Age Differences in Emotion Regulation Strategy Use and Efficacy in Daily Life

by

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Abstract

Despite ageing related losses in health, cognition, and social roles, research shows that older adults often report high levels of emotional well-being compared with people in younger and middle-adulthood. This is referred to as the "paradox of ageing". One possible explanation for this widely reported finding is that older adults use different, and in some cases more effective, strategies to regulate their emotions compared with younger adults. Although a number of studies have examined age differences in emotion regulation (ER) in laboratory contexts, few have examined ER in everyday life contexts.

Building on ageing and ER literatures, this thesis includes a comprehensive review of empirical studies concerned with age differences in ER and reports on the results of a micro-longitudinal study designed to assess ER use and efficacy in younger and older adults. Employing search terms related to ageing and ER, our systematic review identified 20 articles, including 23 relevant studies. Narrative synthesis was adopted to analyse the findings. Results of the systematic review suggested that development in adulthood is not characterised by predictable, normative shifts in preferences for the use of different ER strategies, rather moderator variables are of crucial importance in shaping the emergence of age differences in ER.

The primary focus of our micro-longitudinal study was examination of age differences in the use and efficacy of a broad range of ER strategies (e.g., situational avoidance, problem-solving, humour, distraction, cognitive reappraisal, acceptance, and expressive suppression), in the context of exposure to daily life stressors. Thirty eight younger (aged 17-28) and 44 older (aged 62 and over) adults provided demographic information at baseline assessment and completed measures concerned with daily stress, ER

strategy use, and affect, as part of a 20-day diary study. ER efficacy was operationalised as the extent to which use of regulation strategies weakened the association between stress exposure and negative affect (NA). We observed minimal evidence of enhanced ER strategy use among older adults in both general daily use and use in the context of stress. Similarly, there was little evidence of consistent age differences in ER efficacy at the between-persons (i.e., differences between individuals) and within-persons (i.e., fluctuation day-to-day within individuals) levels, with one exception - at the between-persons level, greater use of acceptance related to weaker coupling of stress and NA (our index of regulatory efficacy), particularly among older adults. Cross-level interactions (i.e., interactive effects of between- and within- person level factors) suggested that among older adults, there appears to be benefit associated with greater use of acceptance, cognitive reappraisal, problem-solving, and expressive suppression, lower levels of negative affect in the context of stress at higher levels of distraction use, and minimal effect of humour on affective outcomes. Findings highlight the importance of changing life contexts in influencing the nature, and effectiveness, of daily ER strategy use. Accordingly, to advance the field, consideration of the interaction of individual difference variables, situational factors, and specific regulation strategies is central.

Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Victoria Allen

BPsychHons

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Chapter 1: Overview and Aims of the Research

1.1 Background and Context

1.1.1 Aging and emotional wellbeing.

Despite potential for age-normative loss in the realms of physical health (Hébert, 1997), sensory abilities (Cruickshanks et al., 2003), fluid cognition (Lövdén, Ghisletta, & Lindenberger, 2004), and social networks (Victor, Scambler, Bond, & Bowling, 2000), emotional wellbeing appears relatively well-maintained into older age. Compared to their younger counterparts, older adults demonstrate lower levels of physiological stress reactivity (Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004), daily stress exposure (Mroczek & Almeida, 2004; Stawski, Sliwinski, Almeida, & Smyth, 2008), and negative affect (NA; Blanchard-Fields & Coats, 2008; Charles, Reynolds, & Gatz, 2001; Cheng, 2004; Mather & Carstensen, 2005; Windsor & Anstey, 2010), in addition to greater levels of emotional stability (Carstensen et al., 2011; Röcke, Li, & Smith, 2009) and positive affect (PA; Mroczek & Kolarz, 1998; Riediger, Schmiedek, Wagner, & Lindenberger, 2009; Windsor & Anstey, 2010). Although there is suggestion that age-related gains in emotional wellbeing stabilise or diminish towards the latter stages of old age (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Hansen & Slagsvold, 2012), as noted by Carstensen, Fung, and Charles (2003), research is still generally indicative of a favourable balance of positive and negative affect with increasing age. The preservation of emotional wellbeing, in the context of age-related decline in other areas of functioning, is often referred to as the "paradox of ageing". Enhanced emotion regulation (ER) is cited widely as a possible explanation for positive profiles of emotional functioning among older adults (Carstensen, 1993; Carstensen, Gross, & Fung, 1998; Charles, 2010; Urry & Gross, 2010).

1.1.2 Emotion regulation.

Emotions are powerful psychological phenomena, involving a temporally coupled system of behavioural, experiential, and physiological response tendencies (Gross, 1998). Emotions are

argued to facilitate survival and flourishing through the integration of motive and thought to shape adaptive responding to environmental demands (Lazarus, 1991). Moreover, emotion permeates almost every aspect of human life, influencing behaviour, interpersonal functioning, physical health, and mental health (Berking & Wupperman, 2012; Brummett et al., 2005; Campellone & Kring, 2013; Ferrer & Mendes, 2018; Gross & Muñoz, 1995; Ong, 2010; Pandey & Choubey, 2010; Richman et al., 2005; Shiota, Campos, Keltner, & Hertenstein, 2004; Smith, Glazer, Ruiz, & Gallo, 2004; Totterdell & Niven, 2012).

A contemporary synthesis of seminal emotion theory (e.g., Ekman, 1992; Frijda, 1988; James, 1884; Lange, 1912; Lazarus, 1991), the modal model of emotion (Gross, 1998) suggests that emotion can be conceptualised as a person-situation transaction, involving the direction of attention toward environmental stimuli, appraisal of stimuli in relation to one's goals, and a multi-level (e.g., subjective, expressive/behavioural, physiological, and phenomenological) system of responses, which in turn can affect the initial emotion eliciting situation (see *Figure 1.1*).

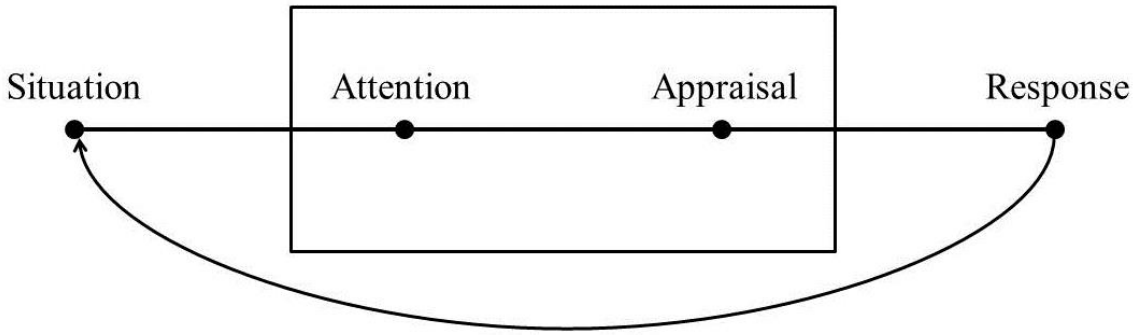

Figure 1.1. Modal model of emotion (adapted from Gross & Thompson, 2006)

While generally adaptive, under certain conditions emotions may be incongruent with broader goals or context thus requiring regulation (McRae, Ochsner, & Gross, 2011). ER involves the modulation of the experiential, behavioural, and physiological aspects of emotional experience (Gross & Thompson, 2006). These heterogeneous processes can be automatic, effortless, and unconscious, or conscious, controlled, and effortful, and may serve to reduce, maintain, or increase emotion (Gross, 1998; John & Gross, 2007). It is suggested that automatic ER is pervasive in daily life and that a combination of automatic and effortful ER is necessary to support wellbeing (Gyurak, Gross, & Etkin, 2011). While ER may often be pro-hedonic, involving the upregulation of positive emotion and downregulation of negative emotion, there is also evidence of contra-hedonic motivation (i.e., the dampening of positive emotion and upregulation of negative emotion), often in service of instrumental goals or when negative emotion is accompanied by positive emotion (Riediger et al., 2009; Tamir, Chiu, & Gross, 2007; Tamir & Gross, 2011; Tamir, Mitchell, & Gross, 2008).

Gross's (1998) widely influential process model of ER outlines five stages at which regulatory strategies can operate within the emotion generative process (see *Figure 2.2*). The five points at which individuals can regulate their emotions reflect different "families" of ER strategies including: situation selection, situation modification, attentional deployment, cognitive change, and response modulation.

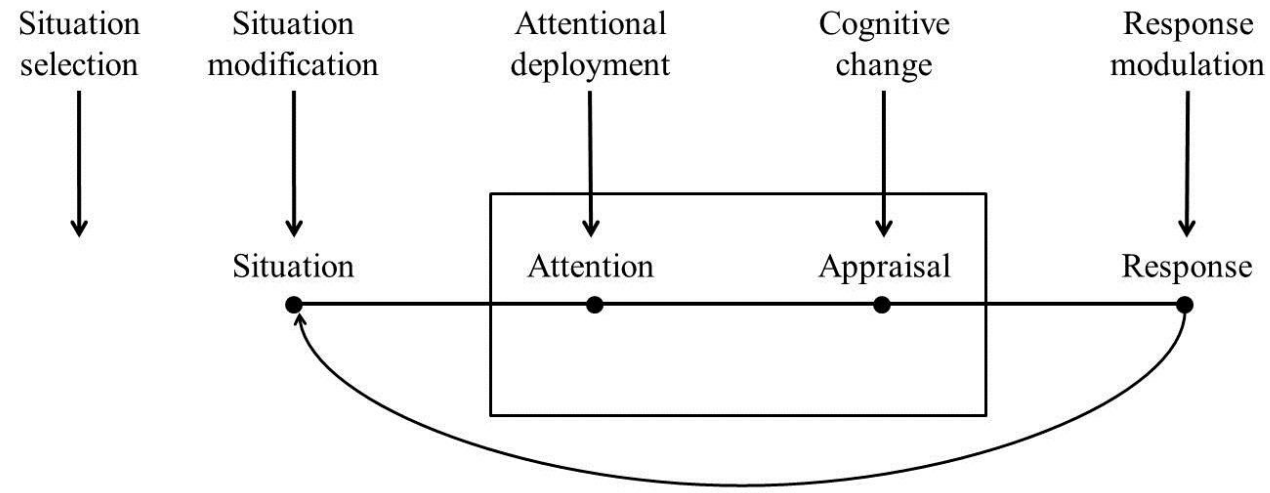

Figure 1.2. Process model of emotion regulation (adapted from Gross & Thompson, 2006)

As per *Figure 1.2*, regulation strategies within the *situation selection* family are implemented before emotion-eliciting stimuli has been encountered and involve selectively entering into or avoiding situations anticipated to elicit particular emotional outcomes. To facilitate selective engagement with situations, effective use of this family of strategies involves knowledge of situations likely to elicit particular emotions, awareness of the types of emotions one will experience in response to specific situations, and information regarding others' emotions in interpersonal situations (Gross & Thompson, 2007). Indeed, affective forecasting (i.e., the extent to which individuals are able to anticipate the likely emotional outcomes of situations before entering into them) appears to support the use of situation selection (Floerke, Sands, Isaacowitz, Thomas, & Urry, 2017, study 2). Likewise, the belief that one is capable of regulating their emotions and doing so effectively (i.e., emotional self-efficacy) appears to be an important resource facilitating use of situation selection, particularly for older adults (Rovenpor, Skogsberg, & Isaacowitz, 2013). Moreover, perhaps unsurprisingly, the extent to which persons favourably evaluate specific emotional states appears to shape the likelihood of them engaging with situations which induce that emotion

(Markovitch, Netzer, & Tamir, 2017). In terms of the utility of situation selection, it appears to be particularly beneficial among those who find ER challenging (i.e., are highly emotionally reactive and low in ER competence; Webb, Lindquist, Jones, Avishai, & Sheeran, 2017), possibly as situation selection strategies are proactive and potentially less effortful compared to other strategies which occur later in the emotion generative cycle. Situation selection may also manifest as marked avoidance of social situations in response to fear and anxiety, as seen among individuals with social anxiety disorder and avoidant personality disorder (Campbell-Sills & Barlow, 2007; Wells & Papageorgiou, 1998), which represents less adaptive regulation.

Once emotionally evocative stimuli have been encountered, individuals may employ *situation modification* strategies involving the use of direct effort (e.g., problem-solving, humour) to modify aspects of the situation. Gross (2002) notes that the concepts of problem-focused coping (i.e., managing or solving the "problem" at the root of distress; Folkman, 2013) and primary control (i.e., modifying external circumstances in line with one's goals; Rothbaum, Weisz, & Snyder, 1982) closely parallel his conceptualisation of situation modification. Situation modification is relatively under-researched compared to other families of regulation strategies, although researchers are starting to develop paradigms to facilitate closer examination of this family of strategies (e.g., Livingstone & Isaacowitz, 2015).

