation strategy for amusing or sad stimuli. However, for older adults there were recall differences between low and high emotional intensive stimuli, with greater recall when viewing amusing and sad films of high emotional intensity, compared with when viewing films of low emotional intensity. Young adults also recalled a greater percentage of information from amusing and sad films than did older adults.

5.4. Discussion

The current study provided further research into the prediction outlined in Study 1 (and arising from the data of the experiment reported in Study 1) that older adults' lower emotional reactivity may contribute to maintained emotion regulation capacity in later life. That is, older adults may require less effort and fewer cognitive resources than young adults to regulate facial expressions of emotion due to age-related biological changes that lessen autonomic responses and lower the levels of emotional reactivity. To determine whether age differences in facial expressivity are implicated in this effect, young and older adults were instructed to regulate their overt facial responses (using expressive suppression) whilst viewing dynamic stimuli of varying intensities. Dynamic integration theory (Labouvie-Vief, 2008) stipulates that older adults' emotion regulation ability might become overwhelmed and less effective with heightened emotional arousal placing increase demands on the limited cognitive resources with ageing. Thus, the primary aim of the current study was to investigate whether older adults were able to effectively regulate their facial expressions of emotion to dynamic stimuli consisting of amusing and sad films of varying emotional intensities. Age differences in emotion reactivity (EMG and SCL) were first confirmed before examining age differences in the effectiveness of emotion regulation (including the impact of regulation efforts on memory performance to index cognitive load).

Emotion Regulation and Ageing

Emotion regulation capacity was investigated by comparing young and older adults' ability to reduce *zygomaticus* and *corrugator* EMG facial muscle responses during the expressive suppression condition compared with the watch condition. It was anticipated that the emotionally evocative dynamic stimuli (beyond the low arousing pictures used in Study 1) may lead to increased pressure on cognitive-affective systems and subsequently reduce emotion regulation success, particularly for older adults who avoid highly arousing positive and negative emotional states (Labouvie-Vief et al., 2014; Scheibe et al., 2013). Furthermore, the current study confirmed the predication that across both age groups, higher intensity films would result in greater levels of EMG and SCL activity compared to lower intensity films during the watch condition. By confirming this, the effects of increased emotional reactivity on emotion regulation demands could be subsequently investigated.

Whilst it was predicted that both age groups could regulate their overt facial expressions to *low*-intensity amusing and sad films, this was not supported. Young and older participants were able to reduce their facial reactivity during the happy films, which was similar to the level of EMG activity evoked in responses to pictures in Study 1, but could not regulate low amusing films (and older adults were unable to regulate sad films). It is therefore possible that the effects of dynamic integration theory (Labouvie-Vief, 2008) were already evident for both age groups in response to emotional films.

As predicted, in response to *high*-intensity amusing and sad films, young adults were able to regulate their overt facial expressions by reducing smile and frown muscle activity (although not to baseline levels). Whilst older adults were able to regulate their emotional expressions by reducing smile muscle activity in response to high-intensity amusing films, they were unable to significantly reduce their frown muscle activity in response to sad films (regardless of intensity). This provides evidence that older adults may demonstrate greater difficulty in managing more intense and longer-lasting negative emotion, possibly due to biological systems becoming more inflexible with age (e.g., in line with SAVI; Charles, 2010; Charles & Luong, 2013). Indeed, compared with other negative emotions (e.g., fear and anger), older adults may be more affected by sad situations than young adults due to increased exposure to losses, such as in social networks and with physical health (Kunzmann & Grühn, 2005; Lohani & Isaacowitz, 2014). However, there is still relatively little known about the discrete emotion of sadness and the relationship between age and emotion regulation (Charles & Carstensen, 2008; Kunzmann & Grühn, 2005; Shallcross et al., 2013), with further examination required across different contexts (Skinner et al., 2014).

Across all amusing and sad films of low- and high-intensity conditions, both age groups were unable to reduce facial reactivity to baseline levels (i.e., neutral facial expressions). Whereas, when viewing happy films, which evoked similar percentage increase of *zygomaticus* EMG activity as positive static pictures in Study 1, both age groups were able to regulate their expressions back to baseline (which was similar to viewing static positive and negative pictures in Study 1). Therefore, it is possible that Labouvie-Vief's (2008) dynamic integration theory is relevant to both young and older adults when faced with situations that elicit heightened emotional and physiological arousal. That is, when participants viewed dynamic films with longer-lasting scenes and of increased relevance, that emotion regulation becomes more challenging resulting in greater demands on resources. This is particularly crucial for older adults, given the age-related declines in cognitive functioning (Hedden & Gabrieli, 2004), thereby limiting the dependability of executive functions (e.g., cognitive control; Kryla-Lighthall & Mather, 2008) that are essential for effortful emotion regulation.

The current study demonstrated the sensitive nature of EMG techniques that allows for the objective recording of subtle changes in facial muscle activity (Tassinary et al., 2007). Traditional techniques, such as behavioural observations of facial coding (Ekman & Friesen, 1978), are prone to observer error and increased difficulty in recognising expressions that may not be overtly visible (Lee, Shackman, Jackson, & Davidson, 2009). Furthermore, as suggested by Phillips et al. (2008), due to changes in appearances of older adults faces (e.g., increased wrinkles), independent coders may exhibit age-related biases and difficulty in accurately interpreting older adults subtle facial displays of emotion (Lohani & Isaacowitz, 2014). Thus, the EMG approach used in the current study overcomes such limitations by increasing the accuracy to detect subtle changes to facial expressions and also provide a reliable measure of emotion regulation that is stable over time (Cohn & Ekman, 2005; Lee et al., 2009).

The expectation that expressive suppression would not alter physiological arousal (indexed by SCL) or subjective experience (indexed by self-report) was supported. That is, the implementation of expressive suppression, compared with the watch condition, did not change physiological responses or subjective accounts of emotion for young or older adults. The explanation for this is related to the late timing of expressive suppression during the emotion generation process, where internal emotional experiences have already been activated (Gross, 1998a; Gross & Levenson, 1997). The lack of regulation effects is consistent with prior research examining the consequences of expressive suppression on physiological arousal (Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Robinson & Demaree, 2009) and subjective experiences (Korb, Grandjean, Samson, Delplanque, & Scherer, 2012; Kunzmann et al., 2005; Phillips et al., 2008), although there are mixed findings, with some studies demonstrating increased or decreased arousal and experience (see Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009). The current study is, however, limited to the use of a single autonomic measure of physiological arousal (i.e., electrodermal), thereby reducing the reliability of understanding the complete effects of expressive suppression on physiological reactivity. Further research that examines additional indices of the sympathetic nervous system, such as the use of cardiovascular and respiratory measures, may provide better understanding into emotion regulation and autonomic activity in young and older adults (Kreibig et al., 2007).

Emotion Reactivity and Ageing

To investigate age differences in emotional reactivity, participants' facial expressions and physiological arousal during the watch condition were recorded with objective facial EMG and SCL techniques, respectively. The prediction that older adults would respond with lower levels of facial muscle activity and physiological activity than young adults across all film intensity conditions was confirmed. This is consistent with the age-related biological changes that are thought to decrease emotional reactivity in later life, such as declines in the neural and autonomic responses to emotional events (Arking, 2006; Cacioppo et al., 1997; Mather et al., 2004).

Specifically for EMG activity, the findings revealed that older adults produced lower levels of *zygomaticus* (smiles and laughter) and *corrugator* (frowns) reactivity to low- and high-intensity films than young adults. These findings are consistent with Study 1, which found age-related reductions in smile and frown muscle EMG responses elicited by positive and negative static pictures (Pedder et al., 2016). The results are also consistent with previous research using EMG (D. P. Smith et al., 2005) and behavioural observation techniques (Carstensen et al., 1995; Kunzmann et al., 2005; Magai et al., 2006) showing reduced facial reactivity in ageing. Therefore, the current data provides support for the explanation that older adults naturally respond with lower emotional reactivity, which may partly contribute to emotion regulation being less difficult to achieve due to having less facial reactions to begin with.

As demonstrated with the current EMG findings, older adults produced lower levels of physiological arousal (SCL) than young adults in response to low- and high-intensity emotional films during the watch condition. This is consistent with previous research examining age differences in skin conductance (Gavazzeni et al., 2008; Lohani & Isaacowitz, 2014), and other psychophysiological procedures showing lower responses in older adults than in young adults (e.g., respiratory and cardiovascular measures; Levenson et al., 1991; Levenson et al., 1994; Tsai et al., 2000). Findings are also in line with the age-related declines in the autonomic nervous system and brain activity (e.g., amygdala) that lead to less emotional responsiveness and thereby reduced physiological activation with age (see summaries by Boucsein et al., 2012; D. P. Smith et al., 2005). Thus, the current findings contribute to the possible explanation that emotion regulation may be less effortful for older adults due to decreased emotion reactivity (according to facial and physiological responses), thereby potentially reducing the regulatory demands for implementing expressive suppression effectively.

Despite the findings of lower EMG and SCL responses in old age and the replication of previous findings (Lohani & Isaacowitz, 2014; D. P. Smith et al., 2005), some studies have demonstrated mixed findings of age differences in emotional reactivity according to measures of facial responses (Tsai et al., 2000) and physiological arousal (Seider et al., 2011). For example, previous research has shown that older adults produce equivalent autonomic reactivity if stimuli is of relevance and meaningful for that age group (Kunzmann & Grühn, 2005). Accordingly, the stimuli used in the current study were developed and piloted (via self-report methods) as effective in eliciting amusement, happiness, and sadness for both young and older adults. Therefore, the current findings of reduced emotional reactivity in older adults controls for the importance of using stimuli relevant for both age groups.

Age-related patterns in self-report ratings were mixed according to the type of emotion-eliciting film. It was anticipated that there would be no age differences in self-reported emotion during the watch condition, which was confirmed for happy films and consistent with previous self-report evidence (Emery & Hess, 2011; Tsai et al., 2000). However, low-intensity amusing films were rated higher for young than older adults, whereas high-intensity amusing films were rated higher for older than young adults. Across both intensity levels, sad films were rated with greater sadness for older than young adults, which is also consistent with previous research using film stimuli (Kliegel et al., 2007; Kunzmann & Grühn, 2005; Lohani & Isaacowitz, 2014; Seider et al., 2011). Indeed, sadness, an emotional state associated with loss, may be of greater significance in old age due to increases in personal losses within social, cognitive, physical, and occupational domains (Lohani & Isaacowitz, 2014) as suggested by life span development theorists (e.g., Carstensen et al., 1999).

Expressive Suppression and Memory

The current study also investigated whether expressive suppression impacted memory performance (i.e., accuracy in recall of film content) as an index of the cognitive demands required during emotion regulation (Morgan & Scheibe, 2014; Richards, 2004). For older adults, findings confirmed that regulation of emotional facial activity during the low-intensity emotional films did not impact memory performance, which is consistent with results from Study 1 (Pedder et al., 2016) and prior research (Emery & Hess, 2011; Scheibe & Blanchard-Fields, 2009), and possibly indicating that emotion regulation of low-intensity stimuli requires minimal cognitive resources to implement. However, the prediction that older adults would demonstrate reduced memory following the regulation of high-intensity emotional films, due to greater cognitive demands and effort, was not supported with regulation of high-intensity stimuli not affecting memory performance in older adults. Furthermore, the expectation that young adults would demonstrate impairments in memory following the use of expressive suppression across all intensity conditions was also not supported. These results do not replicate previous findings of young adults demonstrating memory costs (Bonanno et al., 2004; Gross, 2002; Richards, 2004; Robinson & Demaree, 2009), although is consistent with other studies (e.g., Ortner & de Koning, 2013).

It is possible that the lack of memory costs associated with expressive suppression for older adults during the heightened emotional films, and for young adults across all films, could be due to regulation instructions provided prior to the commencement of each film. Participants had the opportunity to implement the expressive suppression strategy *prior to* the onset of emotional responses, which differs from the conceptualisation of expressive suppression occurring in the final stage of Gross' (1998b) process model, that is, regulation occurs once the emotion response has already been activated (Dan-Glauser & Gross, 2011). Thus, the degree of effort required for regulating emotional facial responses may have been reduced, with less reliance on complex and cognitively demanding self-monitoring and behavioural inhibition processes (Gross, 2002; Winecoff et al., 2011). Therefore, attentional resources that may have been required during regulation (Noh et al., 2011), could have been spared to encoding and processing the stimulus information for later retrieval. Since the current study only examined the memory effects as a secondary aim, more specific research approaches that specifically examine emotion regulation and memory costs would provide better outcomes.

Limitations and Future Directions

A consideration with the current study relates to the focus on the selection of discrete emotions. Specifically, films selected to elicit amusement created conditions of high emotional arousal for positive states (often involving responses of laughter), and where compared with happy films creating conditions of lower emotional arousal (e.g., smiles). Moreover, amusing and happy films created conditions that where more intensive and longer lasting than the pictures of pleasant scenes viewed in Study 1. In contrast, the current study only focused on eliciting one discrete negative emotion (i.e., sadness). Given the nature of the dynamic stimuli, sad films evoked heightened emotional responses when compared with the pictures of unpleasant scenes viewed in Study 1. However, comparable to other negative states (e.g., anger or fear), sadness is evidenced by lower sympathetic arousal (Kreibig, 2010; Kreibig et al., 2007) and withdrawal related behaviour (Christie & Friedman, 2004; Robinson & Demaree, 2009). Therefore, the use of alternative negative discrete emotions, such as anger, may have created conditions of heightened emotional arousal beyond physiological responses associated with sadness (e.g., greater magnitude of *corrugator* muscle activity in response to angry over sad films), thereby providing a better comparison to the amusing stimuli. Future research should investigate the regulation of other discrete negative emotions, such as anger or fear, to determine whether older adults are able to regulate threatening negative emotions effectively.

An alternative means of examining the relationship between emotion regulation effort and reduced emotional reactivity with age includes the strategy of expressive amplification. In contrast to expressive suppression, expressive amplification involves the exaggeration of facial displays of emotion (Demaree, Schmeichel, Robinson, & Everhart, 2004), and is also important in maintaining socially appropriate behaviour, such as increasing *zygomaticus* muscle activity to enhance the appearance of smiling during a stressful job interview (Giuliani et al., 2008). Furthermore, the ability to flexibly use expressive suppression and amplification has been found to predict long-term adjustment, resilience, and wellbeing (Bonanno et al., 2004; Westphal et al., 2010). If expressive suppression were easier and less effortful to implement during low arousing situations for older than young adults, coupled with reduced levels of emotional reactivity required during regulation, then expressive amplification would assumedly require greater effort for older adults to achieve enhanced facial expressions compared with young adults. Support for this suggestion has been found in evidence demonstrating that older adults experience increased difficulty with obtaining expressive amplification than expressive suppression goals (Henry et al., 2009), although some studies have shown older adults were as effective as young adults in amplifying their expressions (Emery & Hess, 2011; Kunzmann et al., 2005). Therefore, future research should closely examine expressive amplification in older adults to better understand the relationship between emotional reactivity and emotion regulation load in ageing.

Given older adults were unable to regulate their emotional responses to sad films using expressive suppression in the current study, further research is needed to investigate additional emotion regulation strategies that may be better suited for managing highly arousing negative emotions. Whilst Study 1 found no differences between strategy conditions when regulating emotional responses to low arousing stimuli for both age groups, other studies have demonstrated differences in strategy effectiveness in response to more highly arousing negative stimuli (Blanchard-Fields et al., 2004; Lohani & Isaacowitz, 2014). That is, research indicates that dependent on the level of emotion evoked, and the context of the emotional event (Skinner et al., 2014), older adults are better at implementing specific strategy types over others (Nowlan et al., 2014) and demonstrate shifts in strategy preferences to compensate for limited cognitive resources (Blanchard-Fields & Coats, 2008; Scheibe et al., 2015). Interestingly, mindfulness-based approaches may indirectly facilitate emotion regulation with less effort and demands on resources, and have revealed promising effects for older adults (De Frias, 2013; Shallcross et al., 2013). Future research should investigate emotion regulation strategies (e.g., focused-breathing) that improve older adults' ability to regulate negative facial expressions when experiencing emotional reactivity that exceeds beyond the threshold of coping.

Conclusion

The current study set out to better understand possible contributors to *how* older adults effectively regulate facial expressions of emotion (i.e., reduced emotional reactivity) and the *limitations* to their emotion regulation capacity (i.e., using dynamic stimuli with heightened emotional intensity). Results confirmed that older adults naturally responded with reduced facial reactivity (via EMG) compared with young adults, and extended this age-related pattern to also include lower levels of physiological arousal (via SCL). The outcomes from this study contribute to the explanation that older adults have less emotional reactivity than young adults to regulate, which may reduce the cognitive demands and render emotion regulation less effortful for older than young adults. Support was found for dynamic integration theory (Labouvie-Vief, 2008), where older adults' emotion regulation ability was compromised when responding with heightened levels of sadness. Indeed, for young and older adults, the use of dynamic long lasting films resulted in emotion regulation efforts becoming more challenging to achieve neutral facial expressions, compared with the low arousing static stimuli observed in Study 1. Findings indicated that the implementation of expressive regulation made no difference to the percentage of film content accurately recalled for young or older adults. When considering the effects on real world implications, older adults may incur difficulty in managing their overt facial expression when experiencing high levels of sadness during social interactions. Indeed, it is possible that alternative strategies, that utilise different skills compared with expressive suppression, may allow older adults to regulate their emotional responses more effectively.

CHAPTER 6: Regulating Sadness with Focused-Breathing: Comparisons with Expressive Suppression and Detached Reappraisal Strategies in Ageing (Study 4)

"Air is the environment where humans come into the world, where they grow, live and work. It can be inhabited by more or fewer currents or vibrations, but trying to return to the stillness of its expanse is preferable… Air gives what is indispensable to live, to grow and to speak… Air allows modulating sounds, speaking with different tones, and also singing, crying or whispering, shouting what seems already evident or keeping the breath for future manifestation. Air lets someone be in the present, enter into presence in the present, which emptiness does not allow to humans."

– Luce Irigaray (2002)

Overview of Chapter

The current study extended Study 3 by investigating alternative strategies to expressive suppression that may improve older adults' ability to regulate negative emotional responses to dynamic films eliciting sadness (which also further extends from the static pictures used in Study 1; Pedder et al., 2016). The current study examined focused-breathing as an alternative approach to emotion regulation, and compared it with detached reappraisal and expressive suppression strategies. In contrast to strategies that directly challenge thoughts and behaviours (e.g., expressive suppression), mindfulness-based strategies like focused-breathing may indirectly influence emotional responses early in the emotion generation process, thereby potentially becoming more efficient and less effortful for older adults (Campbell-Sills et al., 2006; Lalot et al., 2014). Therefore, the current study aimed to determine whether focused-breathing is an effective strategy for older adults when regulating negative emotional responses.

Young and older adults viewed emotion-eliciting sad films that were piloted in Study 2 to evoke heightened negative emotional reactivity. Participants were instructed to watch the films naturally or to regulate their emotional responses separately using each of the three strategies: focused-breathing, detached reappraisal, and expressive suppression. Emotion regulation was measured according to changes in *corrugator* (i.e., frowns) facial electromyography (EMG) muscle activity, as well as changes in autonomic activity (i.e., skin conductance indexing physiological arousal) and subjective experience (self-report). A surprise memory test of the film content was given following the emotion regulation task to index the attentional resources utilised during focused-breathing.

Results from the EMG data revealed that older adults effectively reduced their negative facial expressions when using focused-breathing, but not when using expressive suppression or detached reappraisal strategies. Young adults reduced facial EMG activity with all three strategies, but were most effective when using detached reappraisal. For young and older adults, there was no change to physiological arousal or memory performance across instruction conditions.

Findings demonstrate the use of alternative emotion regulation strategies for young and older adults during emotionally arousing negative situations. This is the first study to provide evidence towards the use of focused-breathing as an effective emotion regulation strategy into old age, thereby providing clinical implications. The current study was the first emotion regulation study to directly examine the outcome of focused-breathing on facial displays of negative emotion (i.e., sadness), and the first to compare the performance of young and older adults. Mindful emotion regulation is a relatively new area within the field of emotion regulation, with minimal investigation in the ageing literature.

6.1. Introduction

In therapeutic settings, breathing instructions are often given to clients as a tool for managing unpleasant emotional states (Edwards, 2008; Gilbert, 1999). Despite the regular teaching of specific breathing techniques, there are limited empirical papers examining the effectiveness of such strategies in emotion regulation. One recent study found that, for young adults, focused-breathing lead to reductions in negative feelings and an ability to tolerate unpleasant emotional stimuli for longer periods than a control group (Arch & Craske, 2006). However, to date, no study has investigated the use of focused-breathing in older adults when regulating negative emotional responses.

Furthermore, Study 3 revealed that older adults experienced impaired ability in regulating their negative facial expressions whilst viewing sadness-eliciting dynamic stimuli. When directed to use expressive suppression in response to sad films, older adults were unable to effectively reduce their overt facial behaviour, whereas young adults were. The conclusions from Study 3 suggested that older adults may be better at using alternative strategies when regulating strong negative emotional responses. The current study investigated older adults' successfulness in using a focused-breathing technique as an alternative emotion regulation strategy. How focused-breathing compares with other well-researched clinical emotion regulation strategies, such as cognitive 'detached' reappraisal (revaluating how one relates to the stimuli) and expressive suppression (directly inhibiting facial expression) currently remains unknown. Additionally, no other known study has measured facial reactivity, physiological arousal, or memory performance in response to instructions to use focused-breathing as an intentional emotion regulation strategy.

In particular, Study 3 demonstrated a valence effect regarding successful emotion regulation in older adults. Whilst older adults were unable to regulate their negative facial expressivity (i.e., frowns) to sad films, they were effective at regulating positive expressivity (i.e., smiles and laughter) to amusing and happy films. Indeed, the emotional state of sadness may be of particular importance in the later stages of life (Kunzmann & Grühn, 2005; Seider et al., 2011). Sadness is a psychophysiological response usually from the experience of loss (Haase et al., 2012), including the realisation that goals are no longer attainable, disappointment with oneself, or when separated from a person of importance (Kreibig et al., 2007). Thus, sadness may be of greater significance in old age due to the increases in personal losses within social, cognitive, physical, and occupational domains (Lohani & Isaacowitz, 2014). Given older adults place increasing emphasis on meaningful connections and relationships (see socioemotional selectivity theory, SST; Carstensen, 1992), such habitual responses may impede positive social interactions and engagement with others.

Mindful Emotion Regulation and Focused-Breathing

Mindfulness is defined as the practice of focusing one's attention without judgement to the present moment, by accepting and noticing feelings, thoughts, and bodily sensations that unfold in any given situation (Kabat-Zinn, 1990; Prakash et al., 2014). The emotion regulation literature is beginning to incorporate the field of mindfulness in understanding and exploring alternative ways to manage and experience emotions, such as through mindful breathing (e.g., see Chambers et al., 2009 for a review). Such a shift is growing in interest as more adaptive strategies that do not require directly challenging or opposing emotional states (e.g., stopping thoughts or emotional reactivity as traditionally viewed by cognitive behavioural approaches) are warranted, such as learning to relate to and experience difficult emotions with greater awareness, acceptance, and flexibility (Erisman & Roemer, 2010). The increase in scientific research that incorporates both emotion regulation and mindfulness fields are providing greater opportunity for shaping the way we relate to, view, experience, and express emotion. Ultimately, mindfulness techniques facilitate alternative approaches to emotion regulation, that may lead to more adaptive management of emotional responses across the life span (Erisman & Roemer, 2010).

Despite the abundance of efficacy studies, little is known about the direct mechanisms of specific mindfulness practices and their effects on human processes, such as emotion regulation (Feldman et al., 2010; Perlman, Salomons, Davidson, & Lutz, 2010). Recent laboratory-based experiments are providing an opportunity to examine individual mechanisms of mindfulness (e.g., mindful breathing, acceptance, and awareness) and their relationship with emotion regulation (Arch & Craske, 2006; Campbell-Sills et al., 2006; Erisman & Roemer, 2010; Feldman et al., 2010). For example, mindful breathing provides an ‘anchor’, with attention paid to the bodily sensations of each inhalation and exhalation (Prakash et al., 2014) and such practices of attention to the breath have been found to enhance emotion regulation capabilities (Arch & Craske, 2006; Farb et al., 2010). Studies have demonstrated that extensive training or practice are not required in order to achieve the immediate benefits of mindfulness techniques on emotional experience (Lalot et al., 2014). Other studies have also found promising findings for the benefits of voluntary respiratory regulation, such as reductions in negative states (e.g., tension, anger, stress, and depressive feelings; Busch et al., 2012), reduced physiological arousal (e.g., skin conductance; Pastor, Menéndez, Sanz, & Abad, 2008), decreased negative self-beliefs and reduced amygdala activity (Goldin & Gross, 2010).

One influential study examined the effects of a 15-minute deep breathing induction on the affective responses to emotional pictures in younger adults (Arch & Craske, 2006). The breathing condition comprised of a mindfulness of the breath awareness instruction, inviting participants to focus on the sensations of breathing on the body (e.g., see Kabat-Zinn, 1990). The main outcome measures were self-report and heart rate measures. Participants in the breathing induction, who were compared with an unfocused attention and worry group, were found to report lower negative affect and maintained positive responses to neutral pictures (Arch & Craske, 2006). Participants were also able to tolerate highly unpleasant images for a greater duration of time compared with the other conditions (Arch &

Craske, 2006). The immediate effects of focused-breathing therefore provide an effective method of influencing negative emotional states without becoming emotionally overwhelmed, and evidence for the role of mindfulness in emotion regulation.

Two key points are worth highlighting with regards the study by Arch and Craske (2006). First, to index emotion regulation success, Arch and Craske's (2006) study relied on two emotional outcome measures, self-report and heart rate. Whilst self-report methods provide insight into subjective experiences, they rely on participants' ability to accurately identify and rate their emotional state according to key emotion words. Heart rate provides objective feedback, however, it is only part of the many physiological changes that occur with emotional activation. It is of interest to determine whether the use of focused-breathing as an emotion regulation strategy is capable of influencing other aspects of emotional responding, such as facial expression and skin conductance.

Second, Arch and Craske (2006) used emotional images from the International Affective Picture System (IAPS; P. J. Lang, Bradley, & Cuthbert, 1997) to elicit emotional responses. As demonstrated in Studies 1 and 3 of the current thesis, the use of emotional films in eliciting emotion evoke greater emotional responses (e.g., facial reactivity as indexed via electromyography, EMG). Findings from Study 3 demonstrated that films induced emotional responses that were more challenging to reduce (i.e., via expressive suppression) to baseline levels, compared with emotional responses in Study 3. Using films to evoke higher levels of negative emotion and facial reactivity would extend Arch and Craske's (2006) study by examining whether focused-breathing techniques are capable of reducing increased emotional responses.

Focused-Breathing and Older Adults

Focused-breathing as an emotion regulation strategy has yet to be directly tested in comparison between young and older adults. There is consistent empirical evidence across the ageing literature that older adults' emotion regulation capacity continues to be effective when compared with young adults (Emery & Hess, 2011; Isaacowitz & Blanchard-Fields, 2012; Lohani & Isaacowitz, 2014; Urry & Gross, 2010). Nonetheless, there are age differences in the preference and use of specific emotion regulation strategies. For instance, compared to young adults, older adults demonstrate better use of positive reappraisal in reducing negative emotion (Lohani & Isaacowitz, 2014; Shiota & Levenson, 2012), and report using cognitive reappraisal strategies more than expressive suppression (John & Gross, 2004). Theoretically, older adults compensate for age-related changes in affective and cognitive functioning by selecting and optimising strategies that they can implement successfully (see Selection, Optimisation and Compensation with Emotion Regulation framework, SOC-ER; Opitz, Gross, et al., 2012; Urry & Gross, 2010). Therefore, further insight into how, or what strategies older adults are successful at, provides greater understanding into the maintained emotion regulation capacity into old age (Prakash et al., 2014).

In the current study, the effectiveness of focused-breathing at reducing emotional responses in older adults will be compared with other well-documented emotion regulation strategies, including detached reappraisal and expressive suppression. Detached reappraisal involves the use of altering thoughts to revaluate how one relates to the affective stimuli. Expressive suppression involves behavioural control to directly inhibit facial displays of emotion. Both strategies form suitable comparisons to focused-breathing, which operates through shifting attentional focus to the flow of each in-and-out breath to ground the body, and thus reduce emotional reactivity (Farb et al., 2010). This raises interest of which approaches are better for young and older adults in regulating negative feelings. Different approaches to regulation are ultimately going to result in different emotional outcomes, such as on facial reactivity and physiological arousal (De Frias, 2013).

Focused-breathing and emotional facial expressions. The effects of focused-breathing on emotional facial expressions may be particular important in late adulthood as older adults place increasing importance on positive social interactions and are motivated to engage in self-regulatory processes that promote meaningful connections (Carstensen, 1992). To date, no known published study has examined the use of focused-breathing as an emotion regulation strategy and the effects on facial reactivity in responses to emotional stimuli. Whilst the impact of emotion regulation on subjective feelings is important (Webb et al., 2012), it is also essential that research evaluates the impact of regulation strategies on behavioural and physiological responses (e.g., facial expression, skin conductance; Mauss & Robinson, 2010). Facial expressions of emotion provide an objective measure of internal emotional states. Similarly, emotional facial displays discretely communicate distinct emotional responses of how one feels to others. To illustrate, facial expressions of sadness involve rising of the inner eyebrows, lowering of mouth corners, and with or without tears (Ekman & Friesen, 1978; Gross et al., 1994; Seider et al., 2011). Regulatory strategies that alter the automatic activation of such emotional expressions are important in displaying situation appropriate facial expressions during social interactions with others.

Furthermore, in understanding the effects of emotion regulation on facial behaviour, majority of research has examined expressive suppression (i.e., due to the direct goal of inhibiting facial displays; e.g., Bonanno et al., 2004; Dan-Glauser & Gross, 2011; Kunzmann et al., 2005). However, inflexible use and chronic use of expressive suppression has been linked with detrimental effects on relationship quality (Butler et al., 2003; Richards et al., 2003), physical health (Gross & Levenson, 1997; Sapolsky, 2007), and cognitive processes (Emery & Hess, 2011; Richards & Gross, 1999). Furthermore, habitual use of expressive suppression results in the inhibition of free and flexible breathing through the chronic bracing of muscular systems, leading to poor breathing habits during regulation (Gilbert, 1999). Recently, other strategies such as detached reappraisal have been demonstrated to be effective at regulating facial expressions (Kim & Hamann, 2012; Lohani & Isaacowitz, 2014; Phillips et al., 2008; Shiota & Levenson, 2009). Evidence is therefore required to determine whether focused-breathing successfully influences internal experience, as well as external displays such as facial expression of emotion.

A recent study investigated the effects of mindful attention on subjective and facial expressions during regulation of positive emotions in young adults (Lalot et al., 2014). The mindful attention instructions involved observing any thoughts, emotions, or sensations that may rise without trying to control or avoid them. This mindfulness condition was compared with popular regulation strategies of detached reappraisal and expressive suppression. According to self-report, participants in the mindful attention and detached reappraisal conditions reported lower positive feelings than in the expressive suppression condition. According to automated CERT coding of facial expressions, participants were able to reduce smiling using mindful attention, however, were more effective when using expressive suppression (Lalot et al., 2014). The authors concluded that future research should investigate the cognitive processes recruited during mindful regulation, as well as other physiological outcomes (Lalot et al., 2014).

Focused-breathing and memory. The process of emotion regulation is well documented as a cognitively demanding task that requires mental effort and resources (Kryla-Lighthall & Mather, 2008; Ochsner & Gross, 2005). For young adults, the use of specific strategies (e.g., expressive suppression) has been shown to reduce memory performance compared to when not engaging in voluntary emotion regulation (Bonanno et al., 2004; Richards & Gross, 1999; Robinson & Demaree, 2009). Interestingly, declines in memory performance due to emotion regulatory efforts have not been observed for older adults (e.g., see Studies 1 and 3 of the current thesis; plus Emery & Hess, 2011; Scheibe & Blanchard-Fields, 2009). Given memory costs vary according to the implemented strategy and by age, further consideration must be given to understanding how older adults are regulating their emotions without impacting memory (Stanley & Isaacowitz, 2014). So far, the effects of focused-breathing on memory performance have not yet been tested in young or older adults.

Focused-breathing requires individuals to continuously maintain focus and attention on each inhalation and exhalation and may direct attention away from stimuli (Koole, 2009). That is, ongoing attention to the breath might serve as a distraction from the emotional situation itself (Alberts et al., 2012). Such distraction and focus on the breath may limit the cognitive resources available for encoding stimulus information. If attention to the breath is serving regulatory processes by ultimately distracting individuals from the emotional qualities of the stimuli, we might then expect reduced memory performances. However, if focused-breathing does not impact memory performance, then it is likely that attentional resources during regulation are spared, and stimulus-encoding processes continue unaffected.

However, given mindfulness-based approaches promote greater awareness of the present, the employment of focused-breathing strategies may actually improve memory performance, or at the very least, offset any cognitive demands of engaging in such regulatory processes. Particularly with practice or regular use, breath-focused regulation may become more automatic (i.e., implicit), reducing the amount of effort or attentional resources required when implementing (Goldin & Gross, 2010). To illustrate, ongoing mindfulness practices have been shown to enhance working memory capacity (Davis & Hayes, 2011), and thereby promote effective emotion regulation processes when memory pathways are challenged (Chambers et al., 2009). This is particularly important for the older adults, who experience deterioration in cognitive resources, yet continue to place emphasis and engage in emotion regulation (Carstensen et al., 2003; Prakash et al., 2014).

The Current Study

The present study investigated the immediate effects of focused-breathing as an alternative emotion regulation strategy in young and older adults. The primary aim was to examine the effectiveness of focused-breathing, in comparison with expressive suppression and detached reappraisal strategies, at reducing facial expressions, physiological arousal, and subjective experience when viewing sadness-eliciting films. Sadness was particularly important for the current study due to the valence effect found in Study 3, where older adults were unable to regulate their facial expressions of sadness, but could regulate amusement and happiness. Thus, the current study extends Study 3 by investigating additional emotion regulation strategies that may improve older adults' ability to effectively reduce facial expressions to strong negative emotions.

The hypotheses related to emotion regulation were three-fold. First, it was predicted that compared to the watch condition, young and older adults would be effective at using focused-breathing to lower subjective feelings of sadness, *corrugator supercilii* 'brow' facial EMG activity (indexing negative facial expression), and skin conductance levels (SCL; indexing physiological arousal). Second, based on previous findings (including Studies 1 and 3), it was anticipated that compared to the watch condition, both young and older adults would be effective at using detached reappraisal to regulate their self-report, facial expression, and arousal levels, but only young adults would be effective at using expressive suppression. Third and more specifically for older adults, it was predicted that the breathing strategy would be more effective than expressive suppression and detached reappraisal at lowering all three emotional outcomes. For young adults, it was predicted that the expressive suppression strategy would be more effective than detached reappraisal and focused-breathing at lowering emotion outcomes.

Additionally, the current study also investigated the effects of the focused-breathing strategy on memory performance. This provided an index of the attentional resources required during emotion regulation strategy use, and thus the subsequent impact on encoding of stimuli information. For young and older adults, it was predicted that the use of the breathing strategy would not decrease accuracy in memory retrieval of film content, in comparison with the watch condition. This would indicate that for both age groups, the encoding (and subsequent memory retrieval) of stimuli information would be unaffected by emotion regulation processes utilised with focused-breathing. Also, relative to the watch condition, no memory effects were predicted for the detached reappraisal condition, however, for young adults (but not older adults), it was anticipated that use of expressive suppression would result in reduced memory performance.

6.2. Method

Participants

Forty young (*M* = 22.00 years, *SD* = 3.96; range 18–33; 24 women) and 40 older adults (*M* = 71.33 years, *SD* = 5.35; range 60–85; 21 women) participated in the study. Data from this study was collected during the same testing session as Study 3, during which the effects of expressive suppression was examined. In this study, however, participants were asked to use two additional strategies (focused-breathing and detached reappraisal) to regulate their emotional responses to sad films of high emotional intensity. All participants were reimbursed $30 for their time and travel expenses, or received course credit. Young adults were recruited through the university undergraduate pool, while older adults were recruited through the community and an established database of older participants. Exclusion criteria for older adults included scores of 84 or below on Addenbrooke's Cognitive Examination-Revised (ACE-R), which is a brief cognitive screening measure assessing orientation, attention, general memory, verbal fluency, language, and spatial memory (Mathuranath et al., 2000). Participants with unmanaged cardiac (e.g., heartbeat, blood pressure), pulmonary (e.g., asthma), psychological, or neurological diagnoses were excluded from the study.

As the same sample was used across Studies 3 and 4, the age-related patterns of performance on background measures were presented in Table 5.1 of Chapter 5. Background measures included: National Adult Reading Test (Nelson & Willison, 1991), Trail Making Test (Reitan, 1992), a delayed recall test (Short Word Test of Screening Examination for Cognitive Impairment; Beatty et al., 1995), Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983), and the Positive and Negative Affect Schedule (state version; D. Watson et al., 1988).

Specific to the current study, additional background measures were completed, as shown in Table 6.1. On a self-reported screening measure for shortness of breath, over-breathing, and hyperventilation (Nijmegen Questionnaire; Van Doorn, Colla, & Folgering, 1983), young adults reported greater concerns than older adults. Separately, participants also reported whether they currently engaged in regular use of breathing-related exercises (e.g., yoga, Tai Chi). According to chi-square, there were no age differences (10 % of young; 20% of older adults), X^2 (1, N = 80) = 1.57, p = .210.

According to the Mindfulness Attention Awareness Scale (K. W. Brown & Ryan, 2003), compared with young, older adults self-reported greater awareness of moment to moment experience, an index of trait mindfulness, which has shown to correlate with self-regulation and psychological wellbeing (K. W. Brown & Ryan, 2003). Separately, participants also self-reported whether they currently engage in any mindfulness-related practices (e.g., meditation). According to chi-square, there were no age differences (12.5% of young; 17.5% of older adults), X^2 (1, N = 80) = 0.39, p = .531.

Table 6.1

Performances on Additional Background Measures[a] for Young and Older Adults

	Young Adults n = 40		Older Adults n = 40		t test[b] (df = 78)		
Characteristic	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Breathing Pattern	16.35	11.18	10.28	6.80	2.94	.004	0.66
MAAS	3.74	0.69	4.25	0.76	3.14	.002	0.70
Overall DERS	84.38	19.38	70.58	17.36	3.34	.001	0.75
Goal Difficulties	15.88	3.24	13.63	3.09	3.17	.002	0.71
Impulse Difficulties	13.13	3.89	11.15	2.78	2.61	.011	0.59
Limited Strategies	19.28	5.30	14.95	3.69	4.24	< .001	0.95
Lack of Awareness	21.75	4.37	21.93	4.18	0.18	.855	0.04
Lack of Clarity	12.73	2.22	13.03	1.99	0.64	.527	0.14
Nonacceptance	13.30	5.79	12.80	5.23	0.41	.686	0.09

Note. Breathing pattern according to the Nijmegen Questionnaire. MAAS = Mindfulness Attention Awareness Scale. Overall DERS = Overal score from the Difficulties in Emotion Regulation Scale. DERS subscales include: goal difficulties, impulse difficulties, limited access to strategies, lack of emotional awareness, lack of emotional clarity, and nonacceptance of emotional responses.

[a]Participants were the same as in Study 3 with background measures reported in Table 5.1, Chapter 5. Only additional measures specific to this study are reported here. [b]Independent *t* test applied, with Cohen's *d* = effect size.

Additionally, on a standardised measure of emotion regulation difficulty, young adults reported greater overall difficulties with emotion regulation than older adults (Difficulties in Emotion Regulation Scale, DERS; Gratz & Roemer, 2004). Specifically, young adults self-reported greater difficulties in engaging with goal-directed emotion regulation behaviour, impulse control difficulties, and limited access to the use of emotion regulation strategies compared to older adults. There were no age differences for emotion regulation difficulties relating to lack of emotional awareness, lack of emotional clarity, or nonacceptance of emotional responses.

Procedure and Materials

Emotion regulation task. This task required participants to reduce their emotional responses to sad video clips using three specified emotion regulation strategies. Participants completed an initial practice and orientation to the task by viewing a neutral film clip, without the use of a regulatory strategy. Participants then viewed four randomised films intended to elicit sadness, and were given the following four instructions in random order, (1) watch with no instruction, (2) expressive suppression, (3) detached reappraisal (a form of cognitive reappraisal), and (4) focused-breathing.[15] All instructions stated to "please view the following videos carefully without looking away from the screen". In the watch condition, participants were instruction to "simply WATCH the video as you naturally would". In the expressive suppression condition, participants were instruction to "try to SUPPRESS any emotion that may arise so that if someone was watching, they could not tell what you were feeling". In the detached reappraisal condition, participants were instructed to "try to REDUCE any emotion that may arise, by viewing the scene with detached interest. That is, viewing objectively rather than as personally or emotionally relevant to you".

In the focused-breathing condition (see Appendix E.8), participants were first provided with brief information on how unpleasant emotions can impact breathing patterns, and healthy breathing techniques. Using a modified script (e.g., based on similar scripts by Arch & Craske, 2006; Feldman et al., 2010; Williams et al., 2007), the researcher facilitated a short breathing exercise where participants had the opportunity to practice. Participants were guided to direct their attention and awareness to their breath, noticing the rhythm and sensations of each breath entering and leaving their body. When ready to proceed with the task, participants were instructed to "try to REDUCE any emotion that may arise, by

[15] The data from the watch and expressive suppression conditions were the same as reported in Study 3. The current study included new data for detached reappraisal and focused-breathing strategies. That is, during the same testing session, participants completed one emotion regulation task, however, strategies were included as part of separate studies due to distinct research questions in Studies 3 and 4.

maintaining your focused-breathing technique to minimise the emotional impact of the scene".

Task instructions and stimuli were presented with E-Prime 2.0 Professional (Psychology Software Tools, Inc., Sharpsburg, PA) on a Microsoft Windows desktop computer and LCD screen. Participants wore over-ear Bose audio headphones and were able to adjust volume as required. Stimuli onset and offset digital event markers were sent from E-Prime to the physiological recording software. Background questionnaires were completed between conditions, so as to minimise possible carry over effects of emotional arousal or strategy use on later instructions.

Stimuli. Sixteen sad film clips obtained from movies and television shows were piloted (see Pilot Study A of Study 2) with 31 adults (16 young and 15 older adults). The four films that elicited the highest self-rated feelings of sadness were selected for the current study, and averaged 133 s in duration.[16] Films were only included if they elicited minimal levels of unrelated emotions (e.g., amusement, anger, disgust, fear, or surprise) and were not reported as confusing. The self-rated sadness and arousal scores of the selected sad films from pilot testing are shown in Table 6.2.[17] One additional neutral film, which depicts a brief scene of mountain goats, was viewed as practice prior to the current emotion regulation task.

[16]The same four sad films were included as part of Study 3.

[17]Using a one-way repeated measures ANOVA, emotional ratings were checked to ensure there were no differences between sad films. There was no main effect of film for sadness, $F(3, 90) = 1.31$, $p = .275$, $\eta_p^2 = .04$, or arousal, $F(2.36, 70.67) = 2.00$, $p = .136$, $\eta_p^2 = .06$, demonstrating no self-reported emotional differences between stimuli.

Table 6.2

Mean Self-Reported Sadness and Arousal Ratings for Sad Films Piloted in Study 2

	Length	Sadness Rating		Arousal Rating	
Film – Scene	(s)	*M*	*SD*	*M*	*SD*
Sophie's Choice – Can't choose which child	132	7.19	1.72	7.23	1.89
NeverEnding Story – Horse dies in swamp	120	7.00	1.77	7.26	1.51
My Girl – Best friend's funeral	141	6.77	1.98	6.55	1.61
The Champ – Boy crying at boxer's death	139	6.45	2.20	6.94	1.73

Note. *N* = 31 (16 young adults, 15 older adults). Sadness rating scales ranged from 1 (not at all sad) to 9 (extremely sad). Arousal rating scales ranged from 1 (calm/dull) to 9 (intense).

Facial EMG. Subtle physiological facial muscle activity was recorded using surface EMG to index negative expressivity. Pairs of 4 mm Ag-Ag CI shielded fixed-wire electrodes containing conductance electrode gel were placed over the *corrugator supercilii* (to index sadness with negative affect) and *zygomaticus major* (to index positive affect, and thus a check to differentiate with negative expressions) muscle region on the left side of the face (Driscoll et al., 2009; Fridlund & Cacioppo, 1986; Tassinary et al., 2007). Muscle sites were first prepared using skin abrasive pads and Nu Prep skin preparation gel before using adhesive washers to attach electrodes to skin surface with an inter-electrode distance of 1 cm. An impedance checker was used to ensure impedance level was below 20 kΩ during signal recording (Tassinary et al., 2007). Activity was recorded using two biopotential amplifiers at a sampling rate of 1,000 Hz with an integrated MP150 system and Acq*Knowledge* 4.2 software package (Biopac Systems, Inc., Goleta, CA). A 50 Hz notch interference filter, along with a 500 Hz low-pass and 10 Hz high-pass filter were applied.

Post data acquisition, raw signals were checked for noise and interference using power spectral density. For the data, a 25 Hz high-pass and a 425 Hz low-pass digital filter were applied to reduce noise (Lohani & Isaacowitz, 2014). A Logitech digital webcam recorded participant's visual facial responses to facilitate the removal of artifacts or non-task specific activity from the EMG signal. Root mean square (RMS) transformations were applied to normalise the distribution of values (De Luca, 2006).

Each film trial consisted of a black screen (5 s), followed by a fixation cross and an orienting acoustic "bop" (0.5 s) before viewing the film. The initial 9 s of each film were omitted from data analysis to allow for participants' orientation to the stimuli and to begin experiencing the target emotion of sadness (Etzel et al., 2006). The following 60 s of EMG recording was extracted for statistical analysis, as this was the maximum allowable duration of stimulus activity for all films within the larger study. The percentage change in stimulus activity was compared with baseline activity recorded 2 s immediately prior to the onset of the orienting sound; a standardisation metric which better accounts for variance across conditions and magnitude of EMG responses between groups (van Boxtel, 2010) and is particularly suitable for ageing research given the age differences in the intensity of emotional EMG responses (Lohani & Isaacowitz, 2014; D. P. Smith et al., 2005). The final score comprised of the average RMS change in activity for 60 s of stimulus exposure, thereby providing an indication of participants' subtle negative facial muscle responses to the emotionally sad stimuli.

Skin conductance. An increase in sweat gland activity, which is controlled by the SNS, provides a physiological indicator of emotional arousal (Busch et al., 2012; Rottenberg et al., 2007). Two 6 mm Ag-Ag CI shielded fixed-wire electrodes containing conductance electrode gel were placed on the distal phalanges of the index and middle fingers of the participant's non-dominant hand (Boucsein et al., 2012; Dawson et al., 1990). Skin abrasive pads were first applied to fingertip surface before using adhesive washers and Velcro straps to attach electrodes to fingers. Exosomatic activity was continuously recorded using direct current during baseline and stimuli periods of the expressive regulation task through a

Biopac Galvanic Skin Response (GSR) amplifier with a sampling rate of 1,000 Hz and a gain of 5 µmho/V (Biopac Systems, Inc., Goleta, CA).

Post data acquisition followed a similar protocol as with the EMG data. However, due to skin conductance being a relatively slow signal, a latency window of 2 s was applied when extracting the 60 s of SCL data for statistical analysis (Boucsein et al., 2012). This resulted in the initial 11 s of each film omitted from data extraction (compared with the 9 s for EMG data). The maximum tonic SCL was compared with baseline levels recorded during viewing of neutral films (Lohani & Isaacowitz, 2014; Rottenberg et al., 2007). This allowed for longer baseline periods than EMG to reflect the differential amplitude time courses of physiological responses systems and for participants' arousal levels to subside (Boucsein et al., 2012; Kreibig, 2010). The final score comprised of the change in microSiemans (µS) activity for 60 s of stimulus exposure, thereby providing an indication of participants' emotional arousal whilst viewing the sad films.

Self-report. Immediately following each film, participants were instructed to rate their emotional experience of the film on a nine-point *Likert* scale, ranging from 1 (not at all sad) to 9 (extremely sad).

Memory questionnaire. On completion of the emotion regulation task, participants were given a surprise memory test relating to the content observed in each film. Consistent with previous emotional memory tests (Robinson & Demaree, 2007, 2009), the current study developed a similar six-item free response test for each film. Example questions included "in what decade was the person in the coffin born?" and "how does the boy try to save the horse?". A scoring grid was developed (see Appendix E.11), involving up to two points for correct answers per question, with a maximum of 12 points to be obtained for each film. Total scores for each film were then related back to the respective instruction conditions. This questionnaire provided a sensitive measure of memory performance to index the memory costs associated with engagement of emotion regulation strategies.

6.3. Results

The present study comprised of a 2 x 4 mixed factorial design. The between-subjects variable was age group (young, older adults) and the within-subjects variable was instruction (watch, expressive suppression, detached reappraisal, focused-breathing). The dependent variables for emotion regulation were change in *corrugator* EMG muscle activity from baseline (indexing negative facial expressivity), SCL recordings of arousal level, and self-reported emotional experience. The dependent variable for memory performance was the percentage of film content accurately recalled. Analyses where assumptions of sphericity were violated, Greenhouse-Geisser corrected values were reported.

Emotional Expression as Indexed by EMG

Preliminary analyses. Sad films were first checked for correctly associated increases in *corrugator* muscle activity in the watch condition (Dan-Glauser & Gross, 2011). Increased *corrugator* activity was greater when viewing the sad film (M = 96.72, SD = 93.37) compared with the neutral film (M = 38.78, SD = 80.87), $t(79) = 4.70$, $p < .001$, d = 0.66. Percentage change in *zygomaticus* activity (an indicator of positive affect) did not differ when viewing sad (M = -2.31, SD = 44.58) and neutral films (M = -1.62, SD = 43.91), $t(79) = -0.12$, $p = .903$, $d = 0.02$. Baseline scores during the watch condition were checked for any age differences that could interfere with the calculation of percentage muscle change. There were no age differences in baseline scores for *corrugator* activity (young: M = 0.32, SD = 0.25; older: M = 0.33, SD = 0.19), $t(78) = 0.21$, $p = .831$, $d = 0.05$.

Analysis of facial expression. This analysis was designed to primarily determine whether both age groups reduced their facial expression in each emotion regulation condition compared to the watch condition. Activity in the *corrugator* muscle region was analysed with a 2 (Age Group; young, older) x 4 (Instruction; watch, expressive suppression, detached reappraisal, focused-breathing) mixed analysis of variance (ANOVA). Young and older adults' mean scores for *corrugator* activity in each instruction condition are displayed in Figure 6.1.

There was a main effect of age group, $F(1, 78) = 17.84$, $p < .001$, $\eta_p^2 = .19$, and instruction, $F(2.64, 205.97) = 18.03$, $p < .001$, $\eta_p^2 = .19$. There was also an Age Group x Instruction interaction, $F(2.64, 205.97) = 4.82$, $p = .004$, $\eta_p^2 = .06$. Of primary interest, tests of simple effects to follow-up the interaction revealed a simple main effect of instruction for young adults, $F(3, 76) = 15.02$, $p < .001$, $\eta_p^2 = .37$, with post hoc analyses revealing that compared with the watch condition, there was lower *corrugator* activity in the expressive suppression ($p < .001$, $d = 0.61$), detached reappraisal ($p < .001$, $d = 1.10$), and focused-breathing conditions ($p < .001$, $d = 0.73$). There was also lower EMG activity in the detached reappraisal than the expressive suppression condition ($p = .003$, $d = 0.55$). There was no difference between focused-breathing and expressive suppression ($p = .195$) or detached reappraisal conditions ($p = .085$).

According to the test of simple effects,[18] there was a non-significant trend approaching significance for a simple main effect of instruction for older adults, $F(3, 76) = 2.56$, $p = .061$, $\eta_p^2 = .09$, with post hoc analyses revealing that compared with the watch condition, there was lower *corrugator* activity in the focused-breathing condition ($p = .007$, $d = 0.88$), and a non-significant trend for lower activity in the expressive suppression ($p = .050$, $d = 0.51$) and detached reappraisal conditions ($p = .079$, $d = 0.44$). There were no differences between the three emotion regulation strategies (*p*s > .113). For focused-breathing there was a large effect, but for expressive suppression and detached reappraisal there were medium effects (Cohen, 1988, defines effect sizes of 0.2 as small, 0.5 as medium, and 0.8 as large).

[18]A conservative approach was used for the tests of simple effects using SPSS syntax where overall participants' (young and old) error term used. Interestingly the less conservative approach of running separate ANOVAs for young and older adults did reveal a significant simple main effect, $F(3, 117) = 6.49$, $p = .001$, $\eta_p^2 = .14$.

Of secondary interest, a further test of simple effects revealed simple main effects of age group for the watch condition, $F(1, 78) = 15.69$, $p < .001$, $\eta_p^2 = .17$, expressive suppression, $F(1, 78) = 9.79$, $p = .002$, $\eta_p^2 = .11$, and focused-breathing, $F(1, 78) = 10.95$, $p = .001$, $\eta_p^2 = .12$, with young adults demonstrating greater *corrugator* activity than older adults in all three conditions. There were no age differences in the detached reappraisal condition, $F(1, 78) = 0.39$, $p = .532$, $\eta_p^2 = .01$.