Strategies within the *attentional deployment* family reflect how people choose to direct their attention within a given situation (Gross, 1998). Two common forms of attentional deployment are distraction (i.e., switching the focus of attention within a situation away from an unpleasant stimulus) and concentration (i.e., focusing attention on specific elements of the situation). Other related types of attentional deployment, which are typically

viewed less favourably include rumination (i.e., perseverative focus on emotion, particularly negative emotion, and the consequences of emotion), worry (i.e., excessive attention focused on actual or potential problems), and thought suppression (i.e., pushing negative thoughts away from conscious awareness). Distraction, concentration, rumination, worry, and thought suppression all represent internal forms of attentional deployment. However, attentional deployment can also take more external or physical forms, such as someone physically withdrawing by covering their face. To date, perhaps the most extensively researched form of attentional deployment is the positivity effect, a bias in attention and memory to attend to positive stimuli, which is typically observed more often in older, relative to younger adults (Mather & Carstensen, 2005).

Research suggests that particular types of attentional deployment may be exaggerated in persons with mood and anxiety disorders. For example, rumination has been extensively linked to major depression (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Similarly, excessive worry has been linked to anxiety disorders (e.g., generalised anxiety disorder) while thought suppression is commonly associated with obsessive-compulsive disorder (Campbell-Sills & Barlow, 2007).

Cognitive change strategies are applied at the appraisal stage of the emotion generative process. Strategies that fall within the cognitive change family involve modifying the thought processes related to the meaning of emotion eliciting stimuli. Reappraisal (i.e., changing the way one thinks about a situation or their capacity to cope with their circumstances) is perhaps the most widely researched cognitive change strategy. Reappraisal can involve directing thought processes towards more positive aspects of emotion eliciting events (positive reappraisal; e.g., Windsor, 2009) or considering the emotional context from a more objective or detached perspective (cognitive reappraisal; e.g., Yeung, Wong, & Lok,

2011). Reappraisal is generally considered an adaptive ER strategy (Gross & John, 2003; McRae, Jacobs, Ray, John, & Gross, 2012), and is suggested to form the basis of cognitive restructuring, a key component of cognitive therapies (Clark & Beck, 2010). Research suggests that cognitive control and fluid intelligence may be important resources supporting the use of reappraisal (Buhle et al., 2014; McRae et al., 2012; Ochsner & Gross, 2005; Ochsner, Silvers, & Buhle, 2012; Opitz, Lee, Gross, & Urry, 2014).

Other types of cognitive change strategies include perspective taking (i.e., looking at things from another person's perspective), cognitive re-framing (i.e., considering the worst-case scenario relative to the current situation), counterfactual thinking (i.e., mental representations generated by thinking about how alternative actions could have changed the trajectory of past situations or circumstances), and acceptance (i.e., process of observing and describing emotional experience without judgement). Of note, over recent decades, acceptance has elicited increasing interest from researchers. Indeed, research suggests that acceptance may be largely comparable to reappraisal in terms of facilitating positive ER (Wolgast, Lundh, & Viborg, 2011). Moreover, acceptance features as an important component of dialectical behaviour therapy, acceptance and commitment therapy, and mindfulness-based therapies (Gratz & Tull, 2010), highlighting the clinical significance of this strategy.

Once emotional response tendencies have been activated, *response modulation* strategies may be used to influence the extent to which physiological, experiential, or behavioural aspects of the emotional experience unfold (Gross, 1998). This may involve modulation of emotion tendencies through engaging in exercise (e.g., Blumenthal et al., 2007; Carek, Laibstain, & Carek, 2011), alcohol and/or drug use (e.g., Cooper, Frone, Russell, & Mudar, 1995), the consumption of food (e.g., "emotional eating"; Spoor, Bekker,

Van Strien, & van Heck, 2007), expressive amplification (e.g., exaggerating the expression of emotion), or suppression (e.g., expressive suppression involving dampening the behavioural and or facial expression of emotion or experiential suppression reflected by attempts to inhibit subjective experience of emotion). Expressive suppression is the most extensively researched strategy within the response modulation family. Research suggests that expressive suppression is effective in reducing the behavioural manifestation of emotion but does not alter the subjective experience of emotion and is accompanied by cognitive (i.e., impaired incidental memory) and physiological (i.e., increased cardiovascular activation) costs (Gross, 1998, 2001; Richards & Gross, 1999, 2006; Roberts, Levenson, & Gross, 2008). A similar pattern of cost-benefits has been established for experiential expression (Dan-Glauser & Gross, 2011). Interestingly, the costs and benefits of suppression may be contingent upon gender roles and cultural display rules. In particular, suppression may allow preservation of self-image among men in western cultures given stereotyped beliefs such as "real men don't cry" and suppression may be more effective and entail fewer "costs" in Eastern versus Western cultures given differences in individualist (i.e., value placed on self-expression and ideas organised in relation to oneself) and collectivist (i.e., emphasis is on harmony and relationships) philosophies (Butler, Lee, & Gross, 2007; Butler, Lee, & Gross, 2009; Miles & Gross, 1999).

Although each family of ER processes is distinct, there are some higher-order commonalities (Gross, 1998). In particular, strategies which operate before emotional responses are generated (i.e., situation selection, situation modification, attentional deployment, and cognitive change) are classified as antecedent-focused regulation strategies. In contrast, response modulation strategies are classified as response-focused strategies, as they operate following the activation of emotion response tendencies. Antecedent-focused

strategies are believed to be more proactive, effective, and less effortful than response modulation strategies (Livingstone & Isaacowitz, 2015). If used appropriately, antecedent ER strategies may allow activation of emotion response tendencies to be circumvented. In contrast, the success of response modulation efforts is more contingent upon ensuring adequate levels of strategy use for handling the intensity of the emotion eliciting regulatory efforts (Sheppes & Gross, 2011).

Recently, Gross (2015) expanded on the original process model of ER (Gross, 1998) to include the role of systems of valuation (i.e., the attachment of positive and negative value to that which we encounter throughout our lives). Gross (2015) proposes that ER is shaped by interactions across systems of valuation. In particular, a positive or negative valuation of a stimulus/situation is made by an initial valuation system which results in emotion. Subsequently, a second valuation system functions to evaluate the operation of the initial valuation system; this sets the trajectory for action to modulate the unfolding emotional experience. Essentially, this extension provides a more nuanced perspective regarding ER in which regulatory efforts alter the situation that initially elicited emotion and reflecting on this process through a second valuation system leads to the realisation of a different set of circumstances to perceive, evaluate, and respond to, which can lead to the maintenance, switching, or termination of ER strategy use.

1.1.3 Emotion regulation across the adult lifespan.

Several theories of adult development point to age differences in ER. For instance, socioemotional selectivity theory (SST; Carstensen, 1993; Carstensen et al., 2003) suggests that across the lifespan all individuals are guided by the same core group of socioemotional goals. Such goals include the pursuit of new experiences and cultivating a sense of belonging. However, the relative importance of these goals varies as a function of future time-

perspective or the perception of one's remaining life-span. Specifically, goals intended to maximise future-opportunity such as personal development, establishment of new social relationships, and acquisition of information, are prioritised when the future is perceived as expansive or open-ended, as is commonly the case for younger adults. In contrast, when future time is perceived as limited, individuals tend to focus on emotionally meaningful goals concerned with the immediate present, such as avoiding negative affective states, maximising positive experiences, and responding to emotional needs flexibly. This perspective is more commonly associated with older age. Age-related shifts towards emotionally meaningful goals are believed to be supported by selective "pruning" of older adults' social networks (i.e., severing ties with peripheral social network members, whilst maintaining meaningful relationships with closer network members; Löckenhoff & Carstensen, 2004), effective implementation of regulatory strategies which optimise positive emotional states, and a positivity bias in cognitive and attentional process (i.e., preference for positive and neutral over negatively valenced stimuli or information) (Carstensen, Gross, & Fung, 1997).

Similarly, the strength and vulnerability integration model (SAVI; Charles, 2010) suggests that age-related gains in emotional wellbeing are supported by more frequent and successful emotion regulatory efforts in daily life. The SAVI model suggests these regulatory efforts are proactive, aimed at avoiding or reducing the experience of NA, whilst maintaining or enhancing PA, through attentional strategies, appraisal processes, and behavioural efforts, and reflect accumulated life experience and realisation of time left to live among older adults. The SAVI model's emphasis on age-related emotion regulatory goals and time perspective strongly echoes SST (Carstensen, 1993; Carstensen et al., 2003). However, according to SAVI theory age-related regulatory strengths are tempered by greater physiological vulnerabilities with age. In particular, reduced physiological flexibility with increasing age is

hypothesised to relate to delayed recovery from distressing events and result in greater physical stress when regulation strategies cannot be successfully implemented or when triggering events are unavoidable. As such, ageing may confer benefits in terms general emotional wellbeing, reducing exposure to emotionally evocative events, and facilitating adaptive post-event regulation, while age-related vulnerabilities prompt greater sensitivity or reactivity to negative events involving high and sustained levels of arousal (e.g., situations involving loss of social belonging, chronic and uncontrollable stress exposure, and/or neurological dysfunction).

Drawing on SST (Carstensen, 1993; Carstensen et al., 2003) and the process model of ER (Gross, 1998, 2015), the selection, optimisation, and compensation with ER (SOC-ER) model (Urry & Gross, 2010) represents another valuable perspective on ageing and ER. The SOC-ER model involves the application of Baltes and Baltes's (1990) selection, optimisation, and compensation (SOC) meta-theory of development to the realm of ER. The SOC meta-theory is an overarching lifespan framework which suggests that developmental potential (i.e., the maximisation of gains and minimisation of losses) can be enhanced at any age through the application of three key concepts: selection (setting realistic goals within the limits of personal capacities), optimisation (investing resources towards meeting goals), and compensation (developing and employing means to counteract losses). The use of these processes enables people to successfully adjust to deficits in cognitive and behavioural resources associated with increasing age. Importantly, the processes of selection, optimisation, and compensation not only foster investment of resources towards the pursuit of adaptive pathways through life but also facilitate disengagement from unrealistic goals which extend beyond the limits of one's personal capacities.

In applying the SOC meta-theory (Baltes & Baltes, 1990) to the domain of ER, Urry and Gross (2010) suggest that the successful regulation of emotion across the lifespan depends on: (i) choosing ER strategies which draw on available resources (selection), (ii) investing time and effort in the use of selected strategies to ensure success (optimisation), and (iii) employing alternate ER strategies when losses prevent the use of other existing strategies (compensation). As such, ER success is dependent upon the extent to which strategy use is supported by the regulatory resources individuals can draw upon. Building on this premise, regulatory resources (e.g., cognitive control, social support) are proposed to vary with age, creating divergent patterns of ER among younger and older adults. For instance, selective social network "pruning" among older adults' (as per SST; Löckenhoff & Carstensen, 2004) may foster close and supportive interpersonal relationships, which could represent an age-related regulatory resource. In contrast, declines in cognitive control with age may represent a relative deficit among older adults (e.g., Opitz et al., 2014; Opitz, Rauch, Terry, & Urry, 2012). As such, complex strategies which draw heavily on cognitive resources (e.g., cognitive reappraisal; Buhle et al., 2014) may better align with the regulatory resources of younger adults while other strategies like situation selection may be better supported by the regulatory resources of older adults such as supportive social networks. Overall, the SOC-ER model predicts that age-related shifts in regulatory resources result in relative strengths and weaknesses in ER for younger and older adults.

Lastly, dynamic integration theory (DIT; Labouvie-Vief, 2003; Labouvie-Vief, Diehl, Jain, & Zhang, 2007) offers an alternative perspective regarding normative changes in ER strategy use across the adult lifespan. DIT proposes that emotional adaptation reflects the integration of two modes of regulation, optimisation and differentiation, which show different trajectories across the adult lifespan. Optimisation involves the pursuit of individual

emotional wellbeing while differentiation is a state of cognitive-affect complexity, reflecting the integration of present feelings with one's broader emotional experience and social context. Age-related gains in emotional wellbeing are consistent with stronger reliance on optimisation processes among older adults. In contrast, age-related declines in cognitive resources are proposed to compromise more complex differentiation processes (believed to peak in middle adulthood), restricting the extent to which older adults can integrate regulatory modes, leading to a compensatory overreliance on optimisation processes. As such, older adults may be able to maintain a balance of PA through optimisation mechanisms but when more complex reflection and cognitive introspection is required, regulation is impaired due to age-related difficulties with differentiation. However, Labouvie-Vief (2003) notes that there may be individual differences in the extent to which older adults experience degradation of complex cognitive-affective representations, which could be suggestive of a degree of variation in developmental change in the integration of regulatory modes with ageing.

There are several points of convergence among the theories of adult development described above. Firstly, there is suggestion that the "paradox of ageing" can be explained in terms of age-related gains in ER. Secondly, the role of future time-perspective is highlighted as a key motivating force underlying the chronic activation of ER goals among older adults. Thirdly age-related strengths and weaknesses in terms of regulatory resources and capacities contribute to developmental differences in ER. Lastly, boundary conditions are outlined by the SOC-ER model (Urry & Gross, 2010), SAVI (Charles, 2010) and DIT (Labouvie-Vief, 2003), with suggestion that age-related gains in ER may dissipate when: individuals lack the resources to support strategy use, stressors are unavoidable, regulation draws heavily on physiological systems which degrade with age, or regulation requires complex differentiation.