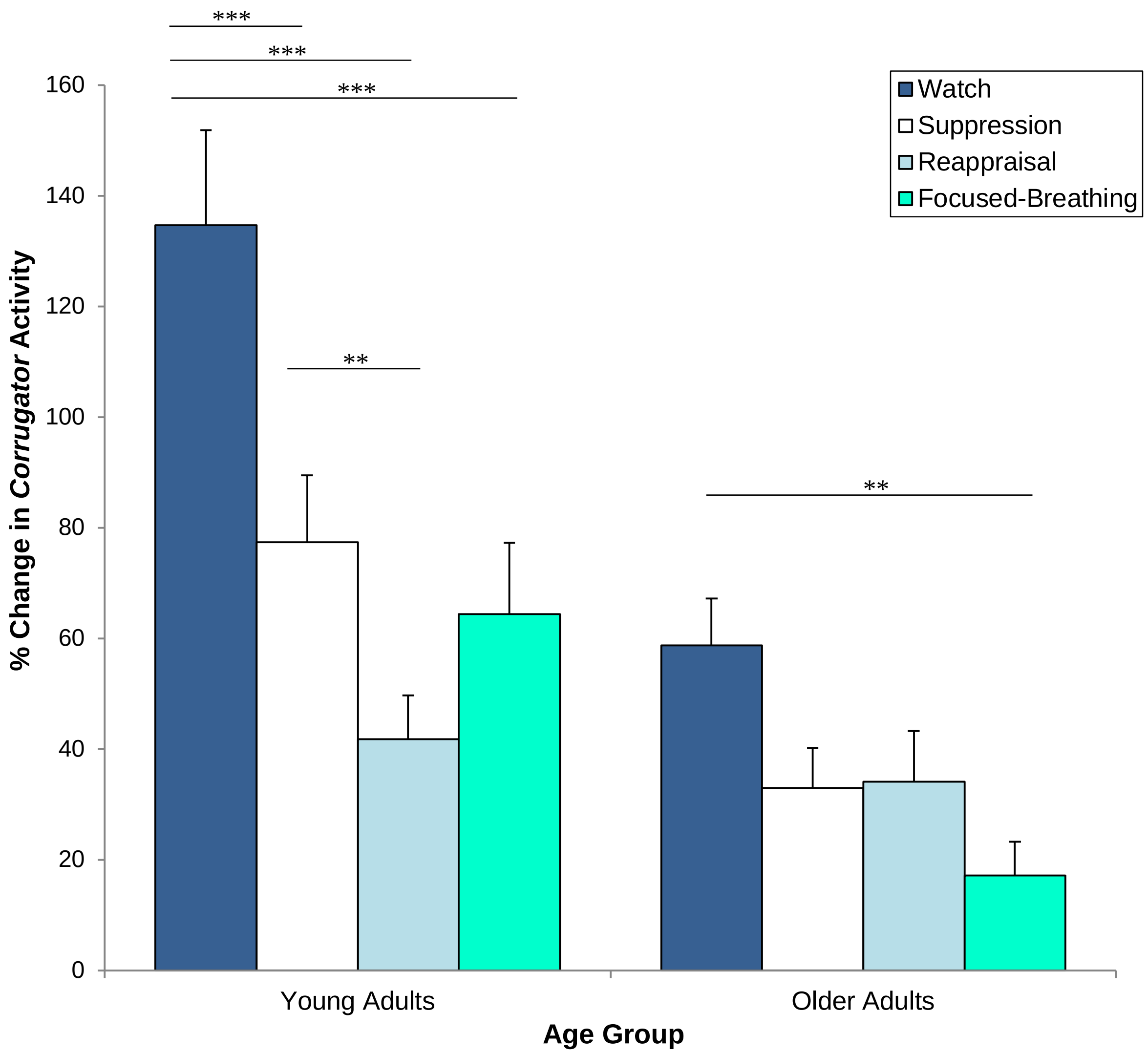

Figure 6.1. Change in *corrugator* activity from baseline when viewing sad films. A higher percentage increase in activity indicates greater muscle use. Expressive suppression, detached reappraisal, and focused-breathing required participants to reduce their emotional responses. Error bars indicate standard errors. Brackets indicate differences between instruction conditions for young and older adults.

$^{**}p < .01$. $^{***}p < .001$.

Summary of EMG data. Young and older adults both showed negative emotional facial responses (indexed by *corrugator* muscle activity) when viewing sad film clips. Young adults were able to reduce this facial activity using all three emotion regulation strategies, and were more effective at decreasing frown responses when using detached reappraisal compared with watch and expressive suppression conditions. For older adults, focused-breathing was effective in reducing negative facial responses, however, expressive suppression and detached reappraisal were not. Of note, compared with young, older adults responded with significantly lower *corrugator* activity in the watch condition. Thus, relative to young, older adults had less facial activity to reduce.

Physiological Arousal as Indexed by SCL

Preliminary analyses. Change in skin conductance was calculated by the increase in SCL from baseline scores when responding to neutral films, with SCL scores when responding to emotional films. Baseline SCL scores during the neutral film was checked for any age differences that could interfere with the calculation of change in skin conductance. There were no age differences in SCL scores (young adults: $M = 0.01$, $SD < 0.01$; older adults, $M = 0.01$, $SD < 0.01$), $t(78) = 1.00$, $p = .320$, $d < 0.01$.

Analyses of skin conductance. This analysis was designed to determine whether both age groups were able to reduce physiological arousal when regulating emotion to sad stimuli. SCL was analysed with a 2 (Age Group; young, older) x 4 (Instruction; watch, expressive suppression, detached reappraisal, focused-breathing) mixed ANOVA, and displayed in Figure 6.2. The dependent variable was change in μS from baseline, representing physiological activation. Young and older adults' mean scores for SCL in each instruction condition are displayed in Figure 6.2. There was a main effect of age group, $F(1, 78) = 13.93$, $p < .001$, $\eta_p^2 = .15$, with young adults ($M = 0.13$, $SD = 0.14$) producing greater SCL than older adults ($M = 0.05$, $SD = 0.07$). There was no main effect of instruction, F(3,

234) = 0.78, p = .507, η_p^2 = .01, or an Age Group x Instruction interaction, F(3, 234) = 1.09, p = .353, η_p^2 = .01.

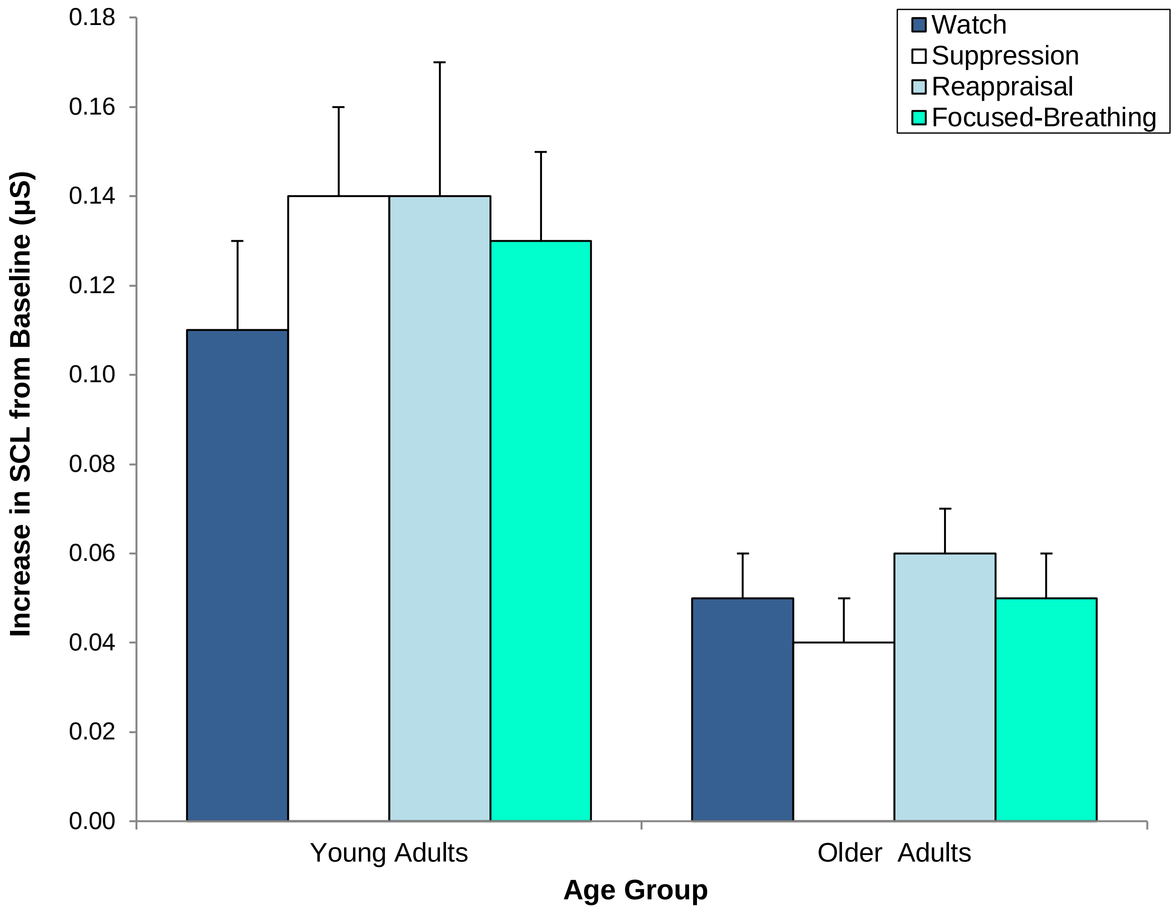

Figure 6.2. Increase in skin conductance activity from baseline when viewing sad films. A higher increase in activity indicates greater physiological arousal. Expressive suppression, detached reappraisal, and focused-breathing required participants to inhibit and reduce their emotional responses. Error bars indicate standard errors. No differences were significant between instruction conditions for young and older adults.

Summary of SCL data. Young and older adults responded with greater levels of skin conductance whilst viewing sad films, when compared with responses to neutral films. Compared to watching films naturally, there were no changes in SCL scores when instructed to regulate expression to emotionally intense stimuli. Additionally, compared with young, older adults responded with significantly lower skin conductance activity. Thus, relative to young, older adults had less physiological arousal in response to emotional films.

Self-Reported Emotional Experience

Preliminary analyses. Checks of emotion ratings were first conducted on films viewed in the watch conditions. Sad films were rated as evoking greater feelings of sadness (M = 6.75, SD = 2.25) than amusement (M = 1.64, SD = 1.32), $t(79) = 16.32$, $p < .001$, d = 2.77.

Analysis of self-reported sadness. This analysis was designed to determine the capacity both age groups could regulate their internal experience of emotion using three strategies. Subjective experience of sadness to the films was analysed with a 2 (Age Group; young, older) x 4 (Instruction; watch, expressive suppression, detached reappraisal, focused-breathing) mixed ANOVA. The dependent variable was the self-reported emotional rating of sadness. Young and older adults' mean scores for self-reported experience in each instruction condition are displayed in Figure 6.3.

There was a main effect of age group, $F(1, 78) = 21.76$, $p < .001$, $\eta_p^2 = .22$, with older adults (M = 7.59, SD = 1.85) rating greater feelings of sadness than young adults (M = 5.89, SD = 2.19). There was no main effect of instruction, $F(2.51, 195.78) = 1.78$, $p = .162$, $\eta_p^2 = .02$, or an Age Group x Instruction interaction, $F(2.51, 195.78) = 0.49$, $p = .655$, η_p^2 = .01.

Summary of self-report data. In response to viewing sad films, older adults self-reported greater levels of sadness than young adults. There were no differences between instruction conditions in subjective responses to these films.

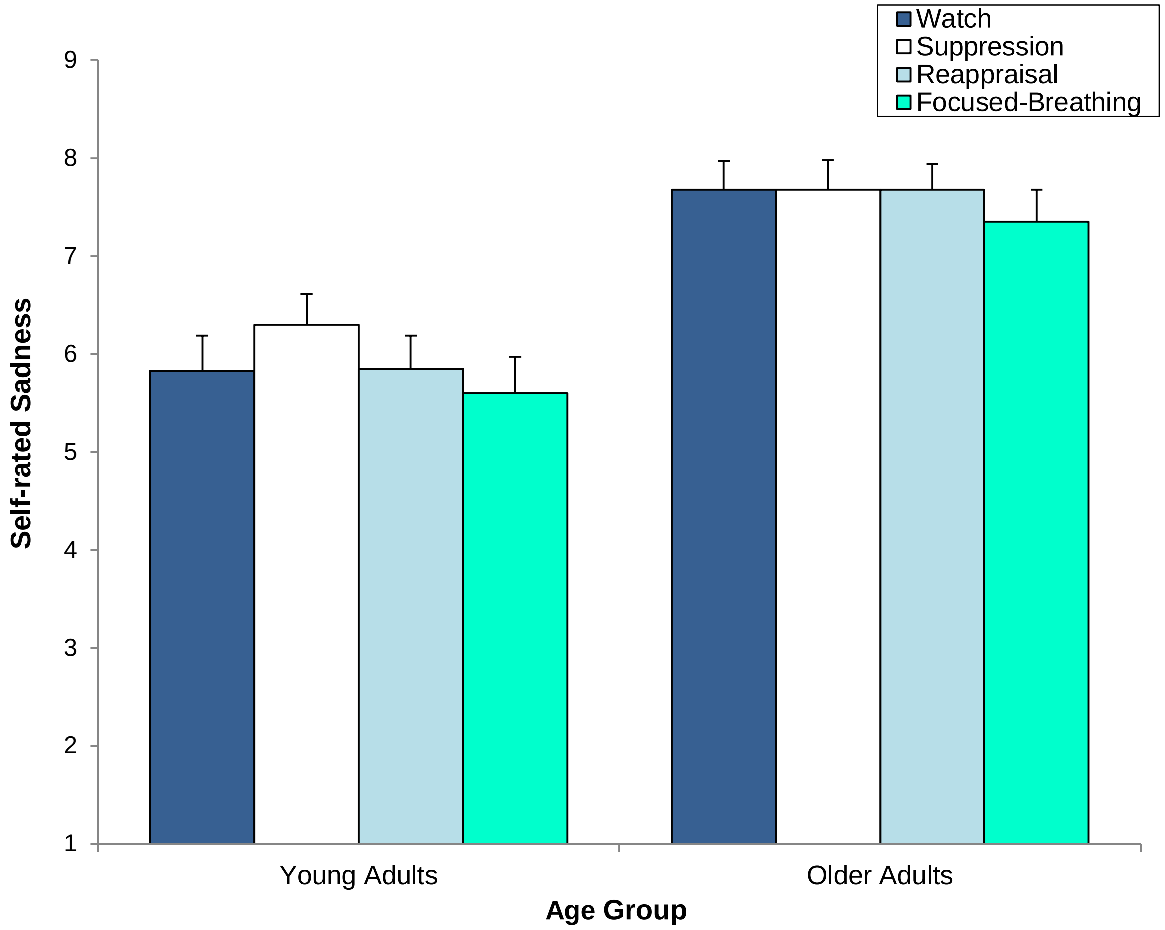

Figure 6.3. Mean scores of self-reported sadness for sad films. A higher rating indicates an "extremely sad" subjective experience, whereas, a lower rating indicates "not at all sad". Expressive suppression, detached reappraisal, and focused-breathing required participants to inhibit and reduce their emotional responses. Error bars indicate standard errors. No differences were significant between instruction conditions for young and older adults.

Impact of Strategy Use on Memory Performance

Analysis of memory recall. This analysis was designed to determine whether the use of different emotion regulation strategies influence the recall of film content viewed. Memory performance was analysed with a 2 (Age Group; young, older adults) x 4 (Instruction; watch, expressive suppression, detached reappraisal, focused-breathing) mixed ANOVA. The dependent variable was the percentage of film information accurately recalled. Young and older adults' mean scores for accurately recalled information in each instruction condition are displayed in Figure 6.4.

There was a main effect of age group, $F(1, 78) = 15.70$, $p < .001$, $\eta_p^2 = .17$, with young adults ($M = 53.13$, $SD = 17.07$) recalling a greater percentage of film information than older adults ($M = 43.70$, $SD = 18.14$). There was no main effect of instruction, $F(3, 234) = 0.58$, $p = .626$, $\eta_p^2 = .01$, or an Age Group x Instruction interaction, $F(3, 234) = 0.53$, $p = .661$, $\eta_p^2 = .01$.

Summary of recall across instruction conditions. Young adults recalled a greater percentage of information than older adults. For both age groups there was no hint of any differences between instruction conditions for the percentage of film content correctly recalled. The absence of main or interaction effects for instruction indicates there was also no memory costs for young and older adults in using expressive suppression, detached reappraisal, or focused-breathing as emotion regulation strategies for sad stimuli.

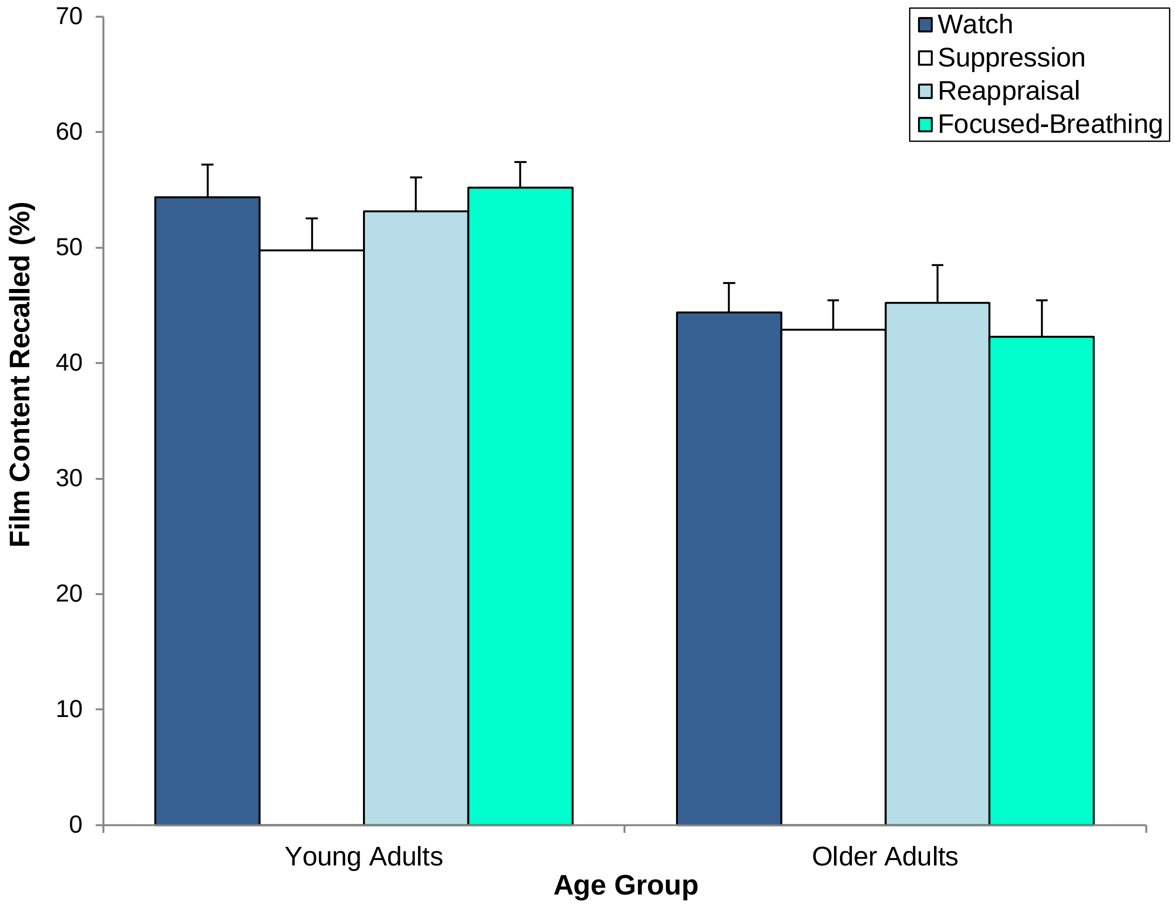

Figure 6.4. Mean scores of percentage of content accurately recalled from sad films. Expressive suppression, detached reappraisal, and focused-breathing required participants to inhibit and reduce their emotional responses. Error bars indicate standard errors. No differences were significant between instruction conditions for young and older adults.

6.4. Discussion

Alternative Emotion Regulation Strategies for Young and Older Adults

The current study investigated the effects of focused-breathing as an alternative emotion regulation strategy for young and older adults. The current study was particularly relevant given the findings of Study 3 where older adults were unable to regulate facial expressions of sadness, and the suggestion that additional strategies should be investigated to determine alternative strategies that may benefit older adults. Thus, the primary aim was to examine the emotional outcomes of using focused-breathing, in contrast with expressive suppression and detached reappraisal, to reduce emotional responses to a piloted set of sadness-eliciting films. For a comprehensive assessment of strategy effectiveness (Mauss & Robinson, 2010), changes to facial expression, physiological arousal, subjective experience, and memory performance were measured. The multimethod approach was designed to better understand how old age might impact the effectiveness of different regulation strategies on emotional and cognitive outcomes (Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009; Urry & Gross, 2010).

The findings from the current study were three-fold. First, older adults were confirmed to be effective at using focused-breathing to regulate facial expressions of emotion (indexed by *corrugator* EMG), but not subjective experience (indexed by self-report) or physiological arousal (indexed by SCL). Second, young adults, but not older adults, were able to regulate facial responses using expressive suppression and detached reappraisal. Third, for both age groups, it was confirmed that the use of focused-breathing did not impair memory performance of film content.

The focused-breathing strategy was uniquely beneficial for older adults in reducing negative facial expression in response to sad films. For older adults, facial reactivity was substantially lower in the focused-breathing condition compared to all other instruction conditions for both age groups. Compared with young adults, older may have been more invested or motivated in the task, or more comfortable in using the breathing technique. For instance, in previous research examining a breathing induction, the sample of young adults reported they did not place much effort in following the breathing instruction (Arch & Craske, 2006). Additional research is required to explore such age-related motivational factors to explain the effects of focused-breathing with the current sample.

Results from the current study also demonstrate that in the implementation of different emotion regulation strategies, age differences exist in the outcomes of such strategies on facial expressivity. That is, in the context of viewing sad films, young and older adults' negative facial responses differed according to the type of strategy used. For young adults, detached reappraisal was most effective at indirectly lowering facial reactivity, whereas, for older adults, focused-breathing was most effective. This suggests that strategies that require different skills and processes are impacted by age leading to varied emotional outcomes (Lohani & Isaacowitz, 2014). In an extension from Study 3, the current study therefore demonstrates that the effectiveness of different emotion regulation strategies may be specific to different age groups, as well as in the context of specific discrete emotions (i.e., sadness) during heightened emotional arousal.

Focused-breathing effects on facial expression. Data from the present study confirmed that focused-breathing can be used effectively and efficiently to indirectly regulate facial expressions of sadness. Young and older adults were able to reduce their negative facial expression (indexed by *corrugator* 'brow' facial EMG activity) using the focused-breathing strategy in comparison with responses during the unregulated watch condition. This suggests that for both age groups, directing attention to one's own breathing and modulating breathing patterns had a significant impact on reducing the intensity of expressed negative emotions.

The findings extend previous research that has demonstrated a specific mindfulness technique, that is mindful attention, was effective in reducing facial expression of emotion (Lalot et al., 2014). However, Lalot et al. (2014) only tested regulation performance in young adults responding to positive stimuli. Thus, the current findings provide evidence for young *and* older adults' use of a mindfulness technique (i.e., focused-breathing) as an alternative emotion regulation strategy in reducing negative expression. Moreover, results indicate that the single use of an intentional focused-breathing task was sufficient in the indirect regulation of facial reactivity. That is, extensive mindfulness training or breathing techniques (Davidson et al., 2003) were not required in order to obtain the benefits of a brief focused-breathing induction (Arch & Craske, 2006).

The current finding extends beyond the common emphasis given to response-focused strategies (e.g., expressive suppression) in altering behavioural responses of emotion (Dan-Glauser & Gross, 2011). Whilst expressive suppression directly inhibits the facial display of emotion, focused-breathing begins to target attentional processes earlier in the emotion generation process (i.e., during antecedent-focused temporal stages), affecting the unfolding of the emotional trajectory (Gross, 1998b). Such mindfulness-based techniques belong within the attentional deployment stage of regulation strategies, occurring before the formation of emotional appraisals and subsequent emotional behavioural (Gross & Thompson, 2007). Indeed, the focused-breathing strategy in the current study may have also relied on responses-focused processes, as participants were additionally instructed to modify their breathing patterns in order to reduce the emotional impact of the sad films. Consequently, the processes involved in the focused-breathing strategy resulted in decreased negative facial expression ‘frowning’ during the viewing of the unpleasant film for both age groups.

In understanding the relative effects of focused-breathing in comparison with empirically established emotion regulation strategies, two additional strategies were compared and contrasted. Thus, young and older adults’ regulation ability in using focused-breathing was compared with the instructions of expressive suppression (directly inhibiting emotional reactions) and detached reappraisal (revaluating the film objectively with detached interest). No other study had investigated age differences in the use of focused-breathing (or other mindfulness-based strategies for that matter), or compared with expressive suppression and detached reappraisal strategies. Compared with older adults, only young adults were effective at reducing their facial expressions of sadness when using expressive suppression and detached reappraisal strategies. Furthermore, young adults were significantly better at using detached reappraisal to reduce frown responses than expressive suppression. Whilst young adults benefited from the effects of focused-breathing in reducing facial reactivity, it was not their most effective strategy, with detached reappraisal found to be the most efficient for this age group.

For older adults, results indicate that focused-breathing was the only effective strategy to reduce negative expression when viewing sad films. The finding that older adults were unable to significantly reduce their negative expression using expressive suppression and detached reappraisal is inconsistent with results from Study 1 (Pedder et al., 2016) and previous research (Emery & Hess, 2011; Kunzmann et al., 2005; Lohani & Isaacowitz, 2014; Shiota & Levenson, 2009). One explanation is that the current sad stimuli evoked greater emotional responses, and consequently more challenging to reduce facial reactivity. For instance, with the current dynamic stimuli, both age groups were unable to reduce their muscle activity back to baseline levels, whereas, in Study 1, participants were more successful at diminishing facial reactivity in response to static stimuli. Older adult's inability to implement both strategies is also of surprise, given emotion regulation was potentially easier for older adults due to responding with significantly less *corrugator* activity than young adults during the watch condition (Study 1; Pedder et al., 2016). Indeed, it is also possible that given older adults' reduced emotional reactivity, there was a lesser degree of muscle activity needing to be regulated, therefore any regulation outcomes were less likely to reach statistical significance.