Given the pervasive influence of SST (Carstensen, 1993; Carstensen et al., 2003) and the integration of lifespan and ER theories provided by the SOC-ER model (Urry & Gross, 2010), the current thesis primarily draws on SST and the SOC-ER model for theoretical guidance[1]. Building on this body of literature, a systematic review of empirical research concerning age differences in ER strategies derived from the process model of ER is provided in **Chapter 2**.

1.2 Affective Processes in Daily Life and Methodological Considerations

Affective scientists have called for studies examining the temporal and daily dynamics of ER (DeSteno, Gross, & Kubzansky, 2013; Gross, Richards, & John, 2006). Examining age differences in daily ER processes is necessary to establish empirical support for influential lifespan theories and demonstrate their applicability in ecologically valid, real-world settings. Micro-longitudinal studies including daily-diary approaches are useful in this regard and have the further advantage of permitting ER strategy use to be examined at between- and within- persons levels. Between-persons (BP) data captures relatively more stable or consistent differences between individuals, whereas within-persons (WP) data reflects short-term variation from one moment or assessment point to another, within the same individual. *Figure 1.3* is provided as an example to illustrate WP and BP variation in the ER strategy of rumination.

[1] As such, there is a degree of overlap/repetition across the manuscripts prepared as part of this thesis and presented as Chapters 2, 3, & 4.

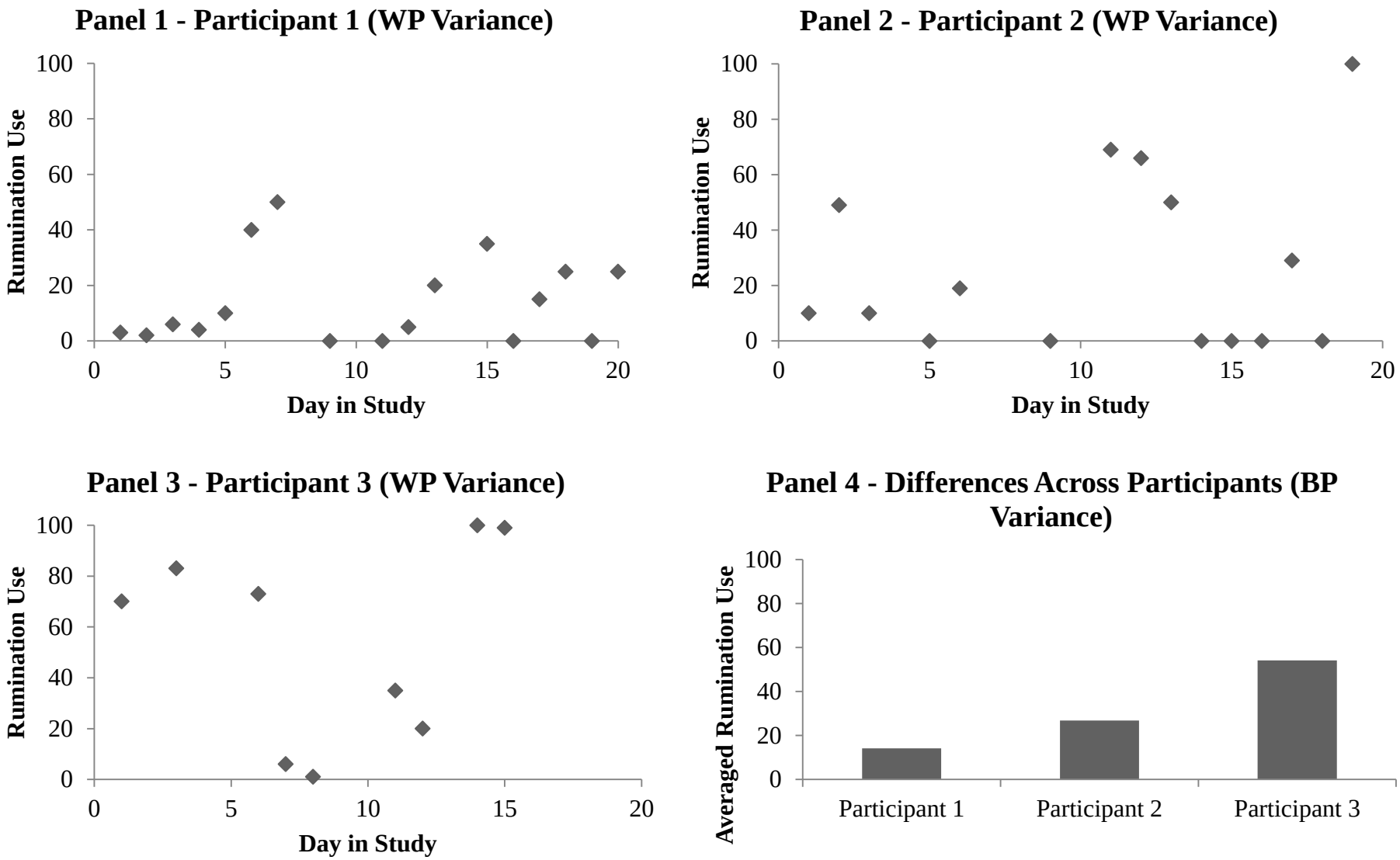

Figure 1.3. Panels one through three depict fluctuations in level of rumination use for three participants across a 20-day micro-longitudinal protocol (WP variance), while the final panel presents individual differences in participants' level of rumination use averaged across days

Daily levels of rumination use for three participants are depicted across Panels 1-3 of *Figure 1.3*. From these panels it is clear that level of rumination use varies from one day to another for each of the three participants, with variable patterns of daily strategy use across the 20 days evident for each of the three participants (WP variance). However, when participants' levels of daily rumination use are averaged, it is also apparent that the three participants differ from each other in their average degree of strategy use (BP variance; Panel 4 of *Figure 3*). Overall, *Figure 1.3* demonstrates how people can differ from one day to another (reflecting intra-individual variability) in ER strategy use, as well as showing different inter-individual patterns of ER strategy use. With this is mind, it is important to consider both BP and WP ER processes as this can provide new scientific insights, avoid the erroneous assumption that differences in WP processes parallel BP differences, allows for more sophisticated modelling accounting for person-situation-ER strategy interactions, and fosters a more nuanced, person-specific model of ER (Doré, Silvers, & Ochsner, 2016). Of particular note, is the potential for examination of the WP coupling of variables such as affect, stress, and ER. Such an approach may provide valuable insights regarding how dynamic, short-term processes interact with one another to shape broader developmental change in psychological phenomena. For instance, if stress is loosely coupled with NA for some individuals and closely coupled for other individuals (as shown in *Figure 1.4* and *Figure 1.5* respectively), then it is likely that the relationship between these two variables is subject to the influence of a third (moderator) variable such as use of a specific ER strategy. If ER strategy use buffers against the coupling of stress and NA then this may represent a pathway to affective wellbeing. Without exploring WP variation in daily processes, such relationships may be overlooked. Moreover, it is argued that this approach improves methodological precision, power, and reliability, as examination of the coupling of WP

processes recognises the contextual variability inherent in affective phenomena (Sliwinski, 2008).

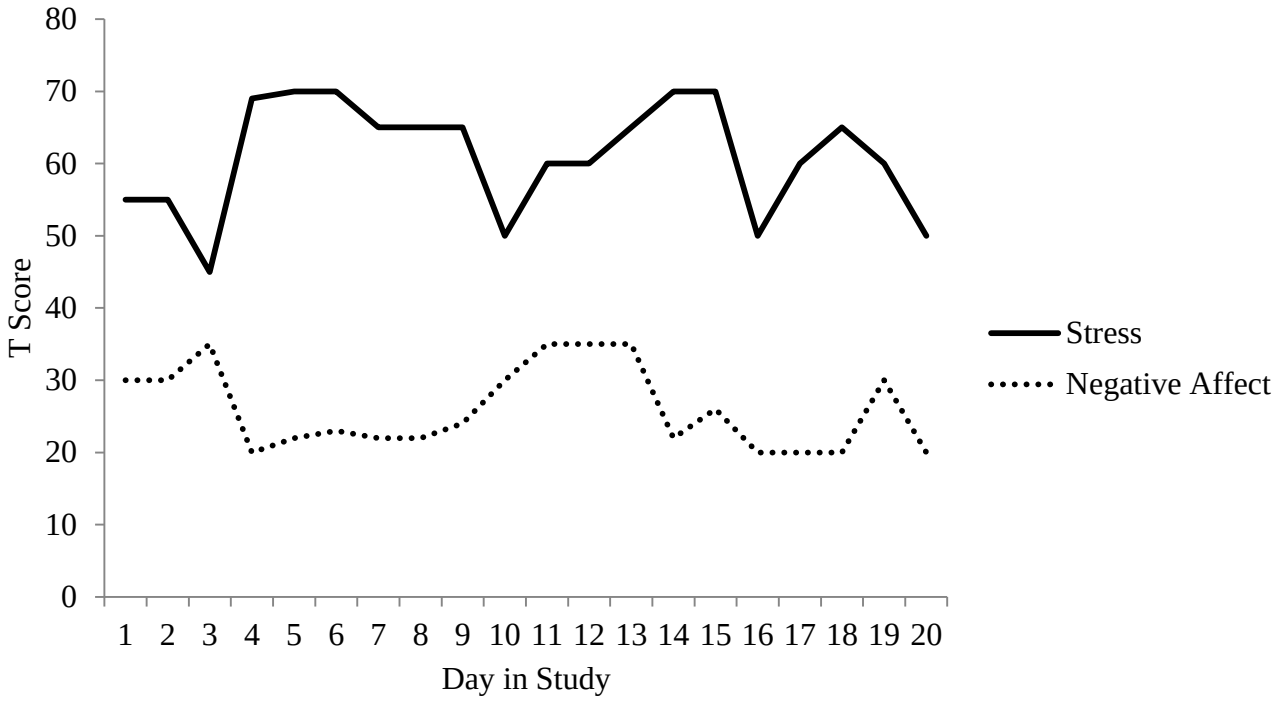

Figure 1.4. Loose Coupling of Daily Stress and Negative Affect (Illustrative Data)

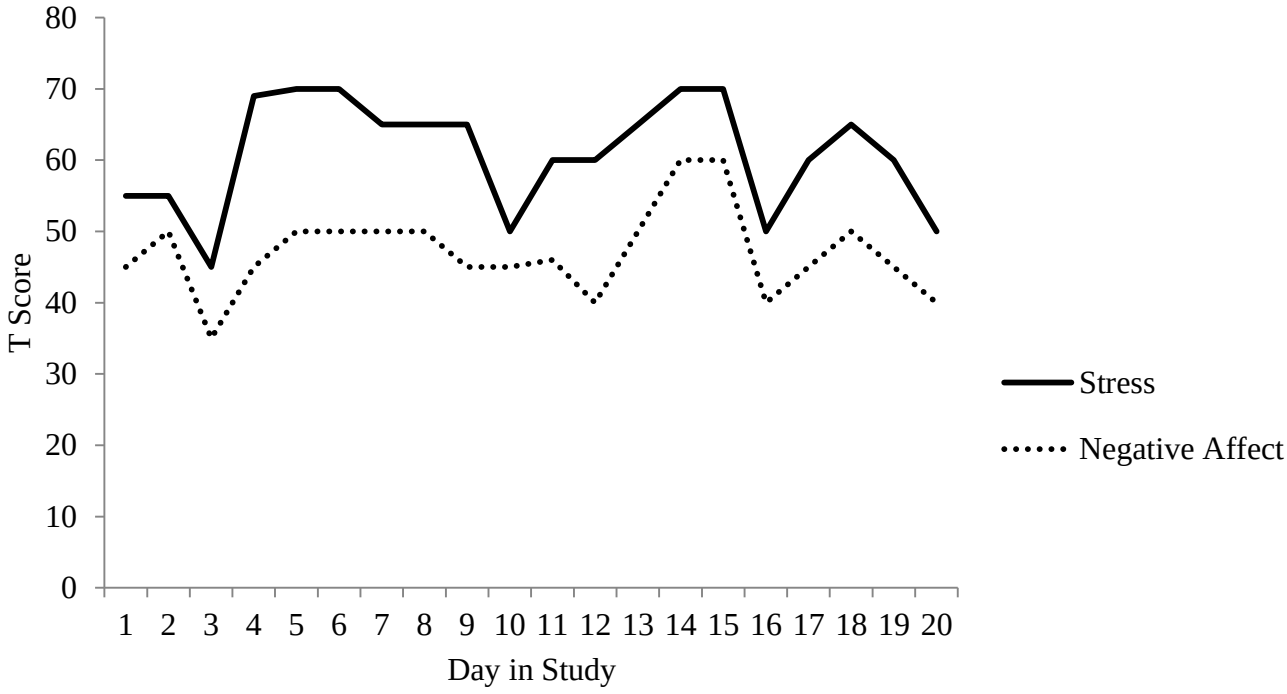

Figure 1.5. Close Coupling of Daily Stress and Negative Affect (Illustrative Data)

To our knowledge, researchers are yet to examine age differences in the daily use and efficacy of ER strategies spanning the *full* range of families outlined by the process model of ER (Gross, 1998, 2015). Moreover, most studies examine ER strategy use and efficacy in isolation, although researchers have highlighted the importance of distinguishing between the *use* and *efficacy* of ER strategies. In particular, Urry and Gross (2010) note that while more frequent use of a given ER strategy should relate to more successful outcomes, that this may not necessarily be the case. Accordingly, forming the basis of this thesis, a micro-longitudinal study was conducted, with data reported regarding the use (**Chapter 3**) and efficacy (**Chapter 4**) of a broad range of ER strategies in the daily lives of younger and older adults.

1.3 Clinical Significance of Emotion Regulation

There is accumulating evidence which suggests that the effective use of ER strategies may support physical health and psychosocial wellbeing (Bower, Kemeny, Taylor, & Fahey, 1998; Dan-Glauser & Gross, 2011; Gianaros et al., 2014; Kinnunen, Kokkonen, Kaprio, & Pulkkinen, 2005; Mauss, Cook, Cheng, & Gross, 2007; Mocaiber et al., 2011; Mohiyeddini, Opacka-Juffry, & Gross, 2014; Quartana, Bounds, Yoon, Goodin, & Burns, 2010; Quartana & Burns, 2010). In terms of physical health and functioning, effective use of regulation strategies may buffer against the adverse physical effects of stress (Kinnunen et al., 2005), although some ER strategies may be more advantageous in this regard than others. For example, research has demonstrated that use of reappraisal reduces the maladaptive cardiovascular sequelae associated with unpleasant experiences (e.g., videos depicting mutilation; Mocaiber et al., 2011). Additionally, the use of reappraisal has been linked to immune processes known to predict slower disease progression (i.e., slower decline in the differentiation of 4 [CD4] T cell levels over two to three years, indicating that the progression of Human Immunodeficiency Virus to a full diagnosis of Acquired Immune Deficiency

syndrome was delayed; Bower et al., 1998). In contrast, the use of suppression exacerbates cardiovascular reactivity associated with negative emotions (Quartana & Burns, 2010). Moreover, habitual suppression has been linked to elevated levels of sympathetic nervous system activity in response to emotional stimuli (Dan-Glauser & Gross, 2011), which in turn has been linked to human immunodeficiency virus (HIV-1) viral load (Cole, 2008) and the growth and metastasis of cancer (Cole & Sood, 2012). Comparing reappraisal and suppression more directly, Denson, Grisham, and Moulds (2011) found that the use of reappraisal was associated with a more positive cardiovascular profile (as indexed by heart rate variability) compared to suppression. Overall, empirical research regarding the associations of ER with physical health and functioning has largely focused on reappraisal and suppression, with the state of literature suggesting that cognitive reappraisal is putatively beneficial in terms of physical health, whereas chronic suppression may be maladaptive.

In terms of the associations of ER with mental health outcomes, difficulties with ER are believed to play an important role in the development, maintenance, and treatment of a broad range of psychological disorders and symptoms (Berking & Wupperman, 2012). For instance, there are established links between, ER and depression (Ehring, Tuschen-Caffier, Schnülle, Fischer, & Gross, 2010; Larsen et al., 2013), autism spectrum disorder (Samson, Hardan, Lee, Phillips, & Gross, 2015; Samson et al., 2014; Samson, Wells, Phillips, Hardan, & Gross, 2015), social anxiety disorder (Brozovich et al., 2015; Jazaieri, Morrison, Goldin, & Gross, 2015; Miu, Vulturar, Chiş, Ungureanu, & Gross, 2013), generalised anxiety disorder (Andreescu et al., 2015), alcohol dependence (Petit et al., 2015), impairment associated with brain injury (Salas, Gross, Rafal, Viñas-Guasch, & Turnbull, 2013; Salas, Gross, & Turnbull, 2014), problematic cannabis use (Boden, Gross, Babson, & Bonn-Miller, 2013), non-suicidal self-injury (McKenzie & Gross, 2014), high psychosis risk (Kimhy et al.,

2016), schizophrenia (Kimhy et al., 2012), subclinical paranoia (Westermann, Boden, Gross, & Lincoln, 2013), bipolar affective disorder (Gruber, Harvey, & Gross, 2012; Gruber, Hay, & Gross, 2014; Hay, Sheppes, Gross, & Gruber, 2015), and post-traumatic stress disorder (Boden, Westermann, et al., 2013; Bonn-Miller, Vujanovic, Boden, & Gross, 2011; Woodward et al., 2015).

Considering specific ER strategies, use of rumination (Nolen-Hoeksema et al., 2008) and suppression (Larsen et al., 2013) appear to be associated with symptoms of depression, while use of rumination (Brozovich et al., 2015) and deficiencies in reappraisal (Miu et al., 2013) may be potent predictors of social anxiety. Similarly, cognitive reappraisal may be compromised among persons with acquired brain injury (Salas et al., 2014). Although some studies suggest it is spontaneous but not instructed use of cognitive reappraisal which is impaired for persons with brain injury (Salas et al., 2013). Similarly, while capacity to use cognitive reappraisal remains intact among persons with bipolar affective disorder, compared to controls, the use of cognitive reappraisal among persons with bipolar is less likely to be initiated spontaneously, is more effortful, and less effective (Gruber et al., 2012; Gruber et al., 2014; Hay et al., 2015). ER may also impact multiple aspects of specific clinical presentations. For instance, persons with post-traumatic stress disorder may experience ER difficulties (Woodward et al., 2015), the extent of which is predictive of post-traumatic stress disorder symptom severity, post-treatment end-state symptom severity (Boden, Westermann, et al., 2013), and comorbid cannabis use (Bonn-Miller et al., 2011). Based on such research, ER represents an important trans-diagnostic feature of psychopathology (Fernandez, Jazaieri, & Gross, 2016; Gross & Jazaieri, 2014).

Interestingly, ER can also predict the course of psychopathology, mediate treatment gains (i.e., serve as a therapeutic mechanism of action), or represent an important post-

treatment gain (Blechert et al., 2015; Boden, Westermann, et al., 2013; Goldin, Lee, et al., 2014; Goldin et al., 2013; Goldin, Ziv, et al., 2014; Jazaieri, Goldin, & Gross, 2017; McRae, Rekshan, Williams, Cooper, & Gross, 2014; Petit et al., 2015; Rottenberg & Gross, 2007). For example, there has been suggestion that efficacy of short-term anti-depressant medication relates to shift in ER strategy use (i.e., greater use of reappraisal and lower levels of suppression to regulate emotion; McRae et al., 2014). Moreover, improving use of ER strategies, in particular reappraisal, represents an important component of the cognitive behavioural treatment of social anxiety (Goldin, Lee, et al., 2014; Goldin et al., 2013; Jazaieri et al., 2017), with treatment gains facilitated through change in systems of reappraising social criticism (Goldin, Ziv, et al., 2014) and promoting social fear extinction (Blechert et al., 2015).

Lastly, from a resilience and positive psychology perspective, successful regulation of emotion, and use of strategies such as reappraisal and acceptance in particular, can moderate the types of emotions we experience in response to particular situations (Siemer, Mauss, & Gross, 2007), allow us to resist temptation and increase goal-congruent behaviour (Leroy, Grégoire, Magen, Gross, & Mikolajczak, 2012), foster positive psychological outcomes (e.g., life satisfaction, psychological wellbeing; Aldao, Nolen-Hoeksema, & Schweizer, 2010; Gross & John, 2003; Gross & Muñoz, 1995; Haga, Kraft, & Corby, 2009; Hu et al., 2014; Mauss, Cook, et al., 2007; Nolen-Hoeksema & Aldao, 2011; Singh, 2011) and contribute to better interpersonal functioning (Butler et al., 2003; English, John, & Gross, 2013; English, John, Srivastava, & Gross, 2012; Gross & John, 2003; Richards, Butler, & Gross, 2003; Srivastava, Tamir, McGonigal, John, & Gross, 2009; Velotti et al., 2016).

Overall, current research highlights that ER contributes to physical and psychosocial health in a number of ways, with strategies such as reappraisal largely predicting more

positive outcomes than strategies like suppression. As such, understanding developmental change in patterns of ER use and efficacy across the adult lifespan may shed light on mechanisms that support physical and mental health.

1.4 The Value of Examining Emotion Regulation in the Context of Ageing

Globally, it is anticipated that the proportion of the world's population aged 60-plus will reach 22% by 2050, a substantial increase from eight percent in 1950 and 11% in 2011 (Beard et al., 2012). Given global demographics are currently characterised by the rapid ageing of humanity, examining factors such as ER which potentially support emotional wellbeing among older adults represents an important avenue of scientific inquiry. Such research may inform social policy and facilitate research-informed adaptations to clinical interventions to support ageing well.

1.5 Aims of Current Research

Theories of adult development (e.g., the SOC-ER model; SST; SAVI; Carstensen, 1993; Carstensen et al., 2003; Charles, 2010; Urry & Gross, 2010) suggest that enhanced ER among older adults may account for the preservation of emotional wellbeing in face of age-normative loss. Indeed, there are well-established links suggesting that adaptive ER contributes to positive outcomes for mental health, psychological wellbeing, physical health, and interpersonal functioning. As such, examining developmental change in ER as a potential explanation of the "paradox of ageing" may be a fruitful avenue to pursue. Such research could elucidate the extent to which enhanced ER represents a pathway to emotional health in older adulthood, which is of particular importance given population ageing (e.g., Beard et al., 2012). However, despite significant growth in the study of ageing and ER over recent decades, there remain a number of important areas which require addressing. For instance, despite extensive efforts to employ laboratory paradigms and questionnaires-based designs to

examine differences in ER among younger and older adults (see **Chapter 2**), there has been no synthesis or broader integration of the results of individual studies. As such, consensus is lacking regarding whether there are consistent differences in ER across the adult lifespan, due to a body of empirical literature which is yet to be reviewed systematically, and that is marked by inconsistent findings and use of divergent methodologies. Moreover, ecologically valid studies, examining age differences in BP and WP profiles of ER strategy use and efficacy across strategies spanning the full range of families outlined by the process model (Gross, 1998, 2015) are wanting. Accordingly, the aims of this thesis were to provide a synthesis of extant research regarding age differences in the use of ER strategies and employ a method high in ecological validity to identify age differences in the use and efficacy of ER strategies. Through these means, the present thesis contributes to the field of ageing and ER by providing the first systematic review of empirical studies regarding age differences in the use of regulation strategies among younger and older adults (**Chapter 2**). Furthermore, to extend existing research, a micro-longitudinal study was conducted to identify BP and WP differences in the use (**Chapter 3**) and efficacy (**Chapter 4**) of ER strategies, spanning the full range of families detailed in the process model (Gross, 1998, 2015), in the daily lives of younger and older adults.

1.6 Systematic Review

The first component of this thesis is a systematic review of empirical studies examining age differences in the use of ER strategies derived from the process model of ER (Gross, 1998), and is presented in **Chapter 2**. Electronic database searches using search terms related to ageing and ER generated a list of potentially relevant references, and articles were screened to ensure they met specified eligibility criteria. Twenty three studies were included in the final review. Popay and colleague's (2006) narrative synthesis protocol was

used to analyse findings. In November of 2017, this study was published in *Aging & Mental Health* (Allen & Windsor, 2017) a copy of this published manuscript is provided in **Appendix A**.

1.7 Micro-Longitudinal Study

The systematic review presented in **Chapter 2** highlighted a number of gaps in existing literature regarding ageing and ER. Firstly, no longitudinal studies met the necessary eligibility criteria to be included in the review. Secondly, studies either employed a questionnaire-based design regarding general regulation tendencies, a laboratory paradigm involving presentation of emotionally evocative stimuli, or a combination of these approaches. This is of concern as there is divergence between profiles of naturalistic ER strategy use and patterns which emerge in more controlled settings (e.g., Liu & Thompson, 2017). Thirdly, most studies examined age differences in a small number of regulation strategies. Indeed, no eligible study included ER strategies spanning the full range of families detailed in the process model (Gross, 1998, 2015). As such, the current state of literature precludes comparison of age differences across families of strategies based on any one study and cross-study comparisons are confounded by use of different samples and methodologies across studies. To address these limitations, the current thesis draws on data from a micro-longitudinal study involving a baseline assessment, daily diary protocol, and three follow-up assessments. As seen in *Figure 1.6,* data regarding ageing and ER represents a small subset of data obtained as part of the broader research protocol. This broader research protocol formed part of a larger scale project conducted through the Flinders University Centre for Ageing Studies regarding self-regulation, ageing, and emotion.