Focused-breathing effects on physiological arousal. Although focused-breathing led to a reduction in facial reactivity, the implementation of this strategy did not alter physiological arousal (indexed by SCL) for young or older adults. This is surprising given that focused-breathing is thought to influence the early emotion generation processes, before physiological responses have been completely activated (Gross, 1998b), and can thus modulate the intensity of such responses. Given that the focused-breathing instructions were directed at modifying the pace and rhythm of breathing, it is assumed such breathing would reduce sympathetic arousal once it occurs (Conrad et al., 2007; Gross, 1998c; Pal, Velkumary, & Madanmohan, 2004). Interestingly, in a recent study with young adults, deep and slow breathing through internal awareness and relaxation processes reduced SCL, whereas using external cues to pace breathing patterns did not alter SCL (Busch et al., 2012). Regular mindfulness practice may be required in order to achieve the benefits on the ANS (Prakash et al., 2014), which has been demonstrated with reduced baseline levels of physiological reactivity (Grecucci et al., 2015). However, the current data suggests that focused-breathing is effective in decreasing sadness for facial expressions, but not for physiological arousal. This highlights that, as with other regulation strategies, focused-breathing appears to alter different components of emotional states.

In addition to focused-breathing, the strategies of expressive suppression and detached reappraisal also did not influence levels of physiological arousal. That is, for young and older adults, no regulation instruction strategy was found to be effective at reducing SCL emotional outcomes compared to responses in the unregulated watch condition. Past research has demonstrated that compared with viewing negative stimuli naturally, there is an increase in physiological arousal with expressive suppression (Gross, 1998a; Hagemann et al., 2006), but no change with detached reappraisal (Gross, 1998a; Kim & Hamann, 2012). There were, however, age effects in physiological arousal responses to the sad films in the current study. Older adults produced smaller increases in SCL than young adults, which is consistent with previous research (Lohani & Isaacowitz, 2014).

A possible explanation for understanding the lack of instruction effects on physiological arousal could be related to the nature of sadness. A number of prior studies have shown that physiological activity (e.g., skin conductance, heart rate, respiration) are actually reduced or slowed in response to viewing sad stimuli (in align with withdrawal action tendencies) than other more intensive fight or flight emotions, such as fear or anger (Etzel et al., 2006; Fernández et al., 2012; Kreibig et al., 2007; Rainville, Bechara, Naqvi, & Damasio, 2006). Given this, skin conductance responses to sad may have been reduced relative to other more intensive emotional states, and thus there was less room or need to change physiological responses. Deep and slow respiration patterns are observed with sad emotional states (Etzel et al., 2006; Kreibig et al., 2007; Philippot, Chapelle, & Blairy, 2002), which is a similar pattern emphasised in the current focused-breathing instructions (e.g., “breathe out slowly to the count of three”). Therefore, focused-breathing effects may be more noticeable on physiological responses to emotional states of higher intensities (e.g., anxiety, anger) that would benefit from slowed respiratory pace and reduced physiological arousal.

Focused-breathing effects on subjective feelings. Despite the success of focused-breathing on reducing facial reactivity in young and older adults, the use of this strategy did not reduce subjective feelings of sadness (indexed by self-report). In fact, for both age groups, focused-breathing had no effect on self-reported experience to sad stimuli. In contrast, prior research has found that a short focused-breathing task resulted in lower levels of self-reported negative emotion for young adults (Arch & Craske, 2006). Findings from the same research demonstrated that participants were able to tolerate negative stimuli for a longer period of time when using the focused-breathing strategy, compared to no strategy (Arch & Craske, 2006). It is therefore possible that focused-breathing changes the relationship with the emotional experience by enhancing the ability to tolerate such emotion, rather than reduce the emotional intensity. Considering the mixed findings between the current study and the previous research (Arch & Craske, 2006), additional research is needed to examine this further.

In addition to the lack of focused-breathing effects on self-report experiences, expressive suppression and detached reappraisal strategies did not influence subjective feelings of sadness. That is, for young and older adults, no regulation instruction strategy was found to be effective at reducing self-reported sadness compared to responses in the unregulated watch condition. Whilst prior research has consistently demonstrated that expressive suppression does not reduce negative emotional experience (Dan-Glauser & Gross, 2011; Emery & Hess, 2011; Gross & Levenson, 1993), it is surprising that detached reappraisal did not have an effect. Detached reappraisal has been shown to reduce unpleasant feelings to negative stimuli due to the focus on modifying emotional experience (Gross, 1998a; Kim & Hamann, 2012; Ray et al., 2010). That is, detached reappraisal (and potentially similar to focused-breathing) is suggested to influence the emotional trajectory at an earlier stage of Gross' (1998b) model, with the opportunity to alter internal emotional experience. It is possible that in the process of instructing participants to regulate their emotional states to sad films, that this in itself, lead to participants maintaining attention and continually checking in with their internal experience of sadness, thus continuing to experience sad emotional states. Additionally, it is possible that given the current set of sad films were piloted to be of high emotional intensity, that participants experienced difficulty reducing internal feelings of sadness.

Focused-breathing effects on memory. The current study also investigated the effects of focused-breathing on memory performance, which had not yet been previously tested. As outlined, stimulus recall provides an index of the cognitive demands associated with the implementation of certain emotion regulation strategies (Kryla-Lighthall & Mather, 2008). As predicted, compared with the unregulated watch condition, the use of focused-breathing did not decrease recall accuracy of film content for young or older adults. This indicates that focused-breathing may not be as resource demanding or as effortful as other emotion regulation approaches, such as expressive suppression (Bonanno et al., 2004; Robinson & Demaree, 2009). Despite participants being instructed to actively increase awareness and modify breathing patterns in response to sad films, the use of these techniques may have been more automatic and less cognitively taxing to implement effectively (Goldin & Gross, 2010). Spared memory costs with focused-breathing are consistent with other similar mindful emotion regulation strategies. For instance, in response to sad films, emotional acceptance has been shown to have no effect on memory performance, whereas expressive suppression resulted in reduced memory (Alberts et al., 2012).

Indeed, it was possible that given focused-breathing involves the ongoing attention to the inhalation and exhalation of each breath (Koole, 2009), that attentional resources could be directed away from the encoding of the film. However, given the lack of memory effects, it appears focused-breathing involves attentional processes that do not draw on the same (or all) attentional resources required during the encoding (and subsequent recall) of stimulus information. That is, ongoing awareness and focus on one's own breath does not appear to distract attention away from the emotional situation or event. Focused-breathing may rely on implicit cognitive pathways that do not interfere with memory encoding processes. However, distinguishing between the direct mechanisms at the cognitive (i.e., attention) or the somatic (body) level of focused-breathing is not able to be determined from the current data.

Additionally, the current study also examined the consequences of detached reappraisal and expressive suppression on memory. The prediction that, for both age groups, detached reappraisal would not result in changes to recall of film information was supported. However, for young adults (but not older adults), it was anticipated that use of expressive suppression would result in reduced memory performance relative to the unregulated watch condition. This prediction was not supported with the current data. Moreover, the type of emotion regulation strategy made no difference to accuracy in recall performance for both age groups. This is in contrast to prior research demonstrating that certain types of emotion regulation strategies, particularly with expressive suppression, influence memory performance in young adults (Emery & Hess, 2011; Richards & Gross, 1999). The lack of memory effects in the current study could be due to how memory was assessed. Previous research obtaining memory effects for expressive suppression used similar prompting questions regarding stimulus information in the current study (Bonanno et al., 2004; Robinson & Demaree, 2007, 2009). Such questions may have cued participants with prompts in retrieving accurate film information. Furthermore, whilst films were selected across differing decades, young adults may have been more familiar with the film, thereby offsetting memory declines associated with expressive suppression.

Mindful Emotion Regulation

The current study provides promising evidence towards the interplay between mindfulness and emotion regulation in an ageing sample. According to emotional and cognitive outcomes, the current data demonstrates that the immediate effects of the focused-breathing technique were effective and efficient as an emotion regulation strategy. Young and older adults were able to reduce negative facial expressions without costs to memory of the emotional scenes. However, focused-breathing along with detached reappraisal and expressive suppression did not alter self-reported feelings of sadness or physiological arousal in the current study. Focused-breathing is one mechanism of action underlying mindfulness practice, with the current research contributing to the growing understanding of the mindful emotion regulation construct (Chambers et al., 2009).

The breath is regarded as a core mechanism of mindfulness practice, and is often utilised similarly in other clinical approaches, such as Acceptance and Commitment Therapy (Hayes et al., 1999) and Dialectical Behavioural Therapy (Linehan, 1993). This is the first study to demonstrate that focused-breathing leads to a reduction in sad facial reactivity for young and older adults. Thus, the current study provides evidence that the mechanism of breathing is one way in which mindfulness processes contribute to emotion regulation. Whilst the efficacy of mindfulness on wellbeing are established, the specific mindfulness mechanisms are still poorly understood (Grecucci et al., 2015). Additional research is required to examine the extent to which mindful attention on the breath was influential in the focused-breathing strategy.

The current findings contribute to the understanding of mindfulness in influencing emotional responses for older adults, particularly in the case of regulating sadness. Sadness has been suggested to be of greater significance for older adults due to increased personal losses within social, cognitive, physical, and health domains (Lohani & Isaacowitz, 2014). This provides preliminary evidence towards the benefits of mindfulness training in older adults. Such training could focus on applying mindfulness-based techniques for older adults to effectively manage emotional responses (Prakash et al., 2014). Interestingly, extensive mindfulness training has shown to increase attentional and working memory resources in old age through moment-to-moment awareness, offsetting age-related declines in such cognitive areas (see Gard, Hölzel, & Lazar, 2014 for a review; Pagnoni & Cekic, 2007). One recent study has also demonstrated that a short-focused mindful breathing induction improved decision-making ability in older adults who had no prior mindfulness training (McHugh et al., 2010).

According to SST, older adults place greater emphasis on emotion regulation to maintain meaningful social relationships (Carstensen & Mikels, 2005; Charles & Carstensen, 2010). Given this importance, such mindfulness skills would benefit older adults in everyday situations to influence their emotional behaviours and maintain emotional wellbeing. That is, mindfulness promotes adaptive emotion regulation with increased awareness and flexibility in responding to emotional events (K. W. Brown & Ryan, 2003; Prakash et al., 2014). Furthermore, the current study expands on the emotion regulation literature to incorporate a mindful regulation strategy, which differs to the cognitive and behavioural-based strategies. This broadens our understanding into the use of mindfulness approaches to regulating emotion and determines the ability for young and older adults to implement such strategies.

Limitations and Future Directions

A consideration with the current study involves the use of a range of autonomic measures to record subtle changes in the SNS (e.g., heart rate, respiration volume and tide). Skin conductance was used to index physiological arousal, however, no differences between instruction conditions were found. However, it is possible that additional techniques, such as cardiovascular and respiratory measures, may reveal differential effects in comparisons across emotion regulation strategies (Gomez, Stahel, & Danuser, 2004; Lohani & Isaacowitz, 2014). For instance, the use of respiratory equipment could objectively measure the degree participants engaged in diaphragmatic breathing (compared with thoracic), which is associated with PSNS activation to soothe the SNS (Dan-Glauser & Gross, 2011; Greenberg, 2010; Ritz, Alatupa, Thöns, & Dahme, 2002). Thus, the use of more exhaustive autonomic measures would provide a more complete picture into ageing and the impact of focused-breathing on other aspects of physiological responding that occurs with emotional activation.

A further consideration relates to the instructions of the focused-breathing strategy and the understanding of mindfulness. The focused-breathing instructions directed participants to alter their respiration patterns (e.g., abdominal breathing) and actively use the breathing strategy to reduce any emotion that may arise. However, traditional teachings of mindful breathing do not direct individuals to control breathing patterns or instruct individuals to purposefully modify their emotional and physiological states (Feldman et al., 2010; Kabat-Zinn, 1990). Mindful breathing instead emphasises greater observation and acceptance of emotional experiences as they arise, providing an anchor, which indirectly alters the intensity of emotional responses. That is, mindfulness indirectly involves processes towards emotion regulation that focus attention on each breath to raise a state of consciousness, choice, and flexibility in responding to emotional states (Kabat-Zinn, 1990). Consequently, the focused-breathing strategy given to the current participants involved instructions from mindfulness techniques and the emotion regulation literature, and thus in line with growing mindful emotion regulation conceptualisation.

Relatedly, mindfulness involves invested time and commitment in training and practice (Alberts et al., 2012). Whilst the focused-breathing instructions were adapted from mindfulness of the breath scripts (Williams et al., 2007), and used in other studies (Arch & Craske, 2006), care must be taken in interpreting the findings as traditional mindfulness practice (Chambers et al., 2009). For a true measure of the mindfulness effects on emotional outcomes, participants would require prior extensive training and regular practice of mindfulness (Arch & Craske, 2006). Therefore, the focused-breathing strategy of the current study provides a technique that is akin to mindfulness practice in examining the immediate effects of a mindfulness induction on emotional responses.

Also of note, the focused-breathing condition may have been easier for participants to follow given the instructions were provided with more detail than those for detached reappraisal or expressive suppression. For instance, under the breathing condition participants received information regarding how emotions can affect one's breathing patterns and had an opportunity to practice this technique. This additional information and practice may have further assisted participants with more knowledge and awareness of their emotional responses, beyond that of simply following task-oriented instructions. Further investigation into the possible effects of practice and enhanced knowledge of emotions prior to emotion regulation is warranted.

Conclusion

The current study confirmed that for young and older adults, focused-breathing was an effective and efficient emotion regulation strategy for reducing facial expressions of sadness. Directing attention to the breath and balancing of breathing patterns was found to effectively reduce facial reactivity for both age groups while viewing sad films of high intensity. Furthermore, no costs to memory performance were observed, suggesting implementing the breath strategy does not affect demands on attentional resources required during stimulus encoding. The effects of focused-breathing were compared with expressive suppression and detached reappraisal strategies. According to changes in EMG muscle activity, focused-breathing appeared to be the most effective strategy at reducing facial reactivity for older adults, whereas, detached reappraisal appeared to be the most effective for young adults. Thus, the current study extends the findings of Study 3 by establishing evidence for alternative strategies that may better assist older adults in regulating strong negative emotions. These results contribute to the understanding of which emotion regulation strategies are most beneficial for each age group in influencing negative facial expressions.

In particular, this was the first study to demonstrate that focused-breathing holds practical implications in the regulation of emotional facial displays, which ultimately may assist older adults in strategies to manage emotional interactions in social situations. Findings from this study provide evidence towards the effectiveness of approaching emotion regulation with mindfulness-based techniques and extending this use to older adults. Participants did not require previous formal mindfulness training to benefit from the immediate effects of the focused-breathing technique on facial expression. However, there were no changes in self-reported sadness or physiological arousal, and it may be that with extended practice of mindful breathing may be required to achieve the benefits on subjective and SNS emotional outcomes. As the current study was the first to investigate the emotional effects of focused-breathing in older adults, further research is required to better understand this strategy in the context of mindful emotion regulation.

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CHAPTER 7: General Discussion

"It is clear that emotional arousal and expression are not always helpful or appropriate in therapy or in life and that, for some clients, training in the capacity for emotional down-regulation must precede or accompany utilization of emotion."

– Leslie S. Greenberg (2010)

Overview of Chapter

The current chapter provides an overall discussion into the outcomes of the research undertaken in this thesis on emotion regulation and ageing. The current thesis investigated the extent to which emotion regulation capacity is preserved in later life. Drawing on the evidence obtained from the novel use of facial electromyography (EMG) during the experimental studies, this chapter reviews findings that in some conditions older adults continue to be effective at regulating their emotions as well as young adults, however, there are limitations to such efforts, such as the use of specific strategies, heightened emotional responses, and negative emotions.

Two key explanations for successful emotion regulation in old age are reviewed and addressed. First, older adults were found to respond to emotional stimuli with reduced emotional reactivity compared to young adults, which may place fewer demands on cognitive resources and effort to engage in emotion regulation effectively. Second, older adults were found to be more effective at implementing specific emotion regulation strategies, demonstrating age differences in the benefits of different strategies. Summaries of the main aims, results, and conclusions of Studies 1, 2, 3, and 4 are also provided.

The theoretical, methodological, clinical, and real world implications are discussed in light of the current findings. These include greater understanding into the theoretical perspectives of emotion regulation in ageing, Gross' (1998b) process model of emotion regulation, and evidence towards mindful emotion regulation. This thesis also developed and piloted a new battery of dynamic films suitable for research with older adults, as well as utilised a comprehensive assessment of emotion regulation involving subjective, expressive, physiological, and cognitive outcome measures. Clinical and real world implications include evidence towards clinical treatment for older adults, support for therapeutic orientations, as well as reflections for the ageing populations.

The limitations and future directions are discussed in line with methodological issues and considerations related to emotion regulation in old age. These include the use of additional physiological measures of assessment, possible condition carryover effects, further examination of mindful emotion regulation strategies, and examination of specific sub-groups within the older adult population.

An overall conclusion for this thesis is provided, highlighting the complex nature of understanding emotion regulation capacity in older adults.

7.1. Overall Rationale and Review

The current thesis primarily investigated the extent to which emotion regulation is preserved in old age. Across Studies 1, 3, and 4, evidence from the novel use of facial electromyography (EMG), demonstrated that in some conditions older adults are able to regulate their emotional responses as well as young adults. However, there are specific limits to this capacity involving the type of strategy used, the intensity and type of emotion-eliciting stimuli, and the valence of the experienced and expressed emotion. Thus, the current research highlights that emotion regulation is not completely spared in later life, and that there are a number of complexities involved when considering the relationship between emotion regulation and ageing. A brief overview of the key findings are first provided below, before addressing proposed factors that might partly explain *how* older adults are able to regulate their emotions and the *limitations* in which emotion regulation capacity is spared for older adults. A brief summary of the aims and findings for each of the four studies are provided at the end of this section.

7.1.1 Key Findings Related to Emotion Regulation Capacity in Older Adults

Strategy effects. Study 4 found that, in response to sad films, older adults were effectively able to regulate negative facial expressions when using focused-breathing, but not when directed to use expressive suppression or cognitive ‘detached’ reappraisal strategies. This supports the suggestion that older adults may become more effective at implementing specific emotion regulation strategies, particularly those that compensate for age-related changes in available resources required for successful regulation. Indeed, the findings also highlighted that emotion regulation is limited for older adults when using more effortful and cognitively demanding strategies of expressive suppression and detached reappraisal.

Emotional intensity and type of stimuli effects. Study 1 (Pedder et al., 2016) revealed that older adults could regulate their facial expressions to positive and negative static pictures; however, when exposed to dynamic stimuli of heightened emotional intensity (such as emotion-eliciting films) in Study 3, older adults experienced difficulty in achieving emotion regulation goals. Thus, support was found for the suggestion that when emotional systems are heightened, more effort and greater resources are required in order for older adults to regulate. Thus, older adults experience emotion regulation impairments resulting from age-related cognitive changes that limited the availability of resources (in line with a component of dynamic integration theory; Labouvie-Vief, 2008).

Valence effects. Study 3 found that whilst older adults were effectively able to use expressive suppression to regulate facial muscle reactivity to amusing and happy films, they were unable to regulate facial reactivity to sad films. This suggests that older adults may be more impacted by negative emotional states, and thereby experience greater challenges in regulating negative facial expressions. This has clear implications when older adults attempt to regulate their facial expressions during unpleasant social interactions, such as consequences to maintaining pleasant interactions with others, and in accordance with motivations to maintain positive and reduce negative emotional states (socioemotional selectivity theory, SST; Carstensen et al., 1999).

Emotional reactivity. Across Studies 1, 3, and 4, it was consistently demonstrated that, during the spontaneous watch condition, older adults responded to positive and negative stimuli (pictures and films) with far less emotional facial (as indexed by facial EMG) and autonomic reactivity (as indexed by skin conductance level, SCL) than young adults. This supports the suggestion that age differences in emotional reactivity might partly explain emotion regulation success in older adults, due to requiring less effort and fewer resources to regulate emotion in old age (Pedder et al., 2016). The novel use of EMG methods was particularly beneficial for this research question, as it provided an objective measure of subtle changes in muscle activity associated with positive and negative emotions, and therefore more sensitive to age differences of which self-report or behavioural observations would not be able to determine as accurately (Phillips et al., 2008).

Memory costs. Regardless of the specific strategy, the emotional valence, or the type of stimuli viewed, older adults consistently did not demonstrate costs to memory performance following emotion regulation. Thus, this supports the suggestion that emotion regulation may become less effortful in old age, or utilise different processes and mechanisms that do not alter memory compared to young adults.

7.1.2 Emotion Regulation and Age Differences in Emotional Reactivity

To understand preserved emotion regulation capacity in old age, the current thesis examined whether emotion regulation may become easier for older adults due to expressing less emotional reactivity than young adults and therefore needing less effort to achieve regulation success. That is, due to age-related biological changes, older adults may respond to emotional events with less behavioural expression and physiological arousal than young adults, resulting in fewer cognitive resources required to effectively implement emotion regulation processes. Across studies, the current thesis investigated age differences in positive and negative facial muscle reactivity according to EMG recordings, physiological arousal according to SCL recordings, as well as subjective experience, whilst viewing emotion-eliciting pictures and films.

Prior to the commencement of the thesis, no other ageing study had used facial EMG techniques to investigate the outcomes of emotion regulation on facial expressions. Previous studies simply relied on self-report (Gross et al., 1997) or behavioural observations (Emery & Hess, 2011; Henry et al., 2009; Kunzmann et al., 2005; Magai et al., 2006; Shiota & Levenson, 2009). Since then, only one study has used *corrugator* EMG to measure older adults' regulation of negative emotional expression (Lohani & Isaacowitz, 2014), however, no study has yet measured the regulation of positive facial expression with *zygomaticus* EMG. In fact, only two ageing studies have so far investigated the effects of emotion regulation on the facial expression of positive emotions (Emery & Hess, 2011; Henry et al., 2009). Currently, the research from the thesis stands as the first to utilise EMG to measure regulation of positive emotions, and the second to utilise EMG to measure the regulation of negative emotions.

Furthermore, the use of facial EMG in the current thesis not only provided the objective measurement of emotion regulation effects on subtle changes in facial behaviour, but it also allowed the opportunity to measure and discover age differences in facial reactivity when young and older adults naturally responded to emotion-eliciting stimuli. Previous self-report and behavioural observation methods were unable to objectively and sensitively investigate the possibility that age differences in emotional reactivity might contribute to older adults' preserved emotion regulation.

Across Studies 1, 3, and 4, EMG evidence was consistently found for reduced emotional reactivity in older adults compared with young adults during the naturally watch conditions. Specifically, regarding facial reactivity, older adults responded to positive and negative stimuli with lower levels of *zygomaticus* (i.e., smiles and laughter) and *corrugator* (i.e., frowns) EMG muscle activity than young adults. Regarding physiological arousal, older adults also responded to positive and negative stimuli with lower levels of electrodermal reactivity (i.e., SCL) than young adults. However, regarding subjective experience, older adults reported the positive and negative stimuli to be of similar or greater emotional ratings than young adults. This indicates that reduced emotional reactivity could not be attributed to older adults perceiving stimuli as less intense. Furthermore, films used in Studies 3 and 4 were piloted and normed in Study 2 to be suitable stimuli for eliciting emotion in both young and older adults, which had not previously been undertaken in the ageing literature.

In the current thesis, the above-mentioned age-related pattern of reduced emotional facial and physiological reactivity, but maintained subjective experience, was consistent across different types of stimuli (pictures, films), different valences (positive, negative), different discrete emotions (amusement, happiness, sadness), different levels of emotional intensity (low, high arousal), and different samples of recruited participants. This consistency indicates that the findings of age differences in emotional reactivity are robust across multiple experimental conditions, and contributes a novel finding to the literature using facial EMG techniques.

Therefore, in investigating older adults' capacity for preserved emotion regulation, the current research thesis inadvertently found support for the explanation that older adults respond to emotional events with less facial reactivity (and less physiological arousal) than young adults, thereby potentially making emotion regulation efforts to reduce facial expressions less effortful. It is therefore possible that older adults require less cognitive resources to effectively implement emotion regulation. This novel set of findings provides greater insight into the emotional ageing process, and provides an explanation for understanding how older adults can successfully regulate their emotion despite age-related cognitive declines.

Further support was found for the contribution of age differences in emotional reactivity to understanding emotion regulation, when older adults' emotional states were evoked to produce greater emotional reactivity (as in Study 3 compared with Study 1). When older adults responded with increased facial reactivity to dynamic stimuli, their ability to regulate negative emotion was impaired. It is therefore possible that while older adults may experience a reduced need for cognitive resources when regulating their emotion in response to mildly or moderately arousing stimuli, their emotion regulation ability is impaired when experiencing heightened emotional arousal due to cognitive-emotional networks becoming overwhelmed. This is consistent with dynamic integration theory (Labouvie-Vief, 2008) and the strength and vulnerability integration model (SAVI; Charles, 2010), where older adults demonstrate greater difficulty in regulating strong emotional reactions due to greater pressure on biological vulnerabilities and flexibility that lead to a 'breakdown' of cognitive-emotional systems required for emotion regulation.

Indeed, it could be suggested that reduced emotional reactivity in old age is due to implicit emotion regulation processes (Mather & Knight, 2005), where older adults automatically seek to reduce emotions to more manageable and lower states (Charles & Luong, 2013). However, the current thesis also found similar patterns of reduced emotion reactivity for positive emotion states according to *zygomaticus* EMG activity. In line with the positivity bias (Mather & Knight, 2005), it would be unlikely that older adults are also implicitly regulating their positive states as well, given preferences for positive emotional experiences (see socioemotional selectivity theory, SST; Carstensen & Mikels, 2005).

Furthermore, to index the cognitive demands and effort involved in emotion regulation, the current thesis also measured memory performance of the emotional stimuli following emotion regulation. According to prior research using young adults, memory costs are observed with the engagement of cognitively demanding emotion regulation strategies (Gross, 2002; Robinson & Demaree, 2009). Across Studies 1, 3, and 4, older adults did not demonstrate impairments to memory performance, suggesting that emotion regulation processes were not as effortful or resource demanding as has been previously found with young adults (Emery & Hess, 2011; Richards et al., 2003). Therefore, the current thesis suggested that reduced emotional reactivity may make emotion regulation less effortful for older adults, and thereby the lack of memory costs provides further evidence to emotion regulation potentially becoming more efficient and relying on less demanding resources in old age.