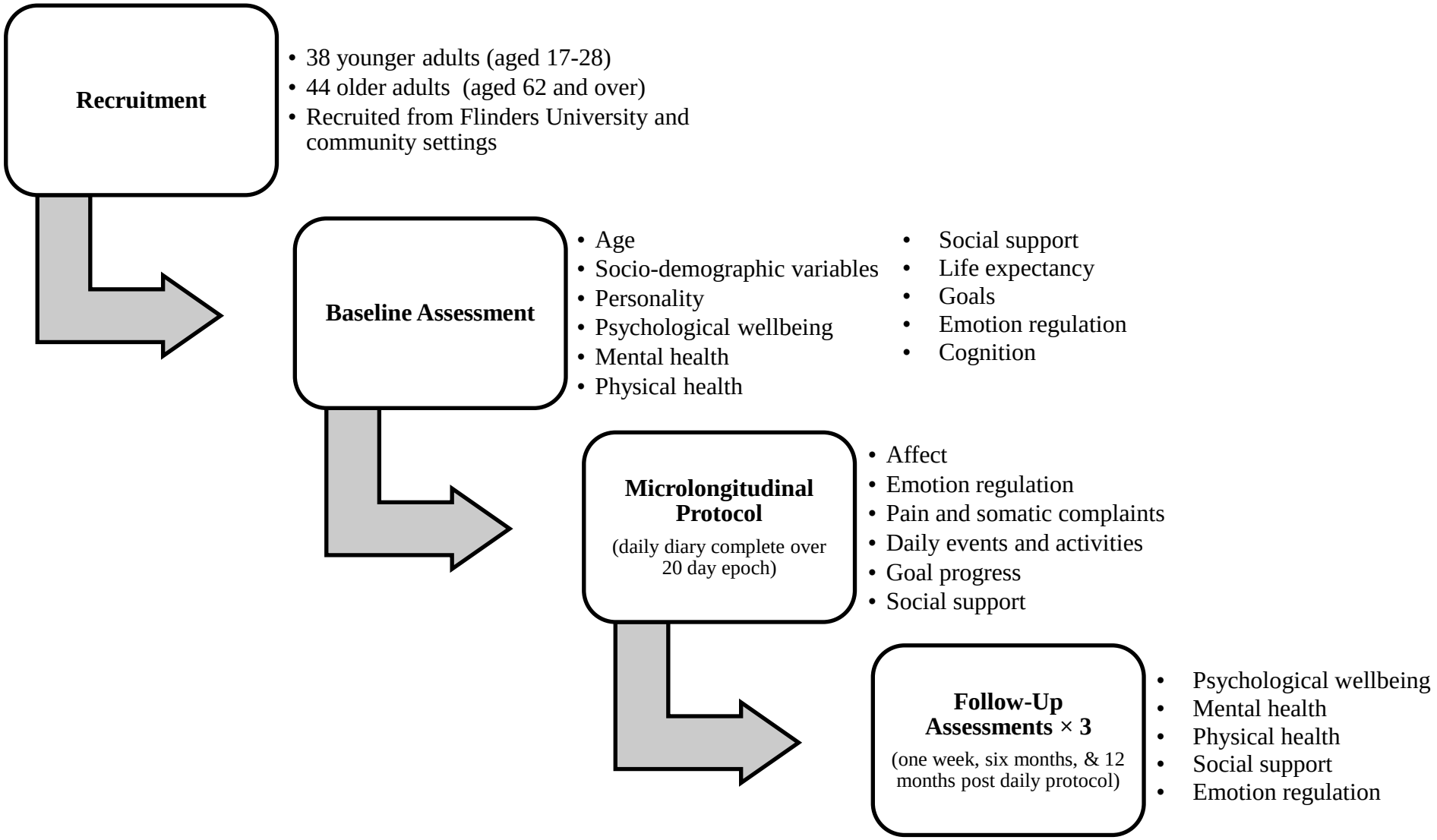

Figure 1.6. Summary of assessment periods, recruitment details, and list of variables measured at key time points

Recruitment details and a summary of constructs measured at particular time-points are provided in *Figure 1.6*. Of note, substantial data across multiple domains of bio-psychosocial functioning were collected as part of the study. However, given our focus on age differences in ER use and efficacy, the current thesis primarily presents data relevant to age, daily ER, and related affective processes (i.e., stress and NA)[2]. Two empirical papers have been prepared using data obtained from the micro-longitudinal study. These papers are presented as **Chapter 3** and **Chapter 4** of this thesis respectively.

Chapter 3 is a manuscript which reports on data regarding age differences in the use of a range of ER strategies (e.g., situational avoidance, humour, problem-solving, distraction, cognitive reappraisal, acceptance, and expressive suppression) across the daily component of our micro-longitudinal protocol. The advantage of a micro-longitudinal design is evident here as the nested structure of data (i.e., repeated assessments across days grouped within individuals) facilitates analysis of data at BP and WP levels. As per *Figure 1.7*, having obtained data across multiple time-points (i.e., days) for each individual enables examination of WP variance, while Level 1 daily data nested within participants (Level 2 factor) allows for comparisons between different participants (BP variance). We draw on both levels of analysis in **Chapter 3,** in addition to considering mechanisms related to ER which may support positive emotional outcomes among older adults (i.e., life context, processes of selectivity; Carstensen et al., 1997). The manuscript presented as **Chapter 3** has been submitted to *Psychology and Aging* and as of the submission of this thesis is awaiting review.

[2] We view examination of age differences in ER use and efficacy among younger and older adults as an essential prerequisite before exploration of more complex relationships (i.e., extent to which age differences in ER use may be moderated by personality factors; extent to which age differences in the efficacy of daily ER strategy use predict health outcomes at follow-up) is undertaken. These types of analyses will be the focus of a subsequent phase of the project.

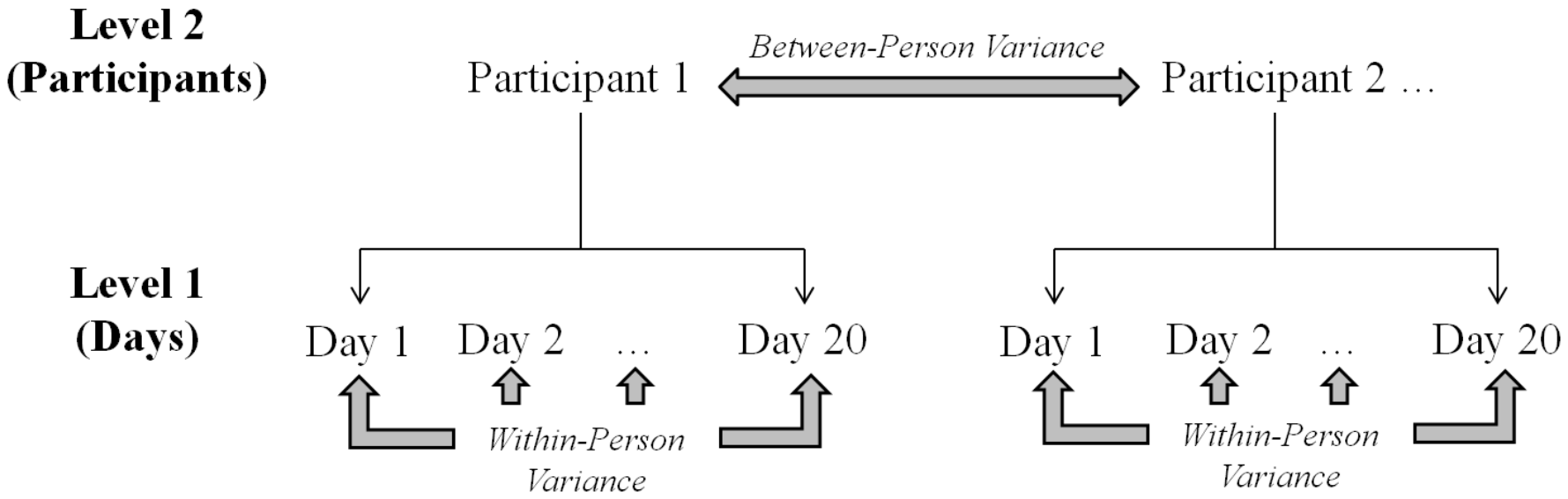

Figure 1.7. Outline of data nesting (Days at Level 1 grouped within participants at Level 2) and relation to BP and WP variance

As highlighted earlier, greater regulation strategy use does not necessarily equate to greater ER strategy efficacy. Consequently, the study of age differences in ER necessitates consideration of both the *use* and *efficacy* of regulation strategies. Therefore, building on **Chapter 3** regarding age differences in ER strategy *use*, in **Chapter 4** data from the micro-longitudinal study is used to investigate age differences in the *efficacy* of ER strategies (e.g., humour, problem-solving, distraction, cognitive reappraisal, acceptance, and expressive suppression) at BP and WP levels. **Chapter 4** is a manuscript based on analysis of this data. This manuscript has been submitted to *Psychology and Aging* and as of the submission of this thesis is awaiting review.

1.8 Implications of the Findings

A summary of key findings from the systematic review and manuscripts prepared using data from the micro-longitudinal study is provided in the final chapter of this thesis (**Chapter 5**). This comprehensive discussion details the how the present thesis contributes to the study of ER across the adult lifespan, theoretically, methodologically, and in terms of clinical implications and directions for future research.

Chapter 2:Age Differences in the Use of Emotion Regulation Strategies Derived from the Process Model of Emotion Regulation: A Systematic Review

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Publication status:

Published version appears in Appendix A.

Allen, V. C., & Windsor, T. D. (2017). Age differences in the use of emotion regulation strategies derived from the process model of emotion regulation: a systematic review. *Aging & mental health*, 1-14. doi:10.1080/13607863.2017.1396575

Candidate's contribution:

Victoria Allen designed the review study, collected data, analysed data and prepared this manuscript under the supervision of Dr Tim Windsor.

Research design 90%; Data collection 100%; Analysis 90%; Writing and editing 85%.

Chapter 2 has been removed due to copyright restrictions

Chapter 3: Only Getting Better with Age? Stress Exposure, Selectivity, and Emotion Regulation Strategy Use in Younger and Older Adults

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Publication status:

Only Getting Better with Age? Stress Exposure, Selectivity, and Emotion Regulation Strategy Use in Younger and Older Adults (Allen & Windsor, 2018) submitted as manuscript for publication to Psychology and Ageing in July 2018.

Candidate's contribution:

Victoria Allen reviewed the literature, designed the study, collected data, analysed data and prepared the manuscript under the supervision of Dr Tim Windsor.

Research design 90%; Data collection 100%; Analysis 85%; Writing and editing 85%.

3.1 Abstract

Objectives: To examine age differences in processes of selectivity and the use of emotion regulation (ER) strategies, in the context of exposure to daily life stressors.

Method: Thirty eight younger (aged 17-28) and 44 older (aged 62 and over) adults provided demographic information at baseline assessment and completed measures concerned with daily stress and ER strategy use, as part of a 20-day diary study.

Results: Older adults reported comparable, or lower, ER strategy use relative to younger adults with the exception of use of problem-solving, which was endorsed more by older participants. Age group did not interact with between-person differences or within-person fluctuations in stress exposure to predict levels of strategy use. Frequency of daily stress exposure and ratings of stressor severity were largely comparable across age groups. Younger adults were over six times more likely than older adults to anticipate future stress exposure. When participants reported that stressful events had not occurred, younger and older adults did not differ in the extent to which they attributed this to situational avoidance relative to other possible reasons (e.g., luck, another reason). Older adults were, however, relatively more likely to attribute the absence of daily stress to generally not encountering stressful situations.

Conclusion: We observed minimal evidence of enhanced ER strategy use among older adults in both general daily use and use in the context of stress. Discrete avoidance of stressful situations does not appear to explain positive hedonic outcomes (i.e., the absence of daily stress) among older adults. We discuss possible alternative mechanisms which may support the emotional wellbeing of older adults.

3.2 Introduction

Older age is a period marked by normative declines in physical health (Hébert, 1997), sensory abilities (Cruickshanks et al., 2003), and fluid cognition (Lövdén et al., 2004), as well as social network losses associated with isolation and loneliness (Victor et al., 2000). However, affective wellbeing remains relatively stable with increasing age (Carstensen et al., 2011), at least up until late life (Windsor, Burns, & Byles, 2012). Developmental changes in processes of selectivity and emotion regulation (ER), described by theories of adult development, have been invoked to account for this phenomenon. Building on this premise, the current paper will examine age differences in the use of different ER strategies selected to represent the families identified in Gross's (1998, 2015) process model. In addition to describing spontaneous patterns of ER use in everyday life contexts, we also examine whether younger and older adults differ in their use of ER strategies on days when they are exposed to stress.

3.2.1 Emotion regulation.

The process model of ER (Gross, 1998, 2015) outlines five families of regulation strategies. *Situation selection* pre-empts the occurrence of emotion and involves shaping emotional experience by selectively entering into or avoiding emotion-eliciting situations. *Situation modification* is another proactive ER strategy in which a situation is modified with the aim of influencing emotional experience. *Attentional deployment* operates later in the emotion generative process and involves the effortful direction of attention towards or away from specific aspects of a situation for regulatory purposes. In contrast, *cognitive change* strategies may be used to alter the emotional significance of a situation by re-evaluating one's perception of the situation or one's ability to cope. Lastly, once an emotion has been generated, *response modulation* strategies can be used to modulate the physiological, experiential, or behavioural components of emotional experience.

3.2.2 Age differences in emotion regulation.

Several lifespan perspectives identify mechanisms that could account for age differences in the use of ER strategies. Most notably, *socioemotional selectivity theory* (SST; Carstensen, 1993) suggests that when future time is perceived as limited, which is more common among older adults, effort is increasingly invested in achieving emotionally meaningful goals and maintaining close interpersonal relationships. Use of specific ER strategies may facilitate pursuit of these predominantly hedonic goals. In particular, proactively avoiding situations with the potential to elicit negative emotions through use of selectivity is believed to become increasingly important with ageing (Sims et al., 2015). Indirect support for this notion is provided by numerous empirical studies. For example, compared to younger or mid-life adults, older adults report fewer stressful events (Mroczek & Almeida, 2004; Stawski et al., 2008), lower levels of negative affect (NA; Mroczek & Almeida, 2004; Windsor & Anstey, 2010; Windsor et al., 2012), and higher levels of low-arousal positive affect (PA; Windsor et al., 2012).

A recent systematic review (Allen & Windsor, 2017) offers additional preliminary insights regarding age differences in ER strategy use. The review identified some evidence for greater use of situation selection, attentional deployment, and acceptance (a cognitive change strategy) among older relative to younger adults, although these relationships were dependent on specific contextual factors and were moderated by individual difference characteristics (e.g., control beliefs). Additionally, emerging evidence suggested greater use of situation modification to downregulate negative emotions among older adults. However, the review identified a number of situation modification subtypes such as problem-solving for which findings were equivocal, and consistent patterns of age differences did not emerge for cognitive reappraisal (a cognitive change strategy) or expressive suppression (a response

modulation strategy). As the studies included in Allen and Windsor's (2017) review employed measures of habitual regulation strategy use or used laboratory paradigms to capture ER, it is yet to be established how age difference in ER strategy use manifest in daily life.

What is currently missing from the literature on age differences in ER strategy use is research considering the full range of Gross's (1998) ER strategies within the same participant sample, and examination of strategy use within the daily lives of younger and older adults. Of particular interest is whether it may be the more gradual cumulative effects of selectivity (e.g., organising one's life in ways that avoid situations likely to produce NA, cf. Sims et al., 2015) that support hedonic wellbeing among older adults, rather than discrete instances of using putatively adaptive ER strategies on a day-to-day basis.

3.2.3 Current study.

The current study aims to determine whether younger and older adults differ in their daily use of a broad range of Gross's (1998) regulation strategies including: situational avoidance (situation selection), humour (situation modification), problem-solving (situation modification), distraction (attentional deployment), cognitive reappraisal (cognitive change), acceptance (cognitive change), and expressive suppression (response modulation). This aim is largely exploratory given the absence of existing studies employing daily assessment methods. However, given the theoretical suggestion that older adults may favour more proactive ER strategies (Livingstone & Isaacowitz, 2015), we tentatively predict that compared to younger adults, older adults will demonstrate greater use of regulation strategies occurring earlier (situational avoidance, humour, problem-solving, distraction) versus later (cognitive change, acceptance, expressive suppression) in the emotion generative cycle.

Profiles of daily ER strategy use may reflect developmental differences in the ways that older and younger adults typically use ER in response to similar emotion-eliciting circumstances (e.g., Blanchard-Fields, Stein, & Watson, 2004). Alternatively, it may be that the different life contexts and constraints which characterise younger versus older adulthood (e.g., Cheng, 2004; Wrosch & Heckhausen, 1996) shape the use of different ER strategies. To control for the possibility that any age differences in strategy use are driven primarily by developmental differences in exposure to situations likely to elicit negative emotions (and consequently a need for down-regulation), we also examined age differences in within-person fluctuation in ER strategy use, comparing days when participants reported experiencing a stressor, with non-stress days (an index of 'reactivity', see Neupert, Almeida, & Charles, 2007).

Shifts in motivation across the adult lifespan, may result in lower stress exposure among older adults through processes of selectivity (Sims et al., 2015). As such, we predict that compared to younger adults, older adults will report less frequent daily stress. In formulating hypotheses regarding the associations of stress, ER strategy use, and age, we were guided by the *selection, optimisation, and compensation with ER* (SOC-ER; Urry & Gross, 2010) model. The SOC-ER model (Urry & Gross, 2010) proposes that age-related change in regulatory resources may render particular ER strategies more or less viable for younger and older adults, resulting in distinct profiles of ER strategy use when regulation is required. The age-related strengths (i.e., supportive social networks) and relative weaknesses (i.e., diminished cognitive control) of older adults are believed to support use of antecedent regulation strategies, while rendering use of more cognitively-taxing regulation strategies less viable. As such, we predict that older adults will report greater use of relatively less cognitively-taxing ER strategies such as humour, distraction, and acceptance on stress days

relative to younger adults, whereas younger adults will be relatively more likely to report using problem-solving, cognitive reappraisal, and expressive suppression, which draw more heavily on cognitive resources.

Lastly, we aim to examine age differences in selectivity indirectly by considering reasons endorsed for not experiencing stressful events on non-stress days. Given the suggestion that older adults structure their environments to foster personal meaning and preserve hedonic wellbeing (Carstensen, 1993), we predict that compared to younger adults, older adults will be more likely to attribute the absence of daily stress to avoidance of stress or not typically being exposed to stress.

3.3 Method

3.3.1 Participants.

Participants were 38 younger (17-28, *M* = 20.73, *SD* = 2.46) and 44 older (62-90, *M* = 73.52, *SD* = 6.65) South Australian adults recruited using research participation flyers displayed at a local university and community centres. Participants received up to $80.00 remuneration for participation. The sample was reasonably well-educated (M_{years} = 14.78, *SD* = 5.09) and approximately 77% female. Modal participant household income (*Mo* = 3.00, *SD* = 3.62) was '$20,000 to $29,999' and on average participants reported 2.10 (*SD* = 2.31) chronic health conditions at baseline.

There was no significant age difference in income, $t(59.18) = .178$, $p = .860$. However, older adults (*M* = 2.70, *SD* = 2.41) reported more chronic health conditions than younger adults (*M* = 1.39, *SD* = 1.99), $t(80) = -2.66$, $p = .010$. Additionally, older adults (*M* = 15.85, *SD* = 6.28) reported greater years of education than younger adults (*M* = 13.57, *SD* = 2.90), $t(60.68) = -2.14$, $p = .036$. Sex distribution did not vary by age group, χ^2 (1, *N* = 82) = 2.17, $p = .141$.

3.3.2 Measures.

Measures were collected as part of a larger study regarding the daily experiences of younger and older adults which included a baseline assessment, 20-day micro-longitudinal protocol, and three follow-up assessments. Only measures pertinent to the current study are discussed here.

Daily ER. Eleven items (see Supplementary Table) consistent with those used by Schutte, Manes, and Malouff (2009), Tan et al. (2012), and created specifically for the present study, were used to measure the extent to which participants used situational avoidance, humour, problem-solving, distraction, cognitive reappraisal, acceptance, and expressive suppression to regulate NA over the last 24 hours. Responses were made on a 100 millimetre visual analogue scale anchored at 'Not at All' (0) and 'Extremely' (100), thus higher scores reflected greater use of the given strategy. Across strategies, 25-58 % of variance in use occurred at the between-person (BP; variation in ER strategy use between individuals) level and 42-75 % at the within-person (WP; variation in ER use from one day to another for the same individual) level (Supplementary Table).

Stress & non-stress days. Items regarding daily stress were adapted from the Daily Inventory of Stressful Events (Almeida, Wethington, & Kessler, 2002). Participants were asked 'Did anything stressful occur in the last 24 hours' (yes/no). If participants responded 'no' they were then asked 'Why do you think nothing stressful happened to you in the last 24 hours?', response options included 'I just got lucky', 'Stressful things don't usually happen to me', 'I avoided stressful situations', 'I handled situations before they became stressful', and 'Another reason'. If participants responded that a stressful event had occurred within the last 24 hours, they were asked 'Which of the following types of stressors have you experienced in the last 24 hours' and could select the following option/s: 'Argument/Disagreement/Conflict',

'Home-related event', 'Event that happened to others', 'Work, volunteer or study related event', 'Health concern or accident', 'Other (i.e., 'anything else that most people would consider stressful)'. Participants indicated 'How stressful or unpleasant was this [stressor type] when it occurred?' on scale from 1 (Not at All) to 7 (Extremely). Additionally, participants were asked 'Do you think anything stressful will happen tomorrow?' (yes/no). For the analyses reported here, stress days were operationalised as days on which any stressor had occurred.

Covariates. At baseline, participants reported their sex (0 = male; 1 = female), education (i.e., years of schooling completed), completed a measure of annual household income and a chronic health condition checklist. Participants used a 12-point scale (1 = 'Less than $10,000' to 12 = '$150,000 or more') to indicate 'What is your total annual household income?'. Chronic health conditions were assessed using a checklist containing 31 chronic health conditions (e.g., 'Arthritis', 'High cholesterol', 'Stroke') adapted from the Midlife in the United States longitudinal study (Brim, Ryff, & Kessler, 2004) and the Health and Retirement Study (Juster & Suzman, 1995). Participants were asked 'Do you have any of the following health conditions?' and marked all applicable health conditions. The total number of items selected was summed.

3.3.3 Procedure

Baseline assessment. Participants completed a 90-minute face-to-face interview at their place of residence or Flinders University. Baseline measures, including covariates, were completed using Apple iPad devices, with questionnaires supported by web-based Qualtrics software.

Micro-longitudinal protocol. Participants were loaned an Apple iPad tablet to facilitate daily completion of a short ($M_{minutes}$= 15.26, SD = 22.85) web-based questionnaire

hosted by Qualtrics. Daily questionnaires were completed over 20 days, between 17:00 on the day the questionnaire was sent out and 02:00 the following morning.

3.3.4 Analysis approach

Following previous studies concerned with age differences in emotion (e.g., Windsor & Anstey, 2010), all analyses included sex, income range, chronic health conditions, and years of education as covariates. Covariates and predictors were grand mean-centred. All data was analysed using STATA Version 13.1 (StataCorp. 2013) with maximum likelihood estimation.

Data screening revealed that the ER variables were typically not normally distributed, with situational avoidance and humour in particular showing substantial positive skewness. Transformations (e.g., logarithmic, square-root) did not improve variable distributions, and running analyses with dichotomised (0 – no use of strategy, 1 – any use of strategy) situational avoidance and humour variables, to address distributional issues, did not alter results [3]. As such, we report original data and used robust standard errors to reduce the likelihood of biased significance tests as per Hox, Moerbeek, and van de Schoot (2010).

Multi-level modelling (MLM) was used to analyse ER data. Null models initially provided estimates of BP and WP variance in ER strategy use (see Supplementary Table). Next, two models including predictor variables were constructed for each ER strategy. Model A, was a two-level model designed to explore age differences in ER strategy use, with Level 2 variables of age group (main predictor variable) and covariates. These models provided our initial test of whether younger and older adults differed in their use of ER strategies. Model

[3] For untransformed and continuous original variables, two-level MLMs were used to test relationships between independent variables and ER measures. However, dichotomising the situational avoidance and humour variables necessitated analyses which could support categorical data. As such, mixed effects logistic regression was used to examine relationships between independent variables (the same variables as those in the MLMs) and dichotomised situational avoidance and humour variables.

B incorporated WP and BP stress, and the stress by age interaction. Responses to '*Did anything stressful occur in the last 24 hours*' (*yes* = 1, *no* = 0) were averaged across study days to create a measure of BP stress, with higher scores reflecting more frequent stress occurrence. To index WP stress, for each completed daily questionnaire, participants' response to '*Did anything stressful occur in the last 24 hours*' (*yes* = 1, *no* = 0) was subtracted from their BP stress score. As such, WP stress reflected the extent to which, stress on a given day of the protocol deviated from the individual's average levels of stress. Thus, Model B allowed assessment of whether in the context of stress, when greater need for downregulation of NA can be assumed, age differences in ER strategy use become more evident. For Model B, inclusion of a random slope for WP stress did not improve model fit for any of the ER models, and therefore was not included. An autoregressive lag-1 residual covariance structure demonstrated superior fit to an unstructured variance-covariance structure and as such was employed across iterations of Model B for each ER strategy. For addition details see Appendix B which provides an interpretive aid for interactions.

Remaining analyses were used to examine associations of age and stress. Firstly, mixed effects logistic regression, with observations nested within individuals, was used to examine age group as a predictor of the presence or absence of any daily stressor. Follow-up analyses involved replication of this analysis for each stressor subtype (e.g., interpersonal stressors, home-related stressors, events that happened to others that participants found stressful, work-related stressors, health-related stressors, and other stressful events). We also considered how age group would relate to stressor subtype severity by constructing two-level MLMs, with observations nested within individuals, and age group (Level 2 predictor) as a predictor of stressor severity ratings, for each stressor subtype. Moreover, a mixed effects logistic regression, with observations nested within individuals, was used to examine age

group as a predictor of whether or not participants would report *yes* or *no* to the daily questionnaire item '*Do you think anything stressful will happen tomorrow?*'.

Lastly, multinomial logistic regression was used to examine age group as a predictor of the relative likelihood of endorsing particular reasons for the absence of daily stress ('*I just got lucky'*, '*Stressful things don't usually happen to me'*, '*I avoided stressful situations'*, '*I handled situations before they became stressful*', and '*Another reason'*). Robust standard errors with variance clustered according to participant identification number were used to account for repeated observations in this last analysis.