In summary, evidence from this thesis provides novel findings towards an alternative way of understanding preserved emotion regulation capacity in old age without affecting memory performance. According to facial EMG *and* SCL, older adults responded to emotional pictures and films with reduced emotional reactivity (facial expressivity and physiological arousal) compared to young adults. It is therefore possible, compared with young adults that older adults require less cognitive resources and effort to effectively regulate their overt facial displays of emotion due to having less facial reactivity to reduce in the first place. The current findings provide an avenue for additional research that will contribute to a greater comprehensive understanding of how emotion regulation capacity is preserved into old age.

7.1.3 Age Differences in Effectiveness of Emotion Regulation Strategies

To enhance the understanding of emotion regulation capacity in old age, the current thesis also examined whether emotion regulation may become more efficient for older adults due to more effective use of specific regulatory strategies that optimise limited resources. That is, with life experience, increased wisdom, and changes in cognitive functioning, older adults may become more effective as using specific emotion regulation strategies that require fewer cognitive resources and less effort compared with young adults. Across studies, the current thesis investigated young and older adults’ ability to effectively regulate their emotional responses, without occurring memory costs, using a range of distinct strategies to static and dynamic stimuli of low and high emotional arousal. Emotion regulation capacity was compared using three strategies: expressive suppression, detached reappraisal, and focused-breathing.

In Study 1 (Pedder et al., 2016), older adults were effective in using expressive suppression and detached reappraisal strategies without costs to memory. That is, in response to positive and negative pictures, older adults were able to regulate their emotional expression (as indexed by facial EMG) and subjective experience (as indexed by self-report) as well as young adults. Therefore, on first examination, it appeared that emotion regulation was spared in old age, as older adults were successful at regulating emotional responses using both types of strategies.

However, Studies 3 and 4 demonstrated that there were limits to older adults' regulation capacity. Older adults experienced greater difficulty in regulating responses to more intense and negative emotionally arousing dynamic stimuli (i.e., films). Specifically, whilst no age or strategy differences where observed in the regulation of low arousing static pictures, there were age and strategy effects in the regulation of highly arousing negative films. In contrast, older adults were able to regulate their facial expressions to positive emotionally arousing stimuli, suggesting that there is also a valence effect in regulation ability for older adults. Whilst young adults were effective at regulating emotional facial expressions using expressive suppression, detached reappraisal, and focused-breathing (though not to baseline levels of neutral facial expressivity), older adults were only able to reduce negative expressions when directed to use the focused-breathing strategy. Therefore, the current thesis provides novel findings into the benefits for older adults to use mindful breathing techniques as an alternative emotion regulation strategy when responding to negative emotionally arousing events.

Given the age-related declines in executive functions (e.g., cognitive control, inhibition; Kryla-Lighthall & Mather, 2008) coupled with a smaller magnitude of prefrontal cortex (PFC) activation in older adults (Opitz, Rauch, et al., 2012), the cognitive resources needed for expressive suppression and detached reappraisal of highly arousing negative emotion may not be available in old age. Thus, compared with young, older adults demonstrated reduced effectiveness in implementing these strategies to regulate high intensity dynamic negative stimuli (Studies 3 and 4) than when responding to low arousing static stimuli (Study 1). On the other hand, focused-breathing may be less taxing on cognitive resources for older adults to implement effectively, and it does so without impacting memory performance. These findings are in line with the selection, optimisation, and compensation with emotion regulation framework (SOC-ER; Urry & Gross, 2010), which suggests that due to changes in cognitive resources older adults may better optimise more efficient strategies to compensate for limited availability of resources required for more effortful strategies.

In summary, the current thesis demonstrated that emotion regulation capacity is not entirely spared in old age, that there are circumstances in which regulatory efforts become impaired for older adults, such as when attempting to regulate facial expressions during negative situations of high emotional arousal. Support was found for focused-breathing to be an effective and efficient strategy for older adults, with expressive suppression and detached reappraisal only effective when responding to positive situations or low levels of negative emotional arousal. No other study has investigated age differences in the use of focused-breathing (or other mindfulness-based strategies for that matter), or has compared it with expressive suppression and detached reappraisal strategies. Indeed, the current thesis also used facial EMG as a novel technique for objectively measuring subtle changes in facial muscle activity, and thus provides greater sensitivity and accuracy in identifying differences in strategy effectiveness between young and older adults.

7.1.4 Summary of Each Specific Study

Study 1 (Chapter 3). The first study, now accepted for publication in *Psychology and Aging* (Pedder et al., 2016), investigated whether age differences in facial reactivity, or the type of strategy utilised, might contribute to explanations of how older adults can regulate their emotion as effectively as young adults. Participants viewed positive and negative pictures and were instructed to watch naturally, use expressive suppression, or use detached reappraisal strategies, followed by a surprise stimulus recall test. Results demonstrated that older adults could regulate their overt facial expression (as indexed by facial electromyography, EMG) and subjective experience of emotion (as indexed by self-report) as well as young adults, and could do so without impairing memory performance. No evidence was found to support the suggestion that the type of regulation strategy might contribute to preserved emotion regulation capacity in old age. That is, for both age groups, expressive suppression and detached reappraisal were just as successful in reducing facial expressions of emotion, and strategy conditions did not impact the number of emotional pictures recalled.

The results revealed that during the watch condition, older adults responded to emotional pictures with less *zygomaticus* (i.e., smiles) and less *corrugator* (i.e., frowns) EMG muscle activity relative to young adults. Coupled with the lack of memory costs associated with regulation efforts, the findings imply that older adults may maintain emotion regulation ability partly due to having less emotional facial reactivity to regulate. Given emotion regulation efforts require cognitive resources, it was therefore proposed that older adults may require fewer resources and less cognitive demands to achieve the same level of emotion regulation as young adults. Study 1 provided the first examination of how age differences in emotional reactivity contribute to preserved emotion regulation capacity in old age, with implications for understanding how older adults can successfully regulate facial displays of emotion in social interactions.

Study 2 (Chapter 4). The second study piloted a range of emotion-eliciting films that were suitable and empirically tested with both young *and* older adults, which could then be used in Studies 3 and 4. The dynamic stimuli were intended to evoke heightened levels of emotion reactivity and arousal that would place greater demands on emotion regulation efforts in the subsequent studies, and thereby provide an extension from the low arousing static pictures used in Study 1. Participants viewed a large range of amusing, happy, sad, and neutral films and were instructed to provide self-reported ratings of discrete emotions and emotional arousal. The final selection of films was chosen according to subjective ratings of the target emotion (e.g., amusement) and arousal with minimal levels of unrelated emotions (e.g., anger, disgust, fear, surprise). These findings clearly and consistently demonstrated that the films discretely elicited the target emotion. Amusing and sad films were also divided into low and high intensity conditions, so as to provide greater flexibility in eliciting variations in emotional reactivity.

Study 2 provided the first empirically tested battery of emotion-eliciting films to include both young and older adults during the stimulus testing process. Thus, the final selection of films was found to be suitable for both age groups and evoked similar levels of the target emotion. Methodological implications include the use of films for effectively eliciting discrete emotional states in experimental settings. Furthermore, the ageing literature could benefit from the use of the emotion-eliciting dynamic stimuli in testing specific age-related research questions.

Study 3 (Chapter 5). The third study further investigated age differences in facial reactivity as a contributor to preserved emotion regulation in later life, as well as the limits to older adults' regulation capacity, such as greater difficulty in regulating heightened positive or negative emotional responses. Specifically, given the proposal from Study 1 that older adults maintain emotion regulation success partly due to lower levels of emotional reactivity requiring less regulatory effort and resources than young adults, Study 3 examined whether older adults remained effective at regulating their overt facial expressions to dynamic stimuli of increased emotional arousal (extending from the static stimuli used in Study 1). Participants viewed amusing, happy, and sad emotion-eliciting films of varying intensities, piloted in Study 2, and were instructed to watch naturally or to regulate their facial behaviour using expressive suppression. Results confirmed that, during the watch condition, older adults responded with lower levels of emotional facial reactivity (as indexed by *zygomaticus* and *corrugator* EMG) and also physiological arousal (as indexed by skin conductance level, SCL) compared with young adults across emotional films.

Both age groups were able to reduce their positive facial expression whilst viewing high-intensity amusing films, but only young adults were able to reduce their negative facial expression whilst viewing sad films. Support was found for a component of Labouvie-Vief's (2008) dynamic integration theory, suggesting that the regulation of heightened negative emotional reactivity becomes more effortful for older adults, potentially due to greater cognitive demands and resources required to achieve emotion regulation goals. Indeed, both age groups demonstrated greater difficulty in reducing facial behaviour to baseline levels (i.e., a neutral expression), highlighting the increased challenges associated with dynamic long-lasting emotional stimuli than that of static pictures used in Study 1. The findings suggest that older adults might demonstrate impaired emotion regulation capacity when attempting to directly reduce facial expressions during social interactions of high negative emotional arousal.

Study 4 (Chapter 6). The final study extended on from Study 3 by investigating alternative strategies that may improve older adults' capacity to regulate highly negative emotion responses more effectively, particularly in light of older adults having difficulty in regulating responses to dynamic negative stimuli. Focused-breathing and detached reappraisal strategies were compared and contrasted with expressive suppression as they rely on different mechanisms, skills, and occur earlier in the emotion generation process, thereby becoming potentially more efficient and less effortful in old age. Participants viewed high-intensive sad films and were instructed to watch naturally or separately use each of the three emotion regulation strategies, followed by a surprise recall test of the content within each film. Results revealed that older adults effectively reduced negative facial expressions (as indexed by *corrugator* EMG activity) with focused-breathing, but not with expressive suppression or detached reappraisal strategies. Young adults were able to reduce overt facial expressions with all three strategies, but were most effective when using detached reappraisal.

The findings contribute to evidence of age differences in the effectiveness and efficiency of specific emotion regulation strategies during emotionally arousing negative situations. Study 4 was the first study to demonstrate that attention directed to the rhythm of each breath is an effective emotion regulation tool well into later life. Additionally, the use of focused-breathing does not impair accuracy of recalled film content, indicating that the attentional resources maintained stimulus encoding during the engagement of emotion regulation processes. The findings highlight practical implications in understanding which strategies are better suited to older adults when regulating facial expressions during social situations. Furthermore, on a clinical level, results provide evidence to the benefits of using mindfulness-based techniques as an effective emotion regulation tool for clients across early and late adulthood. Study 4 also contributes empirical support for the relatively new construct of mindful emotion regulation as an alternative approach to regulating emotions.

7.2. Implications and Contributions of the Findings

7.2.1 Theoretical Implications

Theories of emotion regulation and ageing. The current thesis contributes empirical evidence towards a range of theoretical perspectives on emotion regulation and ageing. For example, despite age-related cognitive declines, older adults were effectively able to regulate their emotional experiences and responses to stimuli of low emotional arousal (Study 1), providing evidence towards the emotional paradox of ageing (Mather, 2012). However, the current thesis demonstrated limits to emotion regulation capacity in old age, such as when faced with highly arousing negative situations (Studies 3 and 4). The latter studies highlight that not all emotion regulation abilities are spared with ageing, which is in line with predictions by dynamic integration theory (Labouvie-Vief, 2008) and SAVI (Charles & Luong, 2013) of compromised regulation with increased emotional arousal.

Accordingly, difficulties with emotion regulation challenge the notion of successful ageing and emotion wellbeing in later life. For instance, SST (Carstensen et al., 1999) suggests that emotion regulation is a crucial component in maintaining meaningfully close relationships and achieving optimal levels of emotional wellbeing for older adults (Suri & Gross, 2012). If older adults are limited in their ability to regulate facial displays of emotion, then this can have consequences on how older adults manage negative social interactions. Indeed, the capacity to regulate outward facial expressions of positive and negative emotion holds important implications to interpersonal interactions and wellbeing across the life span. For older adults, the skill of regulating facial expressions of emotion is particularly crucial in facilitating the ability to shape appropriate interactions with others (Kunzmann et al., 2005; F. R. Lang & Carstensen, 2002).

Findings from Study 4 provide support for the SOC-ER framework (Urry & Gross, 2010), particularly in times of emotionally heightened negative situations. For example, despite poor performances with expressive suppression and cognitive reappraisal, older adults were successfully able to regulate negative facial expressions when using focused-breathing. It is therefore possible in old age, that focused-breathing might require less effort and demands on cognitive resources to implement effectively. Therefore, the current research provides preliminary evidence towards the SOC-ER framework, in establishing that different strategies can be applied more successfully than others during different stages across the life span, which could be associated with the age-related changes in cognitive functioning and availability of resources for emotion regulation.

Gross' (1998b) process model of emotion regulation. Within the context of understanding age differences in the subjective, expressive, physiological, and cognitive outcomes of emotion regulation, results from the current thesis provide further evidence towards antecedent-focused and response-focused strategies proposed in Gross' (1998b) model. For example, Study 1 demonstrated the temporary component of the model, in demonstrating for young and older adults that strategies early in the emotion generation process (e.g., detached reappraisal) continue to impact the later stages of the emotional trajectory (e.g., facial expressions), whereas strategies late in the model (e.g., expressive suppression) were unable to alter early states of emotion (e.g., negative subjective experience). Similarly, the current thesis also provided psychophysiological evidence (EMG) towards the reduction of facial reactivity with strategies that do not directly target facial displays, such as with detached reappraisal and focused-breathing, and the conditions in which this may be limited (i.e., increased emotional arousal).

Furthermore, a valence effect was found when older adults were directed to use expressive suppression in Study 3. Whilst young adults could regulate positive and negative responses using this strategy, older adults could only regulate positive responses. Evidence from the current thesis highlights the importance of considering valence (and more specifically, discrete emotions such as amusement or sadness) when examining the outcomes of emotion regulation strategies. Thus, findings from the current research can be understood in the context of Gross' (1998b) model, in furthering the understanding of regulating positive and negative emotions for both young and older adults.

Mindful emotion regulation. The current research enhances the understanding of the concept of emotion regulation and emphasises the role of active mindfulness processes in influencing emotional responses. The knowledge around emotion regulation has grown beyond the traditional view as simply controlling and preventing negative emotions. Adaptive emotion regulation is better understood as involving the monitoring, evaluating, and modulating of a range of positive and negative emotional states (Erisman & Roemer, 2010; Farb et al., 2010). Mindfulness-based approaches, such as focused attention on the breath, provide an alternative means of facilitating adaptive regulation of emotional responses. For example, through the use of focused-breathing, greater awareness and flexibility can be applied in approaching regulation goals and ultimately achieving a balanced harmony of emotions (Davis & Hayes, 2011; Erisman & Roemer, 2010). As demonstrated with young and older adults in the current research, emotion regulation processes were engaged during the active facilitation of the focused-breathing task. Additional research is required to examine the extent to which greater awareness was influential in the focused-breathing strategy.

The current research contributes to the emotion regulation literature by expanding the focus of research to incorporate a mindful regulation strategy, which is outside the cognitive and behavioural-based approaches. This broadens our understanding into the use of a mindfulness approach to emotion regulation and determines the ability for young and older adults to implement such strategies. Mindful regulation approaches do not directly challenge or oppose emotional states, as is the case with expressive suppression in inhibiting emotional reactivity (Chambers et al., 2009; Erisman & Roemer, 2010). Such mindful regulation approaches are suggested to provide greater flexibility in approaching and relating to emotion, rather than directly acting on emotional thoughts and responses, as with expressive suppression and detached reappraisal (Chambers et al., 2009; Lalot et al., 2014).

7.2.2 Methodological Implications

Battery of emotion-eliciting films for older adults. The first methodological implication relates to the development of a battery of discrete emotion-eliciting films in Study 2 (e.g., amusing, happy, sad, and neutral films). This was the first known study to include older adults, in combination with young adults, during the testing process to obtain a selection of films that are suitable in eliciting discrete emotional states for both age groups. Films were rated as discretely eliciting the target emotion (e.g., sadness) with minimal ratings for unrelated emotions (e.g., amusement, anger, disgust, fear, surprise). No previous film normalisation studies have included young *and* older adults during the same stimulus standardisation process; therefore, the current thesis addresses a prominent methodological gap in the literature on emotion and ageing. Given the importance of age relevant stimuli highlighted by previous research (Kunzmann & Grühn, 2005; Stanley & Isaacowitz, 2014), it is essential that research on emotion is conducted with stimuli suitable and appropriate for both age groups (Beaudreau et al., 2009).

Furthermore, the battery of piloted stimuli in the current thesis is dynamic in nature, which provides experimental conditions of more intensive emotional responses than lower arousing static stimuli (Gross & Levenson, 1995; Sato et al., 2008). Dynamic films represent more lifelike experiences than static pictures due to their longer-lasting multimodal (visual and auditory) components and thereby improve ecological validity (Haase et al., 2012; Rottenberg et al., 2007). For example, the use of more emotionally evocative stimuli (films vs. pictures) in the current research created conditions that allowed for subtle age differences in the implementation of different strategy types to emerge. That is, whilst Study 1 found no age differences in using two emotion regulation strategies whilst responding to positive and negative pictures, Study 4 did find age and strategy effects (e.g., older adults reduced facial reactivity using focused-breathing, but not expressive suppression or detached reappraisal). Therefore, the battery of piloted films provides suitable and appropriate dynamic stimuli for investigating individual differences, such as age, and also for manipulating varying levels of emotional intensity (i.e., amusing and sad films of low- and high-intensity).

Additionally, a questionnaire that assesses memory of film content was developed to accompany the battery of selected films, and also includes a scoring grid for use in future studies (see Appendix E.11). This contributes to the field of emotional memory and ageing, as well as the growing interest in measuring memory performance following emotion regulation efforts (Emery & Hess, 2011; Pedder et al., 2016). In summary, the selection of films developed and piloted in Study 2, provide a source of experimental material for future studies that are seeking dynamic stimuli to effectively elicit discrete emotions in older adults during laboratory settings.

Assessment of emotion regulation. The second methodological implication relates to the comprehensive assessment of emotion regulation using a range of emotional and cognitive outcome measures. Across Studies 1, 3, and 4, psychophysiological equipment was used to objectively and sensitively measure subtle age differences in emotional reactivity and emotion regulation strategies. For example, whilst regulating responses to emotion-eliciting pictures and films, participants' facial expressions were recorded with subtle changes in *zygomaticus* and *corrugator* EMG muscle responses, and participants' physiological arousal was recorded with changes in SCL. Participants also provided subjective ratings of emotional experience on self-report scales. Furthermore, to index the cognitive demands and effort involved in explicit emotion regulation strategies, participants were given a surprise memory test to assess any age or strategy effects on recall performance.

A complete multimodal assessment is particularly important given the complex relationship between ageing, emotion regulation, and the differing effects on multiple channels within the emotion response system (Cacioppo et al., 1997; Magai et al., 2006; D. P. Smith et al., 2005). Findings from this thesis highlight the benefits of using multiple levels of assessment when investigating the effects of emotion regulation to obtain a clear picture towards the success and limitations associated with emotion regulation in old age. Consequently, research using minimal indices of emotion regulation ability can have a substantial impact into how emotion regulation capacity is understood in the research literature, with findings possibly generalised across the spectrum of emotional responses. For example, previous studies assessing emotion regulation have mostly relied on self-report or behavioural observation techniques (Emery & Hess, 2011; Henry et al., 2009; Phillips et al., 2008). Therefore, to obtain a comprehensive understanding of how ageing effects emotion regulation, it is necessary for ongoing research to complete a thorough assessment using a range of subjective, expressive, physiological, and cognitive outcomes measures.

7.2.3 Clinical and Real World Implications

Clinical treatment for older adults. The current results contribute knowledge and empirical evidence to the emotion regulation literature, which ultimately holds implications for improving clinical treatment and psychological interventions with older adults (Scheibe & Carstensen, 2010). With improved interventions, therapists can work directly with older adults to increase their emotion regulation competencies, enhance their emotional harmony, and improve psychological wellbeing (Koole, 2009). For example, no prior research has examined older adults' ability to regulate emotion using a focused-breathing technique (and also without extensive mindfulness training). The current research was the first to investigate and establish evidence for older adults' capacity to effectively alter their emotional responses using this technique, which provides preliminary evidence towards the usefulness of mindfulness training in older adults (A. Smith, 2004), as well as other health-related practices that enhance skills and knowledge with healthy breathing (e.g., yoga or tai chi).

When teaching emotion regulation techniques to clients, it is important that the strategy matches the client's resource and skill capacity (Urry & Gross, 2010). The current thesis provides evidence towards the effectiveness of a range of strategies for young and older adults. Such age group differences in emotion regulation success are particularly important considering the age differences in cognitive resources and executive functions (Hedden & Gabrieli, 2004). Knowing the most appropriate strategies will assist psychologists and counsellors in educating and working with clients of different age groups to employ suitable strategies that assist them in tolerating and managing unwanted emotions.

For instance, the current thesis found that for older adults, focused-breathing was most effective in regulating emotional responses, particularly when experiencing heightened arousal of negative emotions. Focused-breathing could therefore become a necessarily tool practiced with older adults engaged in therapy. In contrast, older adults demonstrated greater difficulty in successfully implementing detached reappraisal and expressive suppression strategies, which suggests that cognitive and behavioural-based interventions have limitations when older adults are faced with long-lasting emotionally arousing emotional events. Though, expressive suppression was found to be effective for regulating facial responses associated with amusement and happiness, therefore the type of strategy appears to also be valence specific. There is still minimal research into the types of emotion regulation strategies that either decline or improve with age, and which strategies are particularly helpful for maintaining mental health and social life across the life span (Scheibe & Carstensen, 2010).

Therapeutic orientations. Given the importance in addressing and enhancing emotion regulation capacity in clinical settings, the current research contains implications for clinical applications with young and older adults. Specifically, the findings contribute to better understanding the direct mechanisms involved in emotion regulation that underlie numerous therapeutic orientations, mainly cognitive behaviour therapy (CBT; Beck, 2011), acceptance and commitment therapy (ACT; Hayes et al., 1999), dialectical behavioural therapy (DBT; Linehan, 1993), and mindfulness approaches (Williams et al., 2007). For instance, detached reappraisal (a cognitive-based strategy) and expressive suppression (a behavioural-based strategy) were effective for young adults across various emotions and contexts, but only effective for older adults during low emotional arousal. Thus, the current study provides evidence towards a CBT approach to emotion regulation.

Furthermore, despite the momentum of mindfulness-based practices in clinical settings and the growing number of efficacy studies, there is minimal empirical research into the direct mechanisms of specific mindfulness practices and the relationship with emotion regulation processes (Arch & Craske, 2006; Feldman et al., 2010). The current thesis provides evidence for focused-breathing being an effective tool for clients across early and late adulthood to implement in order to manage their emotional responses. Thus, the current research also contributes to the benefits of mindfulness practices as an alternative to CBT approaches in working with emotion regulation skills. Mindful emotion regulation provides an alternative for clients to approach emotional goals through greater awareness, acceptance, and flexibility without having to challenge or control the emotional state (Chambers et al., 2009; Lalot et al., 2014). Further research could consider the effects of extensive mindfulness training on long-term benefits to emotion regulation, thereby extending the current findings beyond a brief focused-breathing induction in the laboratory setting.

The current research also provides support for the long history of breath in psychology and across therapeutic orientations (Edwards, 2011). In Study 4, the awareness of one's own breathing patterns as well as the modulation of deeper and slower paced breathing was effective in reducing the expression of negative emotion for both age groups. Whilst the current research examined the focused-breathing strategy in an immediate laboratory setting, ongoing and regular use may also be beneficial in the long-term. For instance, breathing practices in psychology emphasises quality of life improvements with healthy breathing patterns (Edwards, 2008). In therapeutic settings, breathing techniques are regularly given to clients with the goal of counteracting the respiratory changes that occur with unpleasant emotions, such as rapid, shallow, and irregular breathing patterns (Conrad et al., 2007; Philippot et al., 2002). The ability to modify breathing patterns, coupled with mindful awareness of the breath and emotions, provides important skills in regulating emotional distress, tolerating unwanted emotions, and enhancing emotional coping (Greenberg, 2010). The current research addresses gaps in empirical evidence by providing data that supports the benefits of a breathing technique in moderating facial reactivity well into old age.

Ageing population. Current global population trends are demonstrating a demographic increase of the percentage of older adults (Jeste et al., 2010). Indeed, of all projected changes to the Australian population, ageing is considered to be one of the most dramatic (Australian Bureau of Statistics, ABS, 2015). In 2014, the proportion of Australia's total population aged 65 years and over is reported at 14.7%, and it is estimated to increase to 24.5% by 2061 (ABS, 2015). This suggests that ageing will become increasingly more relevant towards mental and medical health services, such as psychiatry and psychology (Victoria Department of Health, 2012). Further understanding of daily emotional functioning in later life will aid the promotion and treatment of mental health within this age group (Scheibe & Zacher, 2013; Silvers et al., 2013). Any research pertaining to the health and emotional wellbeing of older adults is beneficial to ensure that the necessary care and support is available. Given the theoretical and empirical evidence linking emotion regulation and wellbeing in old age (Carstensen et al., 2011; Urry & Gross, 2010), this becomes of increased importance at an individual and a societal level (Silvers et al., 2013).

7.3. Limitations and Future Directions

7.3.1 Methodological Considerations

Physiological methods and outcomes. The first methodological consideration relates to the use of physiological techniques to assess emotional reactivity in young and older adults. The current thesis employed two distinct physiological measures of facial EMG and electrodermal (SCL) activation, providing clear and valuable evidence towards understanding changes to facial expressions and physiological reactivity with emotion regulation in ageing. Future research could measure other distinct physiological patterns, and thereby improve the generalisability of findings to other areas of autonomic responding (Mauss & Robinson, 2010). This is particularly important given the biological changes associated with ageing (Cacioppo et al., 1997; Mather et al., 2004), the different effects of discrete emotions on the autonomic nervous system (Kreibig, 2010; Levenson, 2014), and the physiological consequences of different emotion regulation strategies (Dan-Glauser & Gross, 2011). The use of additional measures, including eye tracking or cardiovascular and respiratory techniques, would provide a more comprehensive assessment of emotion regulation in old age (Kreibig et al., 2007; Shiota & Neufeld, 2014), and could help to determine the physiological consequences of specific strategies on older adults' heart rate or breathing patterns.

The use of physiological measures also comes with the benefit of assessing subtle changes to emotional responses as they unfold over time (Dan-Glauser & Gross, 2011; Etzel et al., 2006). Thus, an additional research area of interest could involve examining the time course of emotion regulation in older adults (Gross & Levenson, 1993). Such research could better distinguish where in the emotion generation process older adults are able to implement specific regulation strategies. For instance, given reduced processing speed and response times in old age (Eckert, 2011), older adults may be delayed in initiating emotion regulation strategies compared with young adults. Research into the temporal dynamics of emotion regulation provides an avenue to investigate this possibility (Koval et al., 2014). Analysis of physiological data over an extended time period may provide greater insight into which emotion regulation strategies are especially effective in altering the emotional response early, and have the ability to maintain such regulation efforts across time (Dan-Glauser & Gross, 2011). Evidence that demonstrates which strategies act early in the emotional trajectory is particularly beneficial for later life, given the increased difficulty older adults experience with heightened emotional responses (see Study 3 and in line with dynamic integration theory; Labouvie-Vief, 2008).