3.4 Results

3.4.1 Sample characteristics & description of variables.

For descriptive statistics and bivariate correlations of study variables see Tables 3.1 and 3.2.

Table 3.1
Descriptive statistics for study variables

		Younger adults			*Older adults*			*Total sample*		
Variables		*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Study days, proportion of:	Stress days	211 (31.20%)	-	-	259 (32.60%)	-	-	470 (31.90%)	-	-
	Non-stress days	465 (68.70%)	-	-	533 (67.00%)	-	-	998 (67.80%)	-	-
Total number of stress days[a]		677	5.62	4.34	795	6.06	4.81	1472	5.86	4.60
Number of daily stressors on stress days[a]		35	1.15	.24	41	1.23	.28	76	1.19	.27
Sex	Male	6 (15.80%)	-	-	13 (29.50%)	-	-	19 (23.20%)	-	-
	Female	32 (84.20%)	-	-	31 (70.50%)	-	-	63 (76.80%)	-	-
Annual household income		33	5.27	4.15	35	5.11	3.10	68	5.19	3.62
Chronic health conditions		38	1.39	1.99	44	2.70	2.41	82	2.10	2.31
Years of education		38	13.57	2.90	43	15.85	6.28	81	14.78	5.09
Situational avoidance[b]		38	32.85	21.63	44	15.45	18.87	82	23.51	21.88
Humour[b]		38	42.82	22.13	44	27.77	21.67	82	34.74	23.02
Problem-solving[b]		37	45.63	15.47	39	58.44	19.83	76	52.20	18.86
Distraction[b]		37	45.13	18.02	30	41.81	22.13	76	43.42	20.17
Cognitive reappraisal[b]		37	45.00	20.58	39	40.67	22.61	76	43.12	21.66
Acceptance[b]		37	45.85	21.41	39	35.86	19.67	76	40.72	21.01
Expressive suppression[b]		37	52.56	19.82	38	42.96	24.39	75	47.70	22.62

Note. [a] = an independent sample *t*-test revealed no significant age difference between groups (i.e., $p < .001$);
[b] = mean use of ER strategy across micro-longitudinal assessment.

Table 3.2
Bivariate correlations among study variables

		1	2	3	4	5	6	7	8	9	10	11	12
1. Age group[a]	*r*	1.00	-.16	-.02	.29**	.23*	-.40**	-.33**	.34**	-.08	-.12	-.24*	-.21
	N	82	82	68	82	81	82	82	76	76	76	76	75
2. Sex	*r*	-	1.00	-.10	.10	-.31**	.10	-.03	.06	.14	.09	.03	-.03
	N		82	68	82	81	82	82	76	76	76	76	75
3. Annual household income	*r*	-	-	1.00	-.02	.04	-.19	-.07	-.15	-.26*	.05	-.24	-.17
	N			68	68	67	68	68	66	66	66	66	65
4. Chronic health condition	*r*	-	-	-	1.00	.02	.04	-.08	-.01	.14	.05	.16	.001
	N				82	81	82	82	76	76	76	76	75
5. Years of education	*r*	-	-	-	-	1.00	-.26*	-.15	.02	-.10	-.05	-.13	-.11
	N					81	81	81	75	75	75	75	74
6. Situational avoidance[b]	*r*	-	-	-	-	-	1.00	.69**	-.05	.36**	.24*	.14	.38**
	N						82	82	76	76	76	76	75
7. Humour[b]	*r*	-	-	-	-	-	-	1.00	.12	.49**	.44**	.31**	.48**
	N							82	76	76	76	76	75
8. Problem-solving[b]	*r*	-	-	-	-	-	-	-	1.00	.15	.22	-.11	.01
	N								76	76	76	76	75
9. Distraction[b]	*r*	-	-	-	-	-	-	-	-	1.00	.55**	.45**	.41**
	N									76	76	76	75
10. Cognitive	*r*	-	-	-	-	-	-	-	-	-	1.00	.36**	.25*

reappraisal[b]	*N*											76	76	75
11. Acceptance[b]	*r*												1.00	.36**
	N	-	-	-	-	-	-	-	-	-	-		76	75
12. Expressive	*r*													1.00
suppression[b]	*N*	-	-	-	-	-	-	-	-	-	-	-	-	75

Notes. [a] = age group was included as a dichotomous variable (younger adults = 0, older adults =1), [b] = mean use of ER strategy across daily assessments. * $p < .05$; ** $p < .01$; *** $p < .001$.

3.4.2 Age differences in emotion regulation strategy use.

Results regarding age differences in ER strategy use are reflected in Model A for each regulation strategy, displayed in Table 3.3. It was anticipated that compared to younger adults, older adults would report greater use of situational avoidance, humour, problem-solving, and distraction and less use of cognitive change, acceptance, and expressive suppression. Results offered minimal support for this hypothesis. Age group did not significantly predict use of distraction or cognitive reappraisal. Older age related to lower levels of situational avoidance, humour, acceptance, and expressive suppression use, and greater self-reported use of problem-solving.

Table 3.3

Multi-level model results for situational avoidance, humour, problem-solving, distraction, cognitive reappraisal, acceptance, and expressive suppression

	Model A				Model B			
	Estimate	Robust SE	95% CI		Estimate	Robust SE	95% CI	
			Lower	Upper			Lower	Upper
Situational avoidance								
Age group	-15.55***	4.62	-24.60	-6.50	-	-	-	-
BP stress	-	-	-	-	-	-	-	-
WP stress	-	-	-	-	-	-	-	-
Age group x BP stress	-	-	-	-	-	-	-	-
Age group x WP stress	-	-	-	-	-	-	-	-
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	.20		-.03		-		-	
Model A	-		-		-		-	
Humour								
Age group	-15.41**	5.36	-25.92	-4.90	-15.55**	5.02	-25.39	-5.70
BP stress	-	-	-	-	26.74*	12.92	1.42	52.06
WP stress	-	-	-	-	1.85	3.25	-4.52	8.21
Age group x BP stress	-	-	-	-	5.51	19.39	-32.49	43.50
Age group x WP stress	-	-	-	-	6.16	4.06	-1.79	14.12
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	.16		-.06		.28		-.08	
Model A	-		-		.15		-.01	
Problem-solving								
Age group	10.40*	4.63	1.33	19.47	13.03**	4.74	3.74	22.32
BP stress	-	-	-	-	15.53	11.85	-7.70	38.76
WP stress	-	-	-	-	6.42	3.89	-1.20	14.04
Age group x BP stress	-	-	-	-	-33.45	17.34	-67.43	.54
Age group x WP stress	-	-	-	-	-2.70	5.36	-13.20	7.81
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	.30		-.02		.53		-.05	
Model A	-		-		.33		-.03	
Distraction								
Age group	-3.62	4.52	-12.47	5.24	-5.50	5.20	-15.69	4.69
BP stress	-	-	-	-	7.33	10.87	-13.98	28.65
WP stress	-	-	-	-	-.68	3.92	-8.35	7.00
Age group x BP stress	-	-	-	-	3.51	17.97	-31.71	38.73
Age group x WP	-	-	-	-	5.94	5.37	-4.59	16.46

stress								
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	.20		.04		.25		.01	
Model A	-		-		.07		-.02	
Cognitive reappraisal								
Age group	-8.65	5.63	-19.68	2.38	-8.92	5.99	-20.66	2.81
BP stress	-	-	-	-	5.11	15.62	-25.50	35.72
WP stress	-	-	-	-	.17	2.88	-5.47	5.82
Age group x BP stress	-	-	-	-	-5.43	22.29	-49.11	38.26
Age group x WP stress	-	-	-	-	1.79	4.38	-6.79	10.38
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	.02		.03		.10		-.01	
Model A	-		-		.08		-.04	
Acceptance								
Age group	-11.29*	4.65	-20.39	-2.18	-11.61*	4.75	-20.91	-2.31
BP stress	-	-	-	-	-8.57	12.19	-32.45	15.32
WP stress	-	-	-	-	8.26*	3.92	.58	15.94
Age group x BP stress	-	-	-	-	.29	19.95	-38.81	39.39
Age group x WP stress	-	-	-	-	-5.24	6.00	-17.00	6.52
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	.33		-.05		.42		-.08	
Model A	-		-		.13		-.03	
Expressive suppression								
Age group	-12.02*	6.07	-23.93	-.12	-14.72*	6.18	-26.83	-2.61
BP stress	-	-	-	-	36.01**	11.43	13.61	58.40
WP stress	-	-	-	-	4.79	3.06	-1.20	10.79
Age group x BP stress	-	-	-	-	18.77	17.39	-15.32	52.85
Age group x WP stress	-	-	-	-	2.47	4.45	-6.26	11.20
Pseudo-R^2	*BP Variance*		*WP Variance*		*BP Variance*		*WP Variance*	
Null model	0.05		0.05		0.32		0.05	
Model A	-		-		0.28		0.01	

Notes. All analyses are controlled for sex, years of education, annual household income, and number of chronic health conditions.

ER = emotion regulation, BP = between-persons differences in given variable, WP = within-persons differences in given variable.

See Appendix B which provides an interpretive aid for interactions included in the above Table.

* $p < .05$; ** $p < .01$; .** $p < .001$.

3.4.3 Age differences in daily stress.

One possible reason for age differences in ER strategy use could be that younger and older adults are differentially exposed to stressful situations likely to elicit negative emotions, which in turn precipitate regulation. As per Table 3.1, younger and older adults reported similar proportions of stress days (around 3 days in every 10) and non-stress days (around 7 days in every 10). Thus, contrary to our predictions, age group was not a significant predictor of reported stress exposure (Table 3.4). With a few exceptions, our additional follow-up analyses regarding the occurrence of specific stressors and ratings of stressor subtype severity (Table 3.4) were largely consistent with an absence of age differences in daily stress. In terms of significant age differences, compared to younger adults, older adults rated home-related stressors as less severe and were almost six times more likely to report an event occurring to others which they themselves found stressful. Compared to older adults, younger adults were over four times more likely to report a work-related stressor and were over six times more likely respond yes to the item '*Do you think anything stressful will happen tomorrow?*'.

Table 3.4

Age group as a predictor of the occurrence of any and particular stressful events, severity of stressor-subtypes, and future anticipated stress

	Probability of event[a]							Severity of stressor[b]			
	Estimate	SE	95% CI		Odds ratio	SE	95% CI		Estimate	SE	95% CI	
			Lower	Upper			Lower	Upper			Lower	Upper
Any stressor	.04	.35	-.65	.72	1.04	.36	.52	2.05	-	-	-	-
Interpersonal stressor	-.83	.72	-2.23	.57	.44	.31	.12	1.77	.002	.03	-.05	.06
Home-related stressor	.89	.51	-.10	1.88	2.44	1.23	.91	6.57	-31.33***	7.27	-45.57	-17.09
Event that happened to others	1.94*	.78	.40	3.48	6.96*	5.45	1.50	32.35	6.39	6.41	-6.18	18.95
Work-related stressor[c]	1.57*	.62	.35	2.78	4.79*	2.96	1.43	16.10	-10.43	8.16	-26.43	5.57
Health-related stressor	1.03	.71	-.36	2.42	2.81	1.99	.70	11.28	-6.68	10.13	-26.53	13.17
Other stressful events	.16	.49	-.80	1.12	1.17	.58	.45	3.07	-1.92	5.53	-12.75	8.90
Anticipated stressful event[c]	1.94**	.67	.59	3.29	6.98**	4.81	1.80	26.97	-	-	-	-

Note. All analyses are controlled for sex, years of education, annual household income, and number of chronic health conditions.
[a] = tested using mixed effects logistic regression given categorical dependent variable; [b] = tested multi-level modelling given continuous dependent variable; [c] =following recommendation of McHugh (2009), to avoid issues with interpretation of negative odds ratio values we reversed the grouping of younger and older age groups (e.g., younger = 0 & older = 1 to younger = 1 & older = 0).
* $p < .05$; ** $p < .01$; .** $p < .001$.

3.4.4 Do levels of stress and age interact to predict emotion regulation strategy use?

Next, we controlled for age differences in the influence of broader life contexts on emotion by examining whether age differences in daily ER use only become evident in the context of stress exposure. It was hypothesised that WP stress and age would interact to predict ER strategy use. More specifically, it was predicted that on stress days, older adults would demonstrate a relatively more pronounced increase in their use of humour, distraction, and acceptance, whereas younger adults would should a more pronounced increase in problem-solving, cognitive reappraisal, and expressive suppression on stress days relative to older adults. Model B, Table 3.3, provides data regarding the interaction of BP and WP stress with age in predicting ER strategy use. Contrary to our hypotheses, at both the between- and within- person levels, age and stress did not interact to predict use of any regulation strategy. Main effects of stress exposure revealed statistically reliable associations for three of the four regulation strategies. At the BP level, participants who reported more frequent exposure to stress employed greater use of humour and expressive suppression relative to those who reported less frequent exposure to stress. At the WP level, participant's reported greater use of acceptance on days when they experienced a stressful event relative to days when they did not.