Psychophysiological techniques could also be applied to experience sampling methods, such as the use of wristbands with heart and skin conductance measures. Such methods could record changes in physiological arousal with emotion regulation (e.g., use of focused-breathing) as older adults encounter emotional aversive social situations. This would provide real time indices of the consequences of emotion regulation efforts on physiological arousal. Such methods would extend the current findings beyond the laboratory setting and enhance the ecological validity. Future research could examine whether the age differences in emotion regulation capacity found in this thesis are also evident in naturalistic settings.

Within-subjects design. Because of the within-subjects design, there are possible emotional carryover effects when responding to the emotional content of one stimulus to the next. This is particularly important for the highly arousing and dynamic stimuli used in Studies 3 and 4. For example, autonomic activity may have substantially increased when responding with laughter to the highly arousing amusing films, thereby requiring longer intervals between films to allow the sympathetic nervous system to return to baseline levels (Kreibig, 2010). The current thesis randomised emotional stimuli across conditions, however, the use of a distractor task or viewing a neutral film clip would also assist in returning emotional responses to baseline (Robinson & Demaree, 2009). Additionally, participants may have become desensitised with each subsequent emotional scene, or be increasingly affected by the stimuli, thus changing the trajectory of emotional responses throughout the testing session (e.g., the attenuation of physiological arousal associated with age; Levenson, 2000). Such effects would be most noticeable in self-report or SCL data where baseline responses were not recorded immediately prior to the onset of the stimulus (unlike EMG, which recorded a new baseline immediately prior to each stimulus). Indeed, strategies could become more or less effortful during the later conditions, depending on whether the participants' mood state had risen or lowered. Assessing positive and negative affect (using PANAS; D. Watson & Clark, 1994) may have assisted for measuring change in mood scores throughout the testing session.

A further consideration relates to the carryover effects of one emotion regulation strategy to the next. That is, with the use of within-subjects design in the current thesis, participants completed all instruction conditions, which included the watch condition as well as each strategy condition (e.g., expressive suppression, detached reappraisal, focused-breathing). Participants may have applied the skills from an earlier instructed strategy to a subsequent strategy in a later condition. To minimise any instruction carryover effects, the instruction order was either counterbalanced (Study 1) or randomised (Studies 3 and 4) within participants. However, future research should consider either using a between-subjects design, or utilise a distractor task between instruction conditions to further prevent carryover effects (e.g., see Lohani & Isaacowitz, 2014).

Reliability of instructed strategies. Similarly, whilst participants were instructed to use one specific strategy at a time, emotion regulation often involves the use of multiple processes throughout the emotion generation process (John & Gross, 2007). For example, individuals may simultaneously reappraise the meaning of the emotional event, inhibit their facial expressions, and breathe deeply to calm physiological arousal (Webb et al., 2012). Participants may have also engaged in implicit or automatic emotion regulation processes during the watch condition (Mauss et al., 2007). As older adults' emotional reactivity was significantly lower in facial EMG and SCL than young adults, it could be argued that older adults were in fact engaging in implicit emotion regulation processes (see Consedine & Mauss, 2014). However, older adults responded with lower psychophysiological activity to both positive and negative material. In line with the positivity effect (Isaacowitz et al., 2006), it would be anticipated that if older adults were implicitly regulating during the watch condition, that their emotional responses would only be reduced for the negative stimuli, and not the positive stimuli.

Indeed, participants in the current research were not requested to describe the strategy they had implemented following each condition. Therefore, despite task instructions, it is possible that participants may have selected mechanisms from multiple regulation strategies to achieve emotional goals, known as *coactive* emotion regulation (Webb et al., 2012). Specifically, during each condition it was not confirmed whether participants implemented a combination of specific strategies provided during the testing session or from alternative strategies (e.g., distraction or looking away from stimuli). Also, the ability to regulate emotion on command with a specified strategy may or may not reflect ones' capacity for emotion regulation success in real world situations. Research into ageing and emotion regulation could directly investigate strategy selection in the face of varying contextual conditions (Blanchard-Fields et al., 2007). To obtain such evidence of age differences in the natural selection of strategies, an additional condition could be included in which participants voluntarily choose and implement their own emotion regulation approach, or select between suggested strategies (Sheppes et al., 2012).

7.3.2 Considerations for Emotion Regulation in Old Age

Mechanisms involved in successful emotion regulation. The current thesis proposed that the observed age differences in emotional reactivity might require less cognitive resources and effort to regulate, thereby making emotion regulation less effortful for older than young adults. However, this thesis did not directly test emotional reactivity and cognitive demands as mediating mechanisms towards successful emotion regulation. Therefore, there are limits in the extent of this proposed relationship, leaving findings as speculative in nature, and serving as one contributor to understanding maintained emotion regulation capacity in later life. Future research could test the dynamic interplay of these variables directly to better understand the proposed relationship and other contributing mechanisms that underlie preserved emotion regulation across varying contexts (Isaacowitz & Blanchard-Fields, 2012).

In addition, further investigation that directly tests the cognitive mechanisms involved in emotion regulation in ageing is needed. This could involve examining conflicting theories of whether older adults do devote more resources to regulation, or whether emotion regulation becomes more efficient (Morgan & Scheibe, 2014). For instance, it is possible that older adults devote more cognitive resources to ensure emotion regulation is effective (Morgan & Scheibe, 2014). This could be due to a number of factors, such as decreased cognitive ability with age (e.g., executive functions) leading to compensation with increased allocation of available cognitive processes and resources (SOC-ER; Urry & Gross, 2010), or through motivational changes where greater priority is given to achieving emotional goals (SST; Carstensen et al., 2003). Alternatively, emotion regulation may become more efficient for older adults, by relying on more automatic processes developed across the life span (Morgan & Scheibe, 2014). This explanation is most fitting with the results of the current thesis, where older adults may use minimal cognitive resources due to having less emotional reactivity (specifically in situations of low emotional arousal). Further direct examination of the extent to which cognitive resources are implicated in different emotion regulation strategies for older adults is warranted. Such studies could deplete cognitive resources involved in specific strategies (e.g., inhibition for expressive suppression) and determine the success of implementing those strategies or the engagement of compensatory strategies (Dahm et al., 2011; Opitz, Gross, et al., 2012).

Mindful emotion regulation strategies. The current study only examined one strategy within the growing field of mindful emotion regulation, and therefore results of focused-breathing cannot be generalised to other types of mindfulness techniques. Investigating additional strategies would provide greater evidence towards the effects of mindfulness on emotion regulation processes in older adults. One such strategy that is receiving increased recognition, both therapeutically and academically, is acceptance (Alberts et al., 2012). Acceptance involves the active process of willingness to engage with negative emotions with greater awareness and understanding, but without judgment, reaction to, or need to control or avoid it (Shallcross et al., 2013; Williams et al., 2007). Ultimately, mindful acceptance changes one's relationship to negative emotional states, by learning to tolerate and allow the discomfort. In young adult samples, acceptance has been found to reduce negative states, particularly when compared with expressive suppression (Campbell-Sills et al., 2006; Eifert & Heffner, 2003; Levitt, Brown, Orsillo, & Barlow, 2004).

Acceptance may be a particularly promising emotion regulation strategy in later life for several reasons (Consedine & Mauss, 2014). First, acceptance is suggested to be more efficient in terms of resources than other strategies (Alberts et al., 2012) and therefore may be particularly more viable for older adults given their age-related cognitive declines (Shallcross et al., 2013). Second, acceptance of uncertainty and unpredictability is a key component of wisdom (Ardelt & Ferrari, 2014), and increased wisdom is associated with ageing and life satisfaction (Ardelt, 1997); therefore theoretically, acceptance is naturally associated with increasing age. In one recent study, older adults demonstrated increased levels of acceptance, which was associated with improved emotional outcomes (Shallcross et al., 2013). Further research on the range of mindful emotion regulation strategies (e.g., acceptance) and emotional outcomes (e.g., facial reactivity) would provide clearer understanding of the relationship between emotion regulation and mindfulness in older adults.

Older adults' perception of emotion. With increased wisdom and experience across the life span, older adults may come to better recognise the functional role of positive and negative states as part of human experience (Riediger et al., 2009). Depending on the situation, older adults may be more willing than young adults to approach unpleasant emotional states that hold adaptive purposes (Shallcross et al., 2013). Such willingness may consequently reduce the intensity of the emotional experience or response to appropriate and manageable moderate levels of emotion (Campbell-Sills et al., 2006). Rather than engaging in maladaptive processes or deliberately avoiding emotions, greater tolerance and willingness to allow and experience emotional states may contribute to better emotional wellbeing and recovery from unpleasant states (Erisman & Roemer, 2010; Haase et al., 2012). Therefore, in investigation of emotion regulation in old age, research should also consider age group differences into the willingness for young and older adults to approach and allow challenging emotional situations, as well as age differences in attitudes, wisdom, and relationship with emotional states.

Furthermore, different emotional states may hold different functional importance in old age. For instance, high self-reported sadness when responding to negative films has been found to be associated with higher levels of wellbeing in older adults than young or middle aged adults, whereas the opposite effect is found for anger (Haase et al., 2012). Other research has also demonstrated that sadness plays a particularly functional role in later life, such as enhancing social connectedness and eliciting support and sympathy from others (Andrews & Thomson, 2009; Lazarus, 1991; Stanley & Isaacowitz, 2014). It is therefore possible that older adults' willingness to approach and experience sadness may provide an alternative explanation for the lack of older adults' success in regulating their responses to the sad films of Studies 3 and 4. However, such questions are unable to be addressed using the current data. Additional research should explore the relationship between age, emotion regulation, and the functional role of emotional states, including older adults' willingness to tolerate and experience discrete emotional states.

Recruitment of healthy older adults. A further consideration with the current thesis is the focus on healthy older adults. The recruited samples of older adults comprised of independent community dwelling individuals, with self-reported high positive affect, estimated scores of above average intellectual ability, and with no major psychological, neurological, or health-related problems. Indeed, the current samples are representative of a substantial proportion of the general ageing population (ABS, 2013), and therefore the current findings hold clinical and real world implications for these older adults. Future research could also investigate emotion regulation in older adults who may be experiencing clinical concerns, such as mild cognitive impairments, physical health complaints, or mental health issues. These members of the community may benefit the most from emotion regulation research, with evidence to provide clear practical implications for how these older adults could better manage difficult emotional situations and increase emotional wellbeing. Only a few studies have examined emotion regulation capacity in clinical groups within the ageing population, such as those with Alzheimer's disease (Henry et al., 2009) or depression (Nolen-Hoeksema & Aldao, 2011; Smoski et al., 2013), with findings suggesting different effects according to the type of strategy. Therefore, future research could also extend the current experimental studies by assessing older adults who are more vulnerable to psychological or neurological health related concerns.

A second consideration is related to the age range of the recruited sample. Across studies in the current thesis, older adults were aged between 60 to 85 years (with a mean close to 72 years), and are referred to in the ageing literature as the young-old (Kunzmann & Grühn, 2005). Therefore, for older adults aged above 85 years (referred to as oldest-old sample) there still remains uncertainty about the age-related patterns of emotional reactivity and emotion regulation capacity. Given the dramatic changes to biological and cognitive functioning in this late stage of life, oldest-old samples may perform quite differently on tasks assessing emotion regulation. For instance, this age group may respond with reduced physiological flexibility (SAVI; Charles & Luong, 2013), limited connectivity with prefrontal regions of the brain (Allard & Kensinger, 2014a), and with even less cognitive resources available for regulation (SOC-ER; Opitz, Gross, et al., 2012). Indeed, findings have suggested that experience of positive emotion decline during the oldest years, which may indicate reduced emotion regulation ability (for a review, see Mroczek, 2001). It is therefore important that future research also investigate emotion regulation capacity in this oldest-old age group.

7.4. Conclusions

In investigating the extent to which emotion regulation capacity is preserved in old age, the current research thesis identified possible contributors to how older adults regulate their emotions as well as young adults, and the limitations to their regulation ability. Specifically, this thesis found evidence for two key explanations in understanding older adults' emotion regulation ability. First, support was consistently found for the suggestion that older adults respond to emotional pictures and films with less emotional reactivity than young adults (according to facial EMG and SCL), and therefore may require less effort and cognitive resources to successfully regulate facial expressions. However, when faced with dynamic stimuli of heightened emotional arousal, older adults' emotion regulation ability was impaired when using the strategy of expressive suppression to reduce negative facial expressions. In contrast, the regulation of positive facial expressions was spared with ageing, suggesting a valence effect occurs when directed to use expressive suppression for dynamic stimuli of increased emotional intensity. Second, support was found for the suggestion that older adults may become more effective at implementing specific emotion regulation strategies when responding to stimuli of high emotional arousal. That is, older adults were uniquely able to regulate their facial expressions using focused-breathing, but not when using detached reappraisal or expressive suppression, and could do so without changes to memory performance.

This thesis is the first to examine age differences in emotional reactivity as a contributor to preserved emotion regulation in older adults, and provides a platform for future investigation into the relationship between emotion regulation and emotion reactivity in ageing. This thesis is also the first to examine the use of focused-breathing as an alternative approach for young and older adults to regulate their emotional facial expressions, with particular benefits for older adults when compared to other strategies. The findings provide greater understanding into older adults' capacity to achieve emotion regulation goals, coupled with the comprehensive assessment of expressive, physiological, subjective, and cognitive outcomes of emotion regulation. This thesis significantly contributes to the literature on emotion regulation and ageing, with clear theoretical and clinical implications. Future research in this area would further enhance the understanding of the contributors to emotion regulation ability in older adults.

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Appendices

Appendix E: Study 3 and Study 4 Materials

E.1 Information Letter and Consent Form

E.2 Demographic Questionnaire

E.3 Nijmegen Breathing Questionnaire

E.4 Mindfulness Attention and Awareness Scale (MAAS)

E.5 Difficulties in Emotion Regulation Scale (DERS)

E.6 Emotion Regulation Task (with Films)

E.7 Self-Report Record Sheet

E.8 Focused-Breathing Condition

E.9 Selected Film Clips Piloted in Study 2

E.10 Video Memory Questionnaire

E.11 Scoring Grid for Video Memory Questionnaire

Appendix F: Research Portfolio

F.1 List of Publications

F.2 List of Publications Unrelated to Thesis but During Candidature

F.3 List of Conferences

F.4 Additional Presentations and Events

Appendix A Ethics Approval

A.1 Initial Ethics Approval

ACU
AUSTRALIAN CATHOLIC UNIVERSITY

Human Research Ethics Committee
Committee Approval Form

Principal Investigator/Supervisor: Peter Rendell

Co-Investigators: Gill Terrett

Student Researcher: David Pedder

Ethics approval has been granted for the following project:
Cognition and Emotion in Older Adulthood

for the period: 03/11/2011-03/09/2012

Human Research Ethics Committee (HREC) Register Number: V2011 28

Special Condition/s of Approval
Prior to commencement of your research, the following permissions are required to be submitted to the ACU HREC:

The following standard conditions as stipulated in the *National Statement on Ethical Conduct in Research Involving Humans* (2007) apply:

(i) that Principal Investigators / Supervisors provide, on the form supplied by the Human Research Ethics Committee, annual reports on matters such as:
- security of records
- compliance with approved consent procedures and documentation
- compliance with special conditions, and

(ii) that researchers report to the HREC immediately any matter that might affect the ethical acceptability of the protocol, such as:
- proposed changes to the protocol
- unforeseen circumstances or events
- adverse effects on participants

The HREC will conduct an audit each year of all projects deemed to be of more than low risk. There will also be random audits of a sample of projects considered to be of negligible risk and low risk on all campuses each year.

Within one month of the conclusion of the project, researchers are required to complete a *Final Report Form* and submit it to the local Research Services Officer.

If the project continues for more than one year, researchers are required to complete an *Annual Progress Report Form* and submit it to the local Research Services Officer within one month of the anniversary date of the ethics approval.

Signed: .... Date: ....03/11/2011............
(Research Services Officer)

Sample of Approval for Ethics Extension (15 November 2013)

V2011 28 Extension Approved

From: **Kylie Pashley**
Sent: Friday, 15 November 2013 11:04:36 AM
To: Dr Gill Terrett; Prof Peter Rendell; David Pedder; Dr Megan Willis; Christina Netscher
Cc: Kylie Pashley

Dear Peter Gregory,

Ethics Register Number : V2011 28
Project Title : Social Cognition and Emotion Processing in Adulthood
Data Collection Date Extended : 31/12/2014

Thank you for returning the Ethics Progress Report for your project.

The Deputy Chair of the Human Research Ethics Committee has approved your request to extend the period of data collection. The new expiry date for data collection is the 31/12/2014 .

We wish you well in this ongoing project.

Kind regards,
Kylie Pashley

Ethics Officer | Research Services
Office of the Deputy Vice Chancellor (Research)
Australian Catholic University
PO Box 456, Virginia, QLD, 4014
T: 07 3623 7429 F: 07 3623 7328

THIS IS AN AUTOMATICALLY GENERATED RESEARCHMASTER EMAIL

Appendix B Background Measures

B.1 Addenbrooke's Cognitive Examination – Revised (ACE-R)

The ACE-R has been removed from this copy.

B.2 National Adult Reading Test (NART)

The NART has been removed from this copy.

B.3 Trail Making Test (TMT)

The TMT been removed from this copy.

B.4 Short Word List – Delayed Recall

The Short Word List has been removed from this copy.

B.5 Hospital Anxiety and Depression Scale (HADS)

The HADS has been removed from this copy.

B.6 Positive and Negative Affect Schedule (PANAS)

The PANAS has been removed from this copy.

Appendix C Study 1 Materials

C.1 Information Letter and Consent Form

ACU
AUSTRALIAN CATHOLIC UNIVERSITY

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

INFORMATION LETTER TO PARTICIPANTS

Dear Participant,

You are invited to take part in a research project designed to study emotion and cognition in adulthood. This study will investigate your responses to photographs and include questions such as how happy or unhappy they make you feel. David Pedder is conducting this study as part of his PhD research project in psychology. The project is part of ongoing research investigating emotional functioning by Professor Peter Rendell and Dr Gill Terrett (Australian Catholic University) and Associate Professor Julie Henry (University of Queensland).

The current study involves two groups of participants of different ages. One group will comprise of younger adults (18 to 35 years) while the second will include older adults (65 to 89 years). Participants will be asked to complete a single testing session of up to two and a half hours at ACU's Melbourne campus, during which there will be opportunities for taking breaks. Participants will also be provided with a return paid envelope and asked to complete three additional questionnaires at home (totalling approximately 30 minutes). Participants will be reimbursed up to $30 for their involvement in this study.

During the session we will first ask you a few background questions about your education and general health. We will then ask you to complete several short questionnaires and paper and pencil tasks, such as word solving puzzles and visual tasks. One task requires that you read words aloud. We will need to record your responses for this task via audiotape in order to ensure accurate scoring.

There is also a main task where you will be asked to view a sequence of photographs displayed on screen. These images may elicit pleasant or unpleasant feelings and you will be asked to rate your mood following each block of six images. During the task, your skin responses will be recorded using non-invasive sensors placed on your skin (cheek, brow and finger). This task will also be recorded on videotape to provide a backup check of the accuracy of the skin measures. In addition, the videotapes may be independently rated by trained researchers working with Professor Rendell. They will view without sound and with no identifying information in a secure and private office.

Participation in this research project is voluntary. You are free to withdraw from the study at any stage without giving any reason. If you are an ACU student withdrawal from this study will in no way affect your ACU studies. Confidentiality will be maintained during the study and in any report. All participants will be given a code and names will not be retained with the data. The findings will be reported in a thesis, with a plan to also report the findings at a conference and/or in a scientific journal. It is emphasised that individual participants will not be able to be identified in any report of the study, as only aggregate data will be reported. Findings of the study will be made available to participants upon request.

Australian Catholic University Limited, ABN 15 050 192 660
Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
Locked Bag 4115 Fitzroy MCD VIC 3065 Australia
CRICOS registered provider: 00004G, 00112C, 00873F, 00885B

Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

ACU
AUSTRALIAN CATHOLIC UNIVERSITY

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

Any questions regarding this project can be directed to the Principal Supervisor, Professor Peter Rendell in the School of Psychology, St. Patrick's Campus (Australian Catholic University, 115 Victoria Parade, Fitzroy 3065, phone 03 9953 3126).

The Human Research Ethics Committee at Australian Catholic University has approved this study. In the event that you have any complaint or concern about the way you have been treated during the study, or if you have any query that the Student Researcher and Principal Supervisor have not been able to satisfy, you may write to:

Chair, Human Research Ethics Committee
C/o Research Services
Australian Catholic University
Locked Bag 4115
FITZROY, VIC. 3065 Tel: 03 9953 3157 Fax: 03 9953 3315

Any complaint will be treated in confidence and investigated fully and any participant lodging such a complaint will be informed of the outcome.

If you are willing to participate please sign the attached informed consent forms. You should sign both copies of the consent form and keep one copy for your records and return the other copy to the principal supervisor. Your support for the research project will be most appreciated.

Yours Sincerely

Professor Peter Rendell
Principal Supervisor

Dr Gill Terrett
Secondary Supervisor

David Pedder
Student Researcher

Assoc Prof Julie Henry
Co-Investigator

Australian Catholic University Limited, ABN 15 050 192 660
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Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

AUSTRALIAN CATHOLIC UNIVERSITY

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

INFORMED CONSENT FORM

Copy for Participant to Keep/Submit

I ……………………………………………………….. (*the participant*) have read and understood the information in the letter inviting participation in this research project, and any questions I have asked have been answered to my satisfaction.

I agree to participate in the activities as outlined in the information letter that involves completing a single testing session of up to two and a half hours at ACU and 30 minutes of questionnaires at home. This session will comprise of undertaking several short paper-and-pencil tasks, completing a task whilst viewing a sequence of photographs that may elicit pleasant or unpleasant emotions, and answering some background questionnaires. I agree to have non-invasive sensors placed on my skin (cheek, brow and finger) to record my skin responses. I also agree for my responses on some of the background tasks to be recorded on audiotape and I agree to be recorded on videotape when viewing the images during the main task.

I agree to participate in this study, realising that I can withdraw at any time. If I am an ACU student, I understand that withdrawal will in no way affect my ACU studies. I agree that research data collected for the study may be published or provided to other researchers in a form that does not identify me in any way. I agree to be contacted by telephone if needed to arrange a mutually convenient time to complete the research tasks. I am over 18 years of age.

Name of participant: ……………………………………………………. (block letters)

Signature: ………………………………………… Date: ………………………..

Principal Supervisor: Professor Peter Rendell

Signature …………..……..…… Date ……..……....

Student Researcher: David Pedder

Signature ……….......…..….. Date …..…..……....

Secondary Supervisor: Dr Gill Terrett

Signature …………..……..…… Date ……..……....

Co-Investigator: Assoc Prof Julie Henry

Signature ……….......…..….. Date …..…..……....

Australian Catholic University Limited, ABN 15 050 192 660
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Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

C.2 Demographic Questionnaire

Demographics Questionnaire

1. Age: .... years Date of birth: ....

2. Gender:

☐ Male

☐ Female

3. Is English your first language: ☐ Yes ☐ No

If not, how many years have you spoken English? ....

4. Country of birth: ....

5. Relationship status:

☐ Single ☐ Defacto ☐ Separated/Divorced

☐ Partnered ☐ Married ☐ Widowed

6. Occupation: ....

7. Highest level of education you have completed: ....

8. How would you describe your state of <u>health</u>:

a. Today?

☐ poor ☐ not very good ☐ good ☐ very good ☐ excellent

b. Over the last month?

☐ poor ☐ not very good ☐ good ☐ very good ☐ excellent

9. Do you have any difficulties with your <u>vision</u>? If yes, please describe:

☐ No

☐ Yes ....

10. Do you have any difficulties with your <u>hearing</u>? If yes, please describe:

☐ No

☐ Yes ....

11. How would you describe how you have been <u>sleeping</u> over the last few weeks?

☐ excellent ☐ very good ☐ good ☐ not very good ☐ poor

Thank You.

C.3 Emotion Regulation Task (with Pictures)

Welcome

1.

In this task, you will be asked to view several sets of images. Prior to each set, separate written instructions will be presented on the screen for you to complete. Following each set, you will then be asked to rate your emotional experience.

This task comprises of three stages of varying instructions. We ask that you try your best to keep your body posture as still as possible during each stage. Please also refrain from looking away from each image.

<spacebar>

2.

We will first complete one practice trial. You will have the opportunity to view one set of images and then rate your emotional experience.

We will then continue with the session.

<spacebar>

3.

Practice

4.

Please view the following images carefully.

Simply WATCH them as you naturally would without looking away from each image.

<spacebar>

5.

6. Blank screen

x

7. Orienting cross and “bop” sound

e.g., IAPS #7235
(chair)

8. Neutral stimuli (repeat slides 6-8 six times)

Now that you have viewed the first set of images, please provide a rating of your emotional experience during this trial.

Using the two scales provided on the sheet, rate how "happy" and how "aroused" you felt.

<Press SPACE when complete>

9.

Stage 1

10.

Please view the following images carefully.

Simply WATCH them as you naturally would without looking away from each image.

<spacebar>

11. Watch Instructions

e.g., IAPS #2340
(Grandfather and kids)

12. Positive stimuli (repeat 6 times)

Using both scales, please rate your emotional experience during this trial.

<Press SPACE when complete>

13.

Please view the following images carefully.

Simply WATCH them as you naturally would without looking away from each image.

<spacebar>

14. Watch Instructions

e.g., IAPS #1201 (spider)

15. Negative stimuli (repeat 6 times)

Using both scales, please rate your emotional experience during this trial.

<Press SPACE when complete>

16.

Stage 2

17.

Try to MINIMISE any emotional expression on your face, so that if someone were watching you, they could NOT to tell what you are feeling.

To do this, we would like you to reduce your facial muscles from displaying any emotion by keeping the relevant muscles on your face very still.

<spacebar>

18. Suppression Instructions

e.g., IAPS #1811
(laughing monkeys)

19. Positive stimuli (repeat 6 times)

Using both scales, please rate your emotional experience during this trial.

Please also describe what strategy you used to follow the instructions of this trial.

<Press SPACE when complete>

20.

Try to MINIMISE any emotional expression on your face, so that if someone were watching you, they could NOT to tell what you are feeling.

To do this, we would like you to reduce your facial muscles from displaying any emotion by keeping the relevant muscles on your face very still.

<spacebar>

21. Suppression Instructions

e.g., IAPS #9300
(dirty toilet)

22. Negative stimuli (repeat 6 times)

Using both scales, please rate your emotional experience during this trial.

Please also describe what strategy you used to follow the instructions of this trial.

<Press SPACE when complete>

23.

Stage 3

24.

Whilst viewing the following images, try to REFOCUS your thinking to imagine that the scenes in each picture are not real, but rather a part of a dream or movie.

To do this, we would like you to view each image with detached interest, viewing them objectively rather than as personally or emotionally relevant to you.

<spacebar>

25. Reappraisal Instructions

e.g., IAPS #9220
(couple at cemetery)

26. Negative stimuli (repeat 6 times)

Using both scales, please rate your emotional experience during this trial.

Please also describe what strategy you used to follow the instructions of this trial.

<Press SPACE when complete>

27.

Whilst viewing the following images, try to REFOCUS your thinking to imagine that the scenes in each picture are not real, but rather a part of a dream or movie.

To do this, we would like you to view each image with detached interest, viewing them objectively rather than as personally or emotionally relevant to you.

<spacebar>

28. Reappraisal Instructions

e.g., IAPS #7325
(girl with watermelon)

29. Positive stimuli (repeat 6 times)

Using both scales, please rate your emotional experience during this trial.

Please also describe what strategy you used to follow the instructions of this trial.

<Press SPACE when complete>

Thank you

30.

C.4 Self-Report Record Sheet

Emotion Rating Scales

Instructions:
On the two scales below, please rate your emotional reaction to the images you just viewed.

	1	2	3	4	5	6	7	8	9	
UNHAPPY	☐	☐	☐	☐	☐	☐	☐	☐	☐	***HAPPY***

Unhappy-Happy Scale: Mark a higher rating if your reaction was one of feeling "*happy, please, satisfied or hopeful*" or mark a lower rating if you felt "*unhappy, annoyed, unsatisfied* or *bored*".

	1	2	3	4	5	6	7	8	9	
CALM	☐	☐	☐	☐	☐	☐	☐	☐	☐	***AROUSED***

Calm-Aroused Scale: Mark a higher rating if your reaction was one of feeling "*stimulated, frenzied, excited* or *intense*" or mark a lower rating if you felt "*relaxed, sluggish, dull* or *sleepy*".

Strategy Check

In a few words, please describe what strategy you used to follow the instructions of this block.

……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………………………………………………………………………………………………..

C.5 IAPS Pictures

Item Numbers for Selected IAPS Pictures used in the Emotion Regulation Task

POSITIVE IMAGES

Set 1	**1811** Monkeys	**2332** Dog & Girl	**2530** Bicycle Couple	**4599** Young Couple2	**8190** Skiing on Mountain	**8620** Lady on Horse
Set 3	**1340** Bird Ladies	**1460** Cub in Tree	**1750** Bunnies	**4625** Young Couple	**5626** Hang glider	**8540** Trio Win
Set 5	**1722** Jaguars	**2070** Baby	**2091** Kittens & Kids	**2391** Pop fishing	**5621** Skydivers	**7325** Watermelon
Set 7	**1441** Polar Bears	**1710** Puppies	**2165** Dad & Baby	**2550** Old Couple	**8162** Hot Air Balloon	**8205** Water Ski Girls
Set 9	**1440** Seal	**1601** Giraffe	**2340** Pop & Kids	**2352** Cheek Kiss	**8496** Waterslide	**8497** Smiling Trio

NEGATIVE IMAGES

Set 2	**2095** Child with Flies	**2205** Hospital Older man	**6213** Terrorist	**9040** Starved Body	**9050** Plane Crash	**9140** Dead Cow
Set 4	**1301** Barking Dog	**3100** Burn Victim	**3160** Diseased Eyes	**6212** Soldier	**9592** Syringe	**9903** Car Accident
Set 6	**2703** African Children	**3181** Battered Female	**7380** Cockroaches	**9220** Couple at Cemetery	**7361** Meat Slicer	**9561** Sick Kitten
Set 8	**1050** Snake	**2900** Crying Boy	**3350** Hospital Baby	**9300** Toilet	**9429** Crowd Assault	**9921** Fire Body
Set 10	**1201** Spider	**3005** Open Grave	**3230** Dying Man	**3300** Disabled Child	**8485** Car Race Fire	**9042** Stick Thru Lips

NEUTRAL IMAGES

Set 11	**7002** Towel	**7004** Spoon	**7009** Mug	**7041** Barrels	**7090** Book	**7235** Chair

C.6 Picture Recall Task

Picture Recall Task

Instructions:

Using the space provided, please record as many images as you can remember from the Emotion Regulation Task. Write a description of each picture in as much detail as possible so it can be identified later.

Please spend no longer than 10 minutes on this.

Thank you.

Appendix D Study 2 Materials

D.1 Information Letter and Consent Form

AUSTRALIAN CATHOLIC UNIVERSITY

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

PARTICIPANT INFORMATION LETTER

Dear Participant,

You are invited to participate in the following research project.

What is the project about?
This research project is investigating emotional processing in adulthood, involving two groups of participants of different ages. One group will comprise of younger adults (18 to 35 years) while the second will include older adults (65 to 89 years). We are interested in how adults experience and express their emotions when viewing short video clips that may elicit pleasant or unpleasant feelings.

Who is undertaking the project?
This project is being conducted by David Pedder and will form the basis for the combined degree of MPsych (Clinical) and PhD at Australian Catholic University (ACU) under the supervision of Professor Peter Rendell and Dr Gill Terrett. This project is part of ongoing research in collaboration with Associate Professor Julie Henry at the University of Queensland.

What will I be asked to do?
Participants will be asked to complete a single testing session of up to 2.5 hours at ACU's Melbourne campus, during which there will be opportunities for taking breaks. We will first ask you a few background questions about your education and general health. We will then ask you to complete several short questionnaires and paper-and-pencil tasks. One task requires that you read words aloud, which we will record your responses via audiotape to ensure accurate scoring. For the main task you will be asked to view on a computer screen a sequence of brief film clips acquired from movies and TV shows. These film clips may elicit pleasant or unpleasant feelings and you will be asked to rate your mood following each clip.

Are there any risks associated with participating in this project?
There is no foreseeable risks, however, there is a chance that you may experience the video clips selected to elicit unpleasant feelings as uncomfortable. These short clips (approximately 1 minute in duration) have been selected from popular fictional movies and are not intended to elicit feelings of distress or fear. These clips are equally balanced with scenes selected to elicit pleasant feelings.

What are the benefits of the research project?
Participants will be reimbursed $30 for their involvement in this study. ACU students may alternatively complete this study for research credit.

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Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
Locked Bag 4115 Fitzroy MCD VIC 3065 Australia
CRICOS registered provider: 00004G, 00112C, 00873F, 00885B

Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

ACU
AUSTRALIAN CATHOLIC UNIVERSITY

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood

SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett

CO-INVESTIGATOR: Assoc Prof Julie Henry

STUDENT RESEARCHER: David Pedder

COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

Can I withdraw from the study?

Participation in this study is completely voluntary. You are not under any obligation to participate. If you agree to participate, you can withdraw from the study at any time without providing a reason and with no adverse consequences. If you are an ACU student withdrawal from this study will in no way affect your ACU studies.

Will anyone else know the results of the project?

Confidentiality will be maintained during the study and in any report. All participants will be given a code and names will not be retained with the data. The findings will be reported in a thesis, with a plan to also report the findings at a conference and/or in a scientific journal. It is emphasised that individual participants will not be able to be identified in any report of the study, as only aggregate data will be reported. Findings of the study will be made available to participants upon request.

Who do I contact if I have questions about the project?

Any questions regarding this project can be directed to the Principal Supervisor, Professor Peter Rendell on 03 9953 3126 in the School of Psychology, ACU, 115 Victoria Parade, Fitzroy 3065.

What if I have a complaint or any concerns?

This study has been approved by the Human Research Ethics Committee (HREC) at ACU with approval number V2011 28. If you have any complaints or concerns about the conduct of the project, you may write to the Chair of the HREC care of the Office of the Deputy Vice Chancellor (Research). Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

Chair, HREC, c/o Office of the Deputy Vice Chancellor (Research)
Australian Catholic University, Melbourne Campus
Locked Bag 4115, FITZROY, VIC, 3065
Ph: 03 9953 3150, Fax: 03 9953 3315
Email: res.ethics@acu.edu.au

I want to participate! How do I sign up?

If you are willing to participate please sign the attached informed consent forms. You should sign both copies of the consent form and keep one copy for your records and return the other copy to the researcher. Your support for the research project will be most appreciated

Yours sincerely,

Prof Peter Rendell
Principal Supervisor

David Pedder
Student Researcher

Dr Gill Terrett
Secondary Supervisor

Assoc Prof Julie Henry
Co-Investigator

Australian Catholic University Limited, ABN 15 050 192 660
Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
Locked Bag 4115 Fitzroy MCD VIC 3065 Australia
CRICOS registered provider: 00004G, 00112C, 00873F, 00885B

Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

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TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

INFORMED CONSENT FORM

Copy for Participant to Keep/Submit

I .... (*the participant*) have read and understood the information in the letter inviting participation in this research study, and any questions I have asked have been answered to my satisfaction.

I agree to participate in the activities as outlined in the information letter that involves completing a single testing session of up to 2.5 hours at the Australian Catholic University (ACU). This session will comprise of answering some questionnaires, undertaking several short paper-and-pencil tasks, and completing a main task that involves viewing a sequence of short film clips that may elicit pleasant or unpleasant emotions. I also agree for my responses on one of the background tasks to be recorded on audiotape.

I agree to participate in this study, realising that I can withdraw at any time. If I am an ACU student, I understand that withdrawal will in no way affect my ACU studies. I agree that research data collected for the study may be published or provided to other researchers in a form that does not identify me in any way. I agree to be contacted by telephone if needed to arrange a mutually convenient time to complete the research tasks. I am over 18 years of age.

Name of participant: .... (block letters)

Signature: .... Date: ....

☐ Please tick if you would be interested in being contacted for further research participation. This is optional and you may decline at any time.

☐ Please tick if you would like a copy of the results sent to you upon completion of the study.

Mailing or email address: ....

Principal Supervisor: Prof Peter Rendell

Signature Date

Student Researcher: David Pedder

Signature Date

Secondary Supervisor: Dr Gill Terrett

Signature

Co-Investigator: Assoc Prof Julie Henry

Signature Date

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Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
Locked Bag 4115 Fitzroy MCD VIC 3065 Australia
CRICOS registered provider: 00004G, 00112C, 00873F, 00885B

Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

D.2 Demographic Questionnaire

Demographic Information

1. Age: …………….. Date of Birth: ……………………..

2. Gender: ○ Male ○ Female ○ Other

3. Handedness: ○ Left ○ Right

4. Country of Birth: ……………..……………………..

5. Is English your first language? ○ Yes ○ No
   If not, how many years have you spoken English? ....

6. Current relationship status:
   ○ Single ○ Defacto ○ Separated/Divorced
   ○ Partnered ○ Married ○ Widowed

7. Occupation: ……………………….………….. ○ Current ○ Retired

8. Highest level of education completed: …………………………………………………

9. How would you best describe your state of health:
   a) Today?
   poor *not very good* *good* *very good* *excellent*

   b) Over the last month?
   poor *not very good* *good* *very good* *excellent*

10. Do you have any difficulties with your vision?
    ○ No
    ○ Yes, please describe: ..………………………………………………………….

11. Do you have any difficulties with your hearing?
    ○ No
    ○ Yes, please describe: ………..………………………………………………………...

Thank you

D.3 Video Rating Task (Pilot Study A)

Task instructions:

This task involves watching a series of short video clips taken from feature length films, television shows and YouTube. This task should take approximately 1.5 hours.

- Each video will play automatically. Please watch each scene carefully.
- Following each video, please rate the emotional experience *you* felt whilst watching it. Press spacebar when you're ready for the next video.
- Each video may elicit pleasant or unpleasant feelings. If you are uncomfortable with any scene, please press spacebar to skip.
- Please also wear headphones during this task, and adjust the volume as required.

Film Clips:

Film – Scene	Date	Source	Length (s)
Amusing Films (Low-intensity)			
Some Mothers Do Ave'Em – rollerskating	1973	TV show	107
Just for Laughs – horrible makeup prank	2011	TV show	101
Just for Laughs – waterpark urinate prank	2011	TV show	72
Mad TV – airplane service skit	2007	TV show	108
Cat cleans kitchen on vacuum cleaner	2013	YouTube	105
Austin Powers – hallway three point turn	1997	Movie	69
Caddyshack – boat lose in harbor	1980	Movie	120
Just for Laughs – news prank, told to duck	2011	TV show	120
Amusing Films (High-intensity)			
I Love Lucy – chocolate factory mishap	1952	TV show	122
Mr Bean – locked out of hotel room	1993	TV show	87
Just for Laughs – police underwear prank	2011	TV show	131
Baby laughing at paper being torn	2011	YouTube	103
Japanese dinosaur scare prank	2013	TV show	88
Walk on the Wild Side - talking animals	2009	TV show	104
The Naked Gun – learner driver car chase	1988	Movie	95
Just for Laughs – British guard prank	2011	TV show	79

Sad Films (Low-intensity)			
Dangerous Minds - news of student shooting	1995	Movie	126
My Dog Skip – dog with arthritis ending	2000	Movie	118
Fresh Prince of Bel-Air – drug use confession	1993	TV show	69
Midnight Cowboy – death on bus trip	1969	Movie	102
E.T. – goodbye to family	1982	Movie	140
Rabbit Hole – crying in car about memory	2010	Movie	99
Dear John – relationship breakup	2010	Movie	112
Seven Pounds – Ezra and Emily meet	2008	Movie	78
Sad Films (High-intensity)			
Sophie's Choice – can't choose which child	1982	Movie	132
The NeverEnding Story – Artax in swamp	1984	Movie	120
My Girl – best friend's funeral	1991	Movie	141
The Champ – boy crying of boxer's death	1979	Movie	139
The Green Mile – execution	1999	Movie	141
Click – father dying in the street	2006	Movie	120
Remember Me – 9/11 World Trade Centre	2010	Movie	120
The Impossible – family reunion	2012	Movie	126
Neutral Films			
Mountain goats	2010	Documentary	43
Mountain villagers	2010	Documentary	35
Lyre bird mimicking	2013	YouTube	71
Flowers in a valley	2010	Documentary	53
Castle information	2010	Documentary	40
Cooking pasta	2010	TV Show	79
Knitting technique	2012	YouTube	64
Watering tomatoes	2012	YouTube	62

D.4 Video Rating Scales (Pilot Study A)

1. Video Clip ID: ……………..

2. From the scene you just viewed, please rate the valence and intensity of your emotional experience.

Negative	1	2	3	4	5	6	7	8	9	**Positive**
Calm/ Dull	1	2	3	4	5	6	7	8	9	**Intense**

3. Using the scales below, please indicate the greatest amount of <u>each emotion</u> you felt whilst watching the scene.

	None / not at all				**Some / somewhat**				**Extremely / a great deal**
Amusement	1	2	3	4	5	6	7	8	9
Anger	1	2	3	4	5	6	7	8	9
Disgust	1	2	3	4	5	6	7	8	9
Fear	1	2	3	4	5	6	7	8	9
Sadness	1	2	3	4	5	6	7	8	9
Surprise	1	2	3	4	5	6	7	8	9
Confusion	1	2	3	4	5	6	7	8	9

4. Did you consciously try to avoid or suppress your feelings to this scene?

☐ Yes
☐ No

5. Have you seen this film clip before?

☐ Yes
☐ No

Comments (optional)

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

D.5 Video Rating Task (Pilot Study B)

Task instructions:

This task involves watching a few short video clips taken from feature length films. This task should take approximately 10 minutes.

- Each video will play automatically. Please watch each scene carefully.
- Following each video, please rate the emotional experience *you* felt whilst watching it. Press spacebar when you're ready for the next video.
- Please also wear headphones during this task, and adjust the volume as required.

Film Clips:

Film – Scene	Date	Source	Length (s)
Happy Films			
Love Actually – airport arrival before credits	2003	Movie	114
10 Things I Hate About You – singing to girl in stadium	1999	Movie	118
Kicking and Screaming – scoring winning goal	2005	Movie	77
500 Days of Summer – dancing in the street	2009	Movie	108

D.6 Video Rating Scales (Pilot Study B)

1. Video Clip ID: ……………..

2. From the scene you just viewed, please rate the valence and intensity of your emotional experience.

Negative	1	2	3	4	5	6	7	8	9	**Positive**
Calm/ Dull	1	2	3	4	5	6	7	8	9	**Intense**

3. Using the scales below, please indicate the greatest amount of <u>each emotion</u> you felt whilst watching the scene.

	None / not at all				**Some / somewhat**				**Extremely / a great deal**
Happiness	1	2	3	4	5	6	7	8	9
Anger	1	2	3	4	5	6	7	8	9
Disgust	1	2	3	4	5	6	7	8	9
Fear	1	2	3	4	5	6	7	8	9
Sadness	1	2	3	4	5	6	7	8	9
Surprise	1	2	3	4	5	6	7	8	9
Confusion	1	2	3	4	5	6	7	8	9

4. Did you consciously try to avoid or suppress your feelings to this scene?
- ☐ Yes
- ☐ No

5. Have you seen this film clip before?
- ☐ Yes
- ☐ No

Comments (optional)

………

………

………

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Appendix E Study 3 and Study 4 Materials

E.1 Information Letter and Consent Form

ACU
AUSTRALIAN CATHOLIC UNIVERSITY

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

INFORMATION LETTER TO PARTICIPANTS

Dear Participant,

You are invited to take part in a research project designed to study emotional processing in adulthood. This study will investigate your responses to short film clips and photographs that may elicit pleasant or unpleasant feelings. David Pedder is conducting this study as part of his PhD research in psychology. The project is part of ongoing research by Prof Peter Rendell and Dr Gill Terrett (Australian Catholic University) and Assoc Prof Julie Henry (University of Queensland).

The current study involves two groups of participants of different ages. One group will comprise of younger adults (18 to 35 years) while the second will include older adults (60 to 89 years). Participants will be asked to complete a single testing session of up to 2.5 hours at ACU's Melbourne campus, during which there will be opportunities for taking breaks. Participants will also be provided with a return paid envelope and asked to complete an additional questionnaire at home (approximately 15 minutes). Participants will be reimbursed $30 for their involvement in this study. ACU students may alternatively complete this study for research credit.

During the session we will first ask you a few background questions about your education and general health. We will then ask you to complete several short questionnaires and paper-and-pencil tasks. One task requires that you read words aloud. We will need to record your responses for this task via audiotape in order to ensure accurate scoring.

There is also two main tasks where you will be asked to view several short film clips and a sequence of photographs displayed on a screen. These clips and images may elicit pleasant or unpleasant feelings and you will be asked to rate your mood following each clip or block of images. During both tasks, your skin responses will be recorded using non-invasive sensors placed on your skin (cheek, brow and finger). These tasks will also be recorded on videotape to provide a backup check of the accuracy of the measures.

Participation in this research project is voluntary. You are free to withdraw from the study at any stage without giving any reason. If you are an ACU student withdrawal from this study will in no way affect your ACU studies. Confidentiality will be maintained during the study and in any report. All participants will be given a code and names will not be retained with the data. The findings will be reported in a thesis, with a plan to also report the findings at a conference and/or in a scientific journal. It is emphasised that individual participants will not be able to be identified in any report of the study, as only aggregate data will be reported. Findings of the study will be made available to participants upon request.

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Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
Locked Bag 4115 Fitzroy MCD VIC 3065 Australia
CRICOS registered provider: 00004G, 00112C, 00873F, 00885B

Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

TITLE OF STUDY: Emotion and Cognition in Adulthood

SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett

CO-INVESTIGATOR: Assoc Prof Julie Henry

STUDENT RESEARCHER: David Pedder

COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

Any questions regarding this project can be directed to the Primary Supervisor, Prof Peter Rendell in the School of Psychology, St. Patrick's Campus (Australian Catholic University, 115 Victoria Parade, Fitzroy 3065, phone 03 9953 3126).

The Human Research Ethics Committee at Australian Catholic University has approved this study. In the event that you have any complaint or concern about the way you have been treated during the study, or if you have any query that the Student Researcher and Primary Supervisor have not been able to satisfy, you may write to:

Chair, Human Research Ethics Committee
C/o Research Services
Australian Catholic University
Locked Bag 4115
FITZROY, VIC. 3065 Tel: 03 9953 3157 Fax: 03 9953 3315

Any complaint will be treated in confidence and investigated fully and any participant lodging such a complaint will be informed of the outcome.

If you are willing to participate please sign the attached informed consent forms. You should sign both copies of the consent form and keep one copy for your records and return the other copy to the primary supervisor. Your support for the research project will be most appreciated.

Yours Sincerely

Prof Peter Rendell
Primary Supervisor

Dr Gill Terrett
Secondary Supervisor

David Pedder
Student Researcher

Assoc Prof Julie Henry
Co-Investigator

Australian Catholic University Limited, ABN 15 050 192 660
Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
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Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

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THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

TITLE OF STUDY: Emotion and Cognition in Adulthood
SUPERVISORS: Prof Peter Rendell & Dr Gill Terrett
CO-INVESTIGATOR: Assoc Prof Julie Henry
STUDENT RESEARCHER: David Pedder
COURSE: Masters in Psychology (Clinical) / Doctor of Philosophy

INFORMED CONSENT FORM

Copy for Participant to Keep/Submit

I …………………………………………… (*the participant*) have read and understood the information in the letter inviting participation in this research study, and any questions I have asked have been answered to my satisfaction.

I agree to participate in the activities as outlined in the information letter that involves completing a single testing session of up to 2.5 hours at ACU and a 10-minute questionnaire at home. This session will comprise of answering some questionnaires, undertaking several short paper-and-pencil tasks, and completing two main tasks that involve viewing several short film clips and a sequence of photographs that may elicit pleasant or unpleasant emotions. I also agree to have non-invasive sensors placed on my skin (cheek, brow and finger) to record my skin responses. I agree for my responses on some of the background tasks to be recorded on audiotape and I agree to be recorded on videotape when viewing the clips and images during the main tasks.

I agree to participate in this study, realising that I can withdraw at any time. If I am an ACU student, I understand that withdrawal will in no way affect my ACU studies. I agree that research data collected for the study may be published or provided to other researchers in a form that does not identify me in any way. I agree to be contacted by telephone if needed to arrange a mutually convenient time to complete the research tasks. I am over 18 years of age.

Name of participant: …………………………………………………. (block letters)

Signature: ………………………………………… Date: ………………………..

☐ Please tick if you would be interested in being contacted for further research participation. This is optional and you may decline at any time.

☐ Please tick if you would like a copy of the results sent to you upon completion of the study.

Mailing or email address: ……………………………………………………………………..

Primary S[illegible]er Rendell

Signature [illegible]ate

Student Researcher: David Pedder

Signature [illegible]Date

Secondary Supervisor: Dr Gill Terrett

Signature

Co-Investigator: Assoc Prof Julie Henry

Signature Date

Australian Catholic University Limited, ABN 15 050 192 660
Melbourne Campus, 115 Victoria Parade Fitzroy Vic 3065, Australia
Locked Bag 4115 Fitzroy MCD VIC 3065 Australia
CRICOS registered provider: 00004G, 00112C, 00873F, 00885B

Professor Peter Rendell
Tel: 03 9953 3126 **Fax:** 03 9953 3205
Email: peter.rendell@acu.edu.au **Web:** www.acu.edu.au

E.2 Demographic Questionnaire

Participant Demographic Information

1. Age: …………….. Date of Birth: ……………………..
2. Gender: ○ Male ○ Female ○ Other
3. Handedness: ○ Left ○ Right ○ Both
4. Country of Birth: ……………..……………………..
5. Is English your first language? ○ Yes ○ No
   If not, how many years have you spoken English? ....
6. Current relationship status:
   ○ Single ○ Defacto ○ Separated/Divorced
   ○ Partnered ○ Married ○ Widowed
7. Occupation: ……………………………………..
8. Level of education completed: ……………………….
9. How would you best describe your state of health:
   a) Today?
   poor *not very good* *good* *very good* *excellent*
   b) Over the last month?
   poor *not very good* *good* *very good* *excellent*
10. Do you have any difficulties with your vision?
    ○ No
    ○ Yes, please describe: ..………………………………………………………….
11. Do you have any difficulties with your hearing?
    ○ No
    ○ Yes, please describe: ..………………………………………………………….
12. Have you ever suffered a brain injury or head trauma?
    ○ No
    ○ Yes, please record diagnosis and severity: ..………………………………………

……………………………………………………………………………………………….

13. Do you have or have had a diagnosed neurological condition (e.g., stroke, epilepsy, Alzheimer's, multiple sclerosis, Parkinson's)?
    ○ No
    ○ Yes, please record diagnosis and severity:

....

....

14. Do you currently have any diagnosed cardiac or pulmonary conditions (e.g., heart disease, heart beat irregularity, high blood pressure, asthma, breathing concerns)?
    ○ No
    ○ Yes, please record diagnosis and severity:

....

....

15. Do you currently have a diagnosed psychiatric illness (e.g., severe anxiety, major depression, psychosis)?
    ○ No
    ○ Yes, please record diagnosis:

....

....

16. Do you currently practice any meditation or relaxation techniques?
    ○ No
    ○ Yes, please record what type (e.g., frequency per week, how many months/years):

....

....

....

17. Have you ever had any formal mindfulness training or therapy?
    ○ No
    ○ Yes, please record when and for how long:

....

....

Thank you

E.3 Nijmegen Breathing Questionnaire

The Nijmegen Breathing Questionnaire has been removed from this copy.

E.4 Mindfulness Attention and Awareness Scale (MAAS)

The MAAS has been removed from this copy.

E.5 Difficulties in Emotion Regulation Scale (DERS)

The DERS has been removed from this copy.

E.6 Emotion Regulation Task (with Films)

Example of the Emotion Regulation Task for Sad Films

Welcome

1.

In this task, you will be shown a number of short film clips.

Prior to each film clip, we will provide you with specific instructions on how to view the scene. After each video press spacebar, then please rate your emotional experience.

Press the SPACEBAR to continue.

2.

Whilst viewing the videos, please refrain from looking away from the screen. Also try to keep your body posture and arms still and relaxed.

Press the SPACEBAR to continue.

3.

- - Practice - -

4.

Please relax and WATCH this video naturally.

Press SPACEBAR to continue.

5.

6. Blank screen

x

7. Orienting ‘x’ and acoustic ‘bop’

8. Video stimulus (neutral)

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

9.

- - Part A - -

10.

Before we begin, quietly rest and relax in your chair, keeping your arms, legs and body still for 20 seconds.

This screen will change when to continue.

11.

Instruction:

Simply WATCH this video as you naturally would.

Press SPACEBAR to start.

12.

13.

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

14.

Instruction:

Try to SUPPRESS any emotion that may arise so that if someone was watching, they could not tell what you were feeling.

Press SPACEBAR to start.

15.

16.

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

17.

- - Part B - -

18.

Before we begin, quietly rest and relax in your chair, keeping your arms, legs and body still for 20 seconds.

This screen will change when to continue.

19.

Instruction:

Whilst viewing the following video, try to REDUCE any emotion that may arise, by viewing the scene with detached interest. That is, viewing objectively rather than as personally or emotionally relevant to you.

Press SPACEBAR to Start.

20.

21.

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

22.

Information on Breathing

When experiencing unpleasant feelings, our breathing patterns change. Unaware, we may hold our breath, breathe fast, shallow, or hyperventilate.

It can be helpful to focus your attention on your breathing patterns, noticing how this affects your emotions.

Press SPACEBAR.

23.

Focused-Breathing

Focused-breathing involves breathing deep from the stomach, in a slow and smooth rhythm.
Breathing in through your nose, expanding the stomach outwards. Then breathing out through your nose or mouth, pulling your stomach inwards.
It can be helpful to say to yourself, "Breathing in, I feel calm. Breathing out, I feel at ease."

Press SPACEBAR.

24.

Practice

To practice this, the researcher will now go through a short breathing exercise with you.

Press SPACEBAR after you have practiced this.

25.

Instruction:

Whilst viewing the following video, try to REDUCE any emotion that may arise, by maintaining your focused-breathing techniques to minimise the emotional impact of the scene.

Press SPACEBAR to start.

26.

27.

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

28.

- - Part C - -

29.

Before we begin, quietly rest and relax in your chair, keeping your arms, legs and body still for 20 seconds.

This screen will change when to continue.

30.

Instruction:

Try to SUPPRESS any emotion that may arise so that if someone was watching, they could not tell what you were feeling.

Press SPACEBAR to start.

31.

32.

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

33.

Instruction:

Simply WATCH this video as you naturally would.

Press SPACEBAR to start.

34.

35.

Please rate your emotional experience.

Record your answers on the piece of paper and press SPACEBAR when completed.

You have now completed this task.
Thank you.

36.

E.7 Self-Report Record Sheet

Rating Emotional Experience

1. Have you seen this film clip before?

- ☐ Yes
- ☐ No
- ☐ Unsure

2. Using the scales below, please indicate the *greatest* amount of each emotion *you* felt whilst watching the film clip.

AMUSEMENT →

1	2	3	4	5	6	7	8	9
Not at all				Some				Extremely / A great deal

SADNESS →

1	2	3	4	5	6	7	8	9
Not at all				Some				Extremely / A great deal

←← POSITIVE vs NEGATIVE →→

1	2	3	4	5	6	7	8	9
Extremely Positive				Neutral				Extremely Negative

E.8 Focused-Breathing Condition

Focused-Breathing Instructions

Brief information
When experiencing unpleasant feelings, our breathing patterns change. Unaware, we may hold our breath, breathe fast, shallow, or hyperventilate. It can be helpful to focus your attention on your breathing patterns, noticing how this affects your emotions.

Instructions about focused-breathing
- Focused-breathing involves breathing deep from the stomach, in a slow and smooth rhythm.
- Breathing in through your nose, expanding the stomach outwards. Then breathing out through your nose or mouth, pulling your stomach inwards.
- It can be helpful to say to yourself, "Breathing in, I feel calm. Breathing out, I feel at ease."

Practice
To practice this, the researcher will now go through a short breathing exercise with you.

Researcher Instructions
Please go through the follow breathing exercise with the participant. Read aloud the below sentences in a calm tone and pace for the participant to follow comfortably.

1. For this practice, you may find it helpful to either close your eyes or focus on a spot in the room.
2. Become comfortable in your chair – sitting upright. Uncross your arms and legs, and place your feet flat on the floor.
3. The aim of the following is to direct your attention and awareness to your breath, noticing the sensation of each breath entering and leaving your body.
4. Now take a slow small breath in through your nose to the count of 2. Focusing on expanding your stomach as you breathe in.
5. Pause for 2 seconds.
6. Then breathe out slowly through your nose or mouth to the count of 3.
7. Breath in, 1, 2. Hold, 1, 2. Breathe out, 1, 2, 3.
8. Breath in, 1, 2. Hold, 1, 2. Breathe out, 1, 2, 3.
9. Now do this on your own, at your own pace, for three more breaths.
10. Remember to focus on the sensations of each breath. If your mind wanders, simply bring your attention back to your breath.

(wait for participant to complete the above)

11. When you are ready, open your eyes and we will continue.

E.9 Selected Film Clips Piloted in Study 2

Film – Scene	Source	Length (s)
Happy Films		
500 Days of Summer – Dancing in the street	Movie	108
10 Things I Hate About You – Singing to girl	Movie	118
Kicking and Screaming – Winning goal	Movie	77
Love Actually – Airport arrive ending	Movie	114
Amusing Films (Low-intensity)		
Cat Cleans Kitchen – Rides vacuum cleaner	YouTube	105
Austin Powers – Three point turn in hallway	Movie	69
Caddyshack – Boat causing chaos in harbour	Movie	120
Just for Laughs – News prank, told to duck	TV show	120
Amusing Films (High-intensity)		
I Love Lucy – Chocolate factory mishap	TV show	122
Mr Bean – Naked and locked out of hotel room	TV show	87
Just for Laughs – Police in underwear prank	TV show	131
Baby Laughing – Watching paper being torn	YouTube	103
Sad Films (Low-intensity)		
Dangerous Minds - News of student shooting	Movie	126
My Dog Skip – Arthritis of dog ending	Movie	118
Fresh Prince of Bel-Air – Drug use confession	TV show	69
Midnight Cowboy – Death on bus trip	Movie	102
Sad Films (High-intensity)		
Sophie's Choice – Can't choose which child	Movie	132
The NeverEnding Story – Artax sink in swamp	Movie	120
My Girl – Best friend's funeral	Movie	141
The Champ – Boy crying over boxer's death	Movie	139
Neutral Films		
Mountain Goats – Information on goats	Documentary	43
Knitting Demonstration – Viewing hands knit	YouTube	64

E.10 Video Memory Questionnaire

Memory Questionnaire of Videos

Instructions: Below are a series of questions relating to the film clips you just viewed. There will be some films clip which you did not view, please ignore the questions relating to this.

Please record your response to any of the questions that you remember. Some questions will be more difficult than others. When asked to recall specific information relating to each scene, this can include, but not limited to: names, locations, colours, clothing, dialogue, interactions and other relevant detail.

Mr Bean

1. What causes Mr Bean to leave his room? ……………………………………..…..
2. What is Mr Bean wearing when he is locked out? ………………………………..…..
3. What object does Mr Bean initially cover himself with? ……………………..…..
4. Mr Bean also covers himself with two signs, what do they say?
   a. …………………….. b. ……………………..
5. How many people almost discover Mr Bean? ………………………..…..
6. What is the last man, who almost discovers Mr Bean, carrying? ………………..

Baby Scene

1. What is the baby fascinated by and what is the reaction? ………………………..…..
   a. When does this reaction stop?……………………………………..…..
2. What is the name of the baby? ……………………………………..…..
3. Who is in the room with the baby? ……………………………………..…..
4. What is the baby wearing and what colour? ……………………………………..…..
5. What is the baby seated on and in which room? ……………………………..…..

Police Officer Prank

1. What are the police officers inspecting? ……………………………………..…..
2. What is the second police officer wearing? ………………………………..…..
3. How many men do the police officers speak with? ……………………………..
4. What is the first police officer holding in his hand? ………………………..…..
5. What is the last thing both police officers do? ………………………..…..
6. What do the police officers verbally say to the participants of the prank?
   ……………………………………..…

Chocolate Factory Scene

1. What is the name of Lucy's colleague? ….…………………………..…..
2. What three things does Lucy do with the chocolates when the boss arrives?
   a. ……………….. b. ………………. c. ……….…….
3. How many departments in the factory had Lucy's colleague worked in previously?
   ……………………………………..…..
4. What are the conditions of Lucy being fired? ………………………..…..
5. What does Lucy do when the conveyer belt speeds up? ………………………….….
6. What is Lucy wearing? ………………………………………..…..

Duck and Walk Prank

1. In which setting/location is this scene filmed? ……………………………..…..
2. Apart from walking/running, how else do people travel past the camera?
   a. ……..……….…. b. ………………… c. …………………
3. What is happening in the scene? ……………………………………..…..
4. How many people are involved in running the prank? ……………………..…..
5. How many walk behind the presenter? ……………………………………..…..
6. How many stop right next to the presenter? ………………………………..…..

Austin Powers – Vehicle Scene

1. What is happening in the main scene? ………………………………..…..
2. In the scene with Austin Powers:
   a. What is this person wearing? ………………………………………..…..
   b. What instructions does he give to this person? ……………………..…..
3. What colour is the vehicle? ………………………………………..…..
4. What is Austin Powers wearing? ……………………………………..…..
5. The scene crosses to another character, what is this person drinking? ……………..…..

Cat Cleans the Kitchen

1. How does the cat clean the kitchen? …………………………………..…..
2. What colour is the cat? …………………………………..…..
3. What is the cat wearing? …………………………………..…..
4. What is the lady in the kitchen doing? …………………………………..…..
5. What is the lady wearing? …………………………………..…..
6. Who/what else enters the kitchen? …………………………………..…..

Boat Scene

1. Briefly describe the scene? ……………………………………………..…..
2. What colour is the boat? …………………………………..…..
3. What are some of the things the boat almost collides with?
   a. ……….……….… d. …………...………
   b. ……….………….. e. ……….…………..
   c. ……….………….. f. ……………………..
4. Where does the anchor land? …………………………………..…..

Soccer Scene

1. What was so eventful about this scene? …………………………………..…..
2. What colour shirt was the key player wearing? ……………………………..…..
3. What is the name of the soccer team? …………………………………..…..
4. How many goals have the team now kicked? ……………………………..…..
5. What colour shirt is the goal keeper wearing? ……………………………..…..
6. When the match finishes, what does the key player do? ……………………..…..

Singing at a High School Scene

1. How does the male character enter the scene whilst singing? …………………..…..
2. What are the key lyrics of the song? …………………………………..…..
3. What causes the male character to stop singing? ……………………………..…..
4. What is the band wearing? …………………………………..…..
5. How does the crowd respond to the singer? ……………………………..…..
6. What is the female characters finale reaction to the situation?
   …………………………

Airport Scene

1. Who is the first person to enter the airport terminal? ……………………………..…..
2. When the young boy and girl meet, what style and colour hair does she have? ……………………………………..…..
3. What type of hat is Harriet wearing? ………….…………………..…..
4. What family member does Harriet have with her? …………………………..…..
5. What is the reaction of the girl in the red jacket? ……………………………..…..
6. What is shown in the last section of the film clip? …………………………..…..

Dance in Street Scene

1. What type of bag is the main character wearing and what is the colour? ……..…..
2. How many water features start when the character walks past? …………………..…..
3. What colour is the builder's hat that the main character high fives? …………..…..
4. What object does the main character catch when dancing with a group of people? ..……………………..…..
5. What is the animation in the film clip and what colour? ……………………..…..
6. Where does the character go at the end of the scene? …………………………..…..

Funeral Scene

1. Who is in the coffin? ……………………………………..…..
2. Where is the funeral held? ……………………………………..…..
3. Who goes up to the coffin? ……………………………………..…..
4. What two key things does this person ask?
   a. ……………………….. b. ……………………...…
5. Before entering the room, where does this person stop? ……………………..…..
6. In what decade was the person in the coffin born? …………………………..…..

Sophie's Choice – Choosing which Child

1. What language are the actors speaking? ……………………………………..…..
2. Which child does the mother give up? ……………………………………..…..
3. Is the scene in colour? ……………………………………..…..
4. What does the mother continue to repeat? ……………………………………..…..
5. What is in the background of the mother? ……………………………………..…..
6. Is this scene set during the day or night? ……………………………………..…..

Boy Crying over Death

1. What does the boy continue to repeat? ……………………………………..…..
2. What is the hair colour of the boy? ……………………………………..…..
3. What is the name of the boy? ……………………………………..…..
4. Who enters the room during the scene? ……………………………………..…..
5. What sport did the man play? ……………………………………..…..
6. When the person enters the room, what is outside? ……………………………..…..

Horse Scene

1. What is happening to the horse in this scene? ………………………………..…..
2. What is the name of the horse? ……………………………………..…..
3. What colour is the horse? ……………………………………..…..
4. What happens to the horse if he doesn't move? ……………………………..…..
5. Briefly describe the location: ……………………………………..…..
6. How does the boy try to save the horse? ……………………………………..…..

School Scene

1. How does the lead actress find out about the news? …………………………..…..
2. What is the bad news? ……………………………………..…..
3. Where does the "bad news" conversation take place? ………………………..…..
4. Who else is told about this news? ……………………………………..…..
5. Briefly describe the appearance of the second person to find out in the scene?
……………………………………..…..
6. How does the scene end? ……………………………………..…..

Bus Scene

1. What happens in this scene? ……………………………………..…..
2. What does the bus driver request the friend to do? ……………………….…..
3. What colour shirt is the man who died wearing? …………………………..…..
4. What destination is the bus travelling to? ……………………………………..…..
5. In which position of the bus are they seated? …………………………..…..
6. Is it day or nighttime? ……………………………………..…..

Dog Scene

1. What type of dog was it? ……………………………………..…..
2. What colour was the dog? ……………………………………..…..
3. What era was the film set in? ……………………………………..…..
4. What condition did the dog have? ……………………………………..…..
5. What does Skip need help getting onto? ……………………………………..…..
6. What did the dog love? ……………………………………..…..

Apology Scene

1. Briefly describe the location of the scene: ……………………………………..…..
2. What is the name of the person who took the pills? ………………………………..
3. How many people are in the scene? ……………………………………..…..
4. What is the name of the person apologising? ………………………………..…..
5. Is the apology accepted? ……………………………………..…..
6. Why did the person apologising buy the pills? ………………………………..…..

E.11 Scoring Grid for Video Memory Questionnaire

Amusing Films (High-Intensity) — Answers

	Mr Bean	2 pts	1 pt	0 pts
1	What causes Mr Bean to leave his room?	Tell neighbours to turn down music	Noisy neighbours	
2	What is Mr Bean wearing when he is locked out?	Nothing		
3	What object does Mr Bean initially cover himself with?	Fire extinguisher		
4	Mr Bean also covers himself with two signs, what do they say?	a) Private b) Exit	1 of 2 correct	
5	How many people almost discover Mr Bean?	Three		
6	What is the last man, who almost discovers Mr Bean, carrying?	Briefcase		

	Chocolate Factory Scene	2 pts	1 pt	0 pts
1	What is the name of Lucy's colleague?	Ethel		
2	What three things does Lucy do with the chocolates when the boss arrives?	a) Put in hat b) Down top c) Eats them	2 of 3 correct	
3	How many departments in the factory had Lucy's colleague worked in previously?	Three	Four	
4	What are the conditions of Lucy being fired?	If one piece of chocolate gets into the packing room unwrapped	Not all chocolates wrapped	
5	What does Lucy do when the conveyer belt speeds up?	Eat the chocolate & put to the side	List 1 action; panics	Concentrate
6	What is Lucy wearing?	Collared (buttoned) shirt with a bakers hat	Shirt with a hat; bakers hat	Hat; apron

	Police Officer Prank	2 pts	1 pt	0 pts
1	What are the police officers inspecting?	Wheels & bonnet of car	Car	
2	What is the second police officer wearing?	High heels, underwear & stockings	List 2 items	
3	How many men do the police officers speak with?	Zero		
4	What is the first police officer holding in his hand?	Radio/walkie talkie		
5	What is the last thing both police officers do?	Hold hands by pinkie	Hold hands	
6	What do the police officers verbally say to the participants of the prank?	Nothing		

	Baby Scene	2 pts	1 pt	0 pts
1	What is the baby fascinated by and what is the reaction?	a) Paper being torn; b) Laughing	List 1 item	
2	And when does this reaction stop?	When the paper stops		
3	What is the name of the baby?	Micah		Michael
4	Who is in the room with the baby?	Father/Man	Male	
5	What is the baby wearing and what colour?	Pink onesie/ jumpsuit	List 1 item	
6	What is the baby seated on and in which room?	Couch in lounge room	List 1 item	

Amusing Films (Low-Intensity) | **Answers**

	Cat Cleans the Kitchen	2 pts	1 pt	0 pts
1	How does the cat clean the kitchen?	Rides the Auto vacuum cleaner	Vacuums	
2	What colour is the cat?	Black	Dark Brown	
3	What is the cat wearing?	Shark costume		Jumper
4	What is the lady in the kitchen doing?	Peeling corn into the bin	Peeling corn	
5	What is the lady wearing?	Yellow shorts, t-shirt	Shorts, t-shirt	
6	Who/what else enters the kitchen?	Dog		Another Pet

	Austin Powers – Vehicle Scene	2 pts	1 pt	0 pts
1	What is happening in the main scene?	Vehicle is stuck and doing a 3 point turn; unable to reverse car; in hallway	Reverse car; vehicle stuck	
2	In the scene with Austin Powers:			
	a) What is this person wearing?	Silver dress	Silver suit/ clothing; dress	
	b) What instructions does he give to this person?	Go and get help	Go and find Dr Evil	
3	What colour is the vehicle?	Yellow	Orange/yellow	Orange
4	What is Austin Powers wearing?	Silver suit/ jacket		Suit; silver
5	The scene crosses to another character, what is this person drinking?	Tea or coffee		

	Boat Scene	2 pts	1 pt	0 pts
1	Briefly describe the scene?	Man wants to head close to another boat and almost collides with other things	Boat almost collides with other things	
2	What colour is the boat?	White and blue (red)	White	Blue
3	What are some of the things the boat almost collides with: a) b) c) d) e) f)	List any 2 items • Speedboats • Jet skis • Man fishing • Buoy • Pontoon of people • Yacht • Sea plane	List any 1 item List any 1 item List any 1 item	
4	Where does the anchor land?	In the other boat; in a man's boat	In a boat	

	Duck and Walk Prank	2 pts	1 pt	0 pts
1	In which setting/location is this scene filmed?	In a park with a footpath/ road	In a park	
2	Apart from walking/running, how else do people travel past the camera?	a) Rollerblade b) Bycicle/Bike c) Car	List 2 of 3	
3	What is happening in the scene?	Crew instructing people to duck as walk past filming	People ducking in front of man	People filming; news report
4	How many people are involved in running the prank?	Three		
5	How many walk behind the presenter?	One		
6	How many stop right next to the presenter?	One		

Happy Films		**Answers**		

	Soccer Scene	**2 pts**	**1 pt**	**0 pts**
1	What was so eventful about this scene?	Boy kicks a goal to win the game	Kicks a goal and wins	
2	What colour shirt was the key player wearing?	Blue		
3	What is the name of the soccer team?	Tigers	Lions	Cats
4	How many goals have the team now kicked?	Four		
5	What colour shirt is the goal keeper wearing?	Red		
6	When the match finishes, what does the key player do?	Lifted up by team mates & runs to man (coach/father)	Celebrates; Hugs man	

	Airport Scene	**2 pts**	**1 pt**	**0 pts**
1	Who is the first person to enter the airport terminal?	Father/ Family man	Man	
2	When the young boy and girl meet, what style and colour hair does she have?	Brown with piggy tails (braided)	List 1 item	
3	What type of hat is Harriet wearing?	Cowboy hat	Red one	
4	What family member does Harriet have with her?	Sister		
5	What is the reaction of the girl in the red jacket?	Runs and jumps on man	List 1 item	Hugs
6	What is shown in the last section of the film clip?	People hugging	Greeting people	

	Dance in Street Scene	**2 pts**	**1 pt**	**0 pts**
1	What type of bag is the main character wearing and what is the colour?	Brown satchel/ side bag/ man bag	List 1 item	
2	How many water features start when the character walks past?	Three		
3	What colour is the builder’s hat that the main character high fives?	Blue		Yellow
4	What object does the main character catch when dancing with a group of people?	Baseball bat	Bat	
5	What is the animation in the film clip and what colour?	a) Bird b) Blue/aqua	List 1 item	
6	Where does the character go at the end of the scene?	Into an elevator	Into a building	

	Singing at a High School Scene	**2 pts**	**1 pt**	**0 pts**
1	How does the male character enter the scene whilst singing?	Slides down pole	Pole	From a building
2	What are the key lyrics of the song?	"I love you baby"	"I can't take my eyes off of you" or "You're just too good to be true"	
3	What causes the male character to stop singing?	Two security/police chase & stop him	Police/ security	
4	What is the band wearing?	Blue t-shirts	Blue tops/ shirts	Uniforms
5	How does the crowd respond to the singer?	Cheer and clap him	Amused/ happy	
6	What is the female characters finale reaction to the situation?	Laughing/ happy	Embarrassed/ surprised; smile	

	Sad Films (High-Intensity)	**Answers**		
	Funeral Scene	**2 pts**	**1 pt**	**0 pts**
1	Who is in the coffin?	Thomas James Senate; Thomas-Jay		A boy
2	Where is the funeral held?	Lounge room of a house; funeral House	House	Funeral home
3	Who goes up to the coffin?	Little girl		Woman
4	What two key things does this person ask?	a) Want to go tree climbing? b) Where are his glasses?	List 1 item	Glasses
5	Before entering the room, where does this person stop?	On the stairs and at the door	Stairs	
6	In what decade was the person in the coffin born?	1960's		

	Sophie's Choice – Choosing which Child	**2 pts**	**1 pt**	**0 pts**
1	What language are the actors speaking?	German/Polish	Subtitled	
2	Which child does the mother give up?	Girl		
3	Is the scene in colour?	No		
4	What does the mother continue to repeat?	"I can't choose"; "Don't make me choose"	"I cannot choose"	
5	What is in the background of the mother?	Other women and a train	Women; train	People
6	Is this scene set during the day or night?	Night		Dusk; dawn

	Boy Crying over Death	**2 pts**	**1 pt**	**0 pts**
1	What does the boy continue to repeat?	List 2 items: "Champ, wakeup; Wake him up; He's not gone; I want Champ"	List 1 item	Wake up
2	What is the hair colour of the boy?	Blonde	Brownie-blonde	
3	What is the name of the boy?	TJ		
4	Who enters the room during the scene?	Lady; mother		
5	What sport did the man play?	Boxing		
6	When the person enters the room, what is outside?	Crowd of reporters	Reporters	People

	Horse Scene	**2 pts**	**1 pt**	**0 pts**
1	What is happening to the horse in this scene?	Boy tries to save horse from sinking in the sadness of the swamp	Horse is sinking in the swamp	
2	What is the name of the horse?	Arjax	Artax	
3	What colour is the horse?	White	White/ grey	
4	What happens to the horse if he doesn't move?	He will sink and die	List 1 item	
5	Briefly describe the location	Dark muddy swamp with trees	Swamp	
6	How does the boy try to save the horse?	Pulling on the reigns and yelling at the horse to fight against the sadness	Pulling on the reigns; yells/ encourages	

Sad Films (Low-Intensity) | **Answers**

	School Scene	2 pts	1 pt	0 pts
1	How does the lead actress find out about the news?	Another teacher interrupts the classroom to tell her	Teacher/ lady/ principal tells her	Someone tells her
2	What is the bad news?	Student was shot *and* killed	Student was shot *or* killed	
3	Where does the "bad news" conversation take place?	Outside the classroom door/ hallway	Outside the classroom	
4	Who else is told about this news?	Students in the classroom	Students	
5	Briefly describe the appearance of the second person to find out in the scene?	Female, black curly hair, red/ brown beret	Dark curly hair and beret	
6	How does the scene end?	Tear running down cheek of one student	Class crying/ upset	Teacher hugs student

	Bus Scene	2 pts	1 pt	0 pts
1	What happens in this scene?	Bus pulls over due to a passenger dying in his seat	Passenger dies	
2	What does the bus driver request the friend to do?	"Reach over and close his eyes"	Close his eyes	
3	What colour shirt is the man who died wearing?	Hawaiian (orange/ yellow)	Hawaiian shirt	
4	What destination is the bus travelling to?	Miami		Florida
5	In which position of the bus are they seated?	Back corner; back left/ right, window	Back	Towards back
6	Is it day or nighttime?	Daytime		

	Dog Scene	2 pts	1 pt	0 pts
1	What type of dog was it?	Terrier/ Jack Russel		
2	What colour was the dog?	White with light brown spots	White and brown	
3	What era was the film set in?	1930s/40s; WW2	First half of century	
4	What condition did the dog have?	Arthritis		
5	What does Skip need help getting onto?	His owner's bed	A bed	
6	What did the dog love?	Rubbed on the back of his neck	Patted on his neck	Rubbed/ patted

	Apology Scene	2 pts	1 pt	0 pts
1	Briefly describe the location of the scene	Lounge room with adjacent kitchen	Lounge room	
2	What is the name of the person who took the pills?	Carlton		
3	How many people are in the scene?	Six		
4	What is the name of the person apologising?	Will		
5	Is the apology accepted?	Yes		
6	Why did the person apologising buy the pills?	To stay awake for basketball practice & exams	To stay awake for school	Stressed

Appendix F Research Portfolio

F.1 List of Publications Related to Thesis

Pedder, D. J., Terrett, G., Bailey, P. E., Henry, J. D., Ruffman, T., & Rendell, P. G. (2016). Reduced facial reactivity as a contributor to preserved emotion regulation in older adults. *Psychology and Aging*, *31*, 114-125. doi: 10.1037/a0039985

Statement of Contribution of Others:

I acknowledge that my contribution to the above paper is 50%.

David J. Pedder ……………

I acknowledge that my contribution to the above paper is 15%.

Gill Terrett .. ..

I acknowledge that my contribution to the above paper is 10%.

Phoebe E. Bailey ………………………………………

I acknowledge that my contribution to the above paper is 10%.

Julie D. Henry ……………………………………

I acknowledge that my contribution to the above paper is 5%.

Ted Ruffman ……………………………………

I acknowledge that my contribution to the above paper is 10%.

Peter G. Rendell … …..

F.2 List of Publications Unrelated to Thesis but During Candidature

Kalokerinos, E. K., Greenaway, K. H., **Pedder, D. J.,** & Margetts, E. A. (2014). Don’t grin when you win: The social costs of emotion suppression in performance situations. *Emotion*, *14*, 180-186. doi: 10.1037/a0034442

Kaufmann, L. M., Williams, B., Hosking, W., Anderson, J. R., & **Pedder, D. J.** (2015). Identifying as in, out, or sexually inexperienced: Perception of sex-related personal disclosures. *Sensoria: A Journal of Mind, Brain and Culture, 11*, 28-40. doi: 10.7790/sa.v11i1.411

F.3 List of Conferences

The List of Conferences has been removed from this copy.

F.4 Additional Presentations and Events

The list of Additional Presentations and Events has been removed from this copy.