3.4.5 The absence of daily stress and selectivity.

A multinomial logistic regression, with the reference category of *'I avoided stressful situations',* was used to test whether, compared to younger adults, older adults would be more likely to attribute the absence of daily stress to having avoided it (a proxy for the ER strategy *situation selection*) than other types of reasons (Table 3.5). Contrary to our hypothesis, older age was not associated with a greater likelihood of endorsing '*I avoided stressful situations*' relative to '*I just got lucky*' or '*Another reason*'. Moreover, compared to younger adults,

older adults were almost nine times more likely to attribute the absence of daily stress to '*Stressful things don't usually happen to me*' and more than 3 times more likely to report '*I handled situations before they became stressful*' relative to '*I avoided stressful situations*'. It was also predicted that, compared to younger adults, older adults would be more likely to endorse '*Stressful things don't usually happen to me'* than other reasons for the absence of daily stress. In order to provide comparisons not available in the initial multinomial logistic regression, a follow-up analysis was conducted using '*Stressful things don't usually happen to me'* as the reference category (Table 3.6). Age group was not a significant predictor of the likelihood of reporting '*I handled situations before they became stressful*' over '*Stressful things don't usually happen to me'.* However, more consistent with our hypothesis, based on relative risk ratios, compared to younger adults, older adults were 91% less likely to attribute the absence of daily stress to 'I just got lucky' than 'stressful things don't usually happen to me', and 85% less likely to attribute the absence of daily stress to 'another reason' than 'stressful things don't usually happen to me'.

Table 3.5.

Multinomial logistic regression results regarding age as a predictor of reasons for not experiencing stress, with reference category of 'I avoided stressful situations'

	Co-efficient	95% CIs		Relative risk ratio	95% CIs	
		Lower	Upper		Lower	Upper
'I just got lucky' (*N = 187)*						
Age group	-.20 (.72)	-1.61	1.21	.82(.59)	.20	3.35
Sex (female)	-1.44 (.75)	-2.91	.03	.24(.18)	.05	1.03
Chronic health conditions	-.15 (.14)	-.43	.13	.86 (.12)	.65	1.14
Years of education	-.10 (.08)	-.25	.06	.91 (.07)	.78	1.06
Income	.21 (.08)*	.04	.37	1.23* (.10)	1.05	1.45
'Stressful things don't usually happen to me' (*N* = 132.00)						
Age group	2.16 (.82)**	.55	3.77	8.69 (7.14)**	1.74	43.53
Sex (female)	-2.30 (.82)**	-3.91	-.68	.10 (.08)**	.02	.50
Chronic health conditions	-.08 (.16)	-.40	.24	.92 (.15)	.67	1.27
Years of education	-.05 (.07)	-.19	.09	.95 (.07)	.82	1.09
Income	.19 (.11)	-.02	.40	1.21 (.13)	.98	1.49
'I handled situations before they became stressful' (*N* = 331.00)						
Age group	1.26 (.61)*	.07	2.44	3.51 (2.13)*	1.07	11.52
Sex (female)	-1.19 (.63)	-2.42	.04	.30 (.19)	.09	1.04
Chronic health conditions	-.19 (.09)*	-.37	-.01	.83 (.08)*	.70	.99
Years of education	.01 (.06)	-.10	.13	1.01 (.06)	.90	1.14
Income	.14 (.07)*	.002	.29	1.16 (.08)*	1.00	1.33
'Another reason' (*N* = 222.00)						
Age group	.29 (.77)	-1.22	1.79	1.33 (1.02)	.29	6.00
Sex (female)	.44 (.48)	-.49	1.38	1.56 (.74)	.61	3.96
Chronic health conditions	-.34 (.13)*	-.59	-.08	.71 (.09)*	.55	.92
Years of education	-.02 (.09)	-.20	.16	.98 (.09)	.82	1.18
Income	<.01 (.11)	-.21	.22	1.00 (.12)	.81	1.24

Notes. Reference category for the equation is '*I avoided stressful situations*' (*N* = 125.00). Robust standard errors in parentheses.

* $p = .05$; ** $p < .01$; *** $p < .001$.

Table 3.6.
Multinomial logistic regression results regarding age as a predictor of reasons for not experiencing stress, with reference category of '*Stressful things don't usually happen to me*'

	Co-efficient	95% CIs		Relative risk ratio	95% CIs	
		Lower	Upper		Lower	Upper
'I avoided stressful situations' (*N* = 125.00)						
Age group	-2.16 (.82)**	-3.77	-.55	.12 (.09)**	.02	.58
Sex (female)	2.30 (.82)**	.68	3.91	9.93 (8.16)**	1.98	49.74
Chronic health conditions	.08 (.16)	-.24	.40	1.08 (.18)	.79	1.49
Years of education	.05 (.07)	-.09	.19	1.05 (.08)	.91	1.21
Income	-.19 (.11)	-.40	.02	.83 (.09)	.67	1.02
'I just got lucky' (*N = 187)*						
Age group	-2.36 (.79)**	-3.90	-.82	.09 (.07)**	.02	.44
Sex (female)	.86 (.80)	-.71	2.42	2.36 (1.88)	.49	11.28
Chronic health conditions	-.07 (.21)	-.48	.34	.93 (.19)	.62	1.40
Years of education	-.05 (.09)	-.23	.13	.95 (.0)	.80	1.14
Income	.02 (.09)	-.16	.20	1.02 (.10)	.85	1.22
'I handled situations before they became stressful' (*N* = 331.00)						
Age group	-.91 (.73)	-2.34	.52	.40 (.29)	.10	1.69
Sex (female)	1.10 (.73)	-.34	2.54	3.01 (2.21)	.71	12.68
Chronic health conditions	-.12 (.18)	-.46	.24	.90 (.16)	.63	1.27
Years of education	.06 (.08)	-.09	.22	1.07 (.08)	.91	1.24
Income	-.05 (.09)	-.22	.13	.96 (.08)	.80	1.14
'Another reason' (*N* = 222.00)						
Age group	-1.88 (.88)*	-3.61	-.15	.15 (.14)*	.03	.86
Sex (female)	2.74 (.90)**	.97	4.51	15.49 (13.99)**	2.64	90.90
Chronic health conditions	-.26 (.20)	-.64	.13	.77 (.15)	.53	1.14
Years of education	.03 (.10)	-.17	.24	1.03 (.11)	.84	1.27
Income	-.19 (.12)	-.42	1.12	.83 (.10)	.66	1.04

Notes. Reference category for the equation is '*Stressful things don't usually happen to me*' (*N* = 132.00).
Robust standard errors in parentheses.
* $p = .05$; ** $p < .01$; *** $p < .001$.

3.5 Discussion

The aims of the present study were to determine whether younger and older adults differ in their general self-reported daily use of ER strategies and to examine if age differences in ER strategy use are constrained by life context, only emerging in the context of stress exposure. To provide additional context we considered more general age differences in stress exposure, stressor severity, future anticipated stress, and reasons provided as explanations for the absence of daily stress.

Our study was the first that we are aware of to examine age differences in the use of ER strategies in everyday life contexts. Given the lack of prior empirical evidence, we regarded our investigation as largely exploratory. However, in light of lifespan perspectives such as SST (Carstensen, 1993) and the SOC-ER model (Urry & Gross, 2010), which suggest that shifts in motivation and resources with age may influence profiles of ER strategy use, we made some tentative predictions to guide our analysis. Specifically, in terms of general, daily strategy use, we predicted that relative to younger adults, older adults would report greater use of proactive regulation strategies (situational avoidance, humour, problem-solving, distraction) and less use of strategies occurring later in the emotion generative cycle (cognitive change, acceptance, expressive suppression).

In contrast to our predictions, results suggested comparable use of distraction and cognitive reappraisal across age groups, greater use of situational avoidance, humour, acceptance, and expressive suppression by younger adults, and greater use of problem-solving among older adults. Similar levels of stress exposure reported by older and younger participants suggests that younger adults' endorsement of a broader range of strategies may not be a direct result of their being exposed to more frequent stressors, across more varied contexts. Based on these findings we might speculate that younger adults adopt a more

generalised approach to regulation, employing a more diverse array of regulation strategies, while older adults are more specialist regulators, favouring those strategies that have previously proven to be effective. It is possible that greater use of a wider range of regulation strategies among younger adults is indicative of greater ER flexibility or the capacity to employ different ER strategies in response to specific regulatory contexts (Aldao, Sheppes, & Gross, 2015). However, specialist ER among older adults could be an artefact of the types of regulatory situations older adults encounter being particularly responsive to a sole regulation strategy (i.e. problem-solving) rather than lower ER flexibility per se. For example, older adults were more inclined to report an event occurring to others which they themselves found stressful, in such situations, problem-solving may be a particularly helpful regulation strategy and may offer solutions to the challenges others are facing.

Older adults reported greater use of problem-solving relative to younger adults. Compared to other regulation strategies, problem-solving could reflect a somewhat detached regulatory orientation by which older adults can essentially solve the 'problem' posed by the emotion while minimising engagement with the affective component of the emotionally evocative situation. Consistent with SST (Carstensen, 1993) this would reduce the extent to which older adults are required to engage with negative emotion, and could enable older adults draw on cumulative life experience developed through solving similar problems in the past (Blanchard-Fields, 2007). Once again, the available data do not allow for explicitly testing this speculation. Future research might examine this more directly, to determine whether the use of problem-solving among older adults reflects a somewhat emotionally detached, problem-focused regulatory mechanism and/or whether cumulative life experience represents a valuable resource supporting use of this strategy.

From the perspective of the SOC-ER model (Urry & Gross, 2010), results suggestive of greater use of situational avoidance, humour, acceptance, and expressive suppression by younger adults may be indicative of age-related decline in resources which support strategy use. Research regarding how regulatory resources provide a basis for ER strategy use is limited, so further research is needed to identify the specific resources that regulation strategies draw on and examine whether age-related shifts in resource availability can account for different age-related profiles of ER strategy use. In particular, examining how broad or circumscribed the effects of age differences in regulatory resources are in shaping use of different ER within the same regulatory family could help contextualise age differences in patterns of ER use. For instance, although age differences in cognitive control have been linked to cognitive reappraisal (Opitz et al., 2012), it is yet to be established whether cognitive control is an important resource supporting the use of other cognitive change strategies such as acceptance.

We also examined the possibility that age differences in ER strategy use only emerge when there is heightened need for regulatory efforts such as in response to stress. Within such circumstances, profiles of age-related strengths (e.g., supportive social networks) and weaknesses (e.g., declining cognitive control) in regulatory resources, as described by the SOC-ER model (Urry & Gross, 2010), may exert their strongest influence. As such, we anticipated that in the context of self-reported daily stress, older adults would possibly report greater use of less cognitively-taxing ER strategies (e.g., humour, distraction, and acceptance), while younger adults would favour use of strategies which draw more heavily on cognitive resources (e.g., problem-solving, cognitive reappraisal, and expressive suppression). However, contrary to our hypothesis, age and stress did not interact to predict use of any of our included ER strategies. Consequently, one might speculate that stress has

limited utility in terms of explaining circumstances under which age differences in ER use emerge. It may therefore be more useful to focus on variables like control beliefs, or the type of emotion that regulatory efforts are directed towards which have been shown in previous studies to moderate strategy use (Rovenpor et al., 2013; Schirda et al., 2016).

It is possible that several of our unexpected findings stemmed from methodological limitations. Regarding the stress and ER results, having participants complete assessments at the end of the day, when stressors are potentially resolved and use of ER strategies may be somewhat distant, could result in more positive recall and introduce biases related to deterioration of memory with the passage of time. However, we also note that such retrospective biases are likely to be more pronounced in studies using more traditional habitual assessments of strategy use (e.g., studies using the Emotion Regulation Questionnaire; Gross & John, 2003). These biases may be more exaggerated among older adults due to potential cognitive decline (Lövdén et al., 2004) and a positivity bias in the memory of older adults (Mather & Carstensen, 2005). Ecological momentary assessment (EMA) approaches would capture associations of stress and ER as they unfold closer to real time, and as such could provide a more stringent test of associations among age, stress, and ER.

We examined age differences in use of ER strategies in the context of downregulating NA on days of stress exposure. However, it is possible that ER also operates to upregulate positive emotions when people are stressed. This notion would be consistent with the premise of the co-activation model of healthy coping (Larsen, Hemenover, Norris, & Cacioppo, 2003) which proposes that during times of stress, positive emotions enhance people's ability to confront adversity and leads them to feel better in its wake. Relatedly, ER strategy use has been examined without consideration of efficacy of regulatory efforts. As such, lower levels

of ER strategy use could reflect more effective regulation (i.e., lower levels of strategy use required to achieve desired regulatory outcomes). In order to make firm conclusions regarding developmental change in ER, researchers will need to consider strategy use in the context of regulatory efficacy including examination of the relationship of ER strategies with positive emotions in the context of stress.

As self-reported stressor exposure and ratings of stressor severity were largely comparable across age groups, our results suggest that experiences of daily stress may not be as consistently different for younger and older adults as suggested by previous research (e.g., Brose, Scheibe, & Schmiedek, 2013; Stawski et al., 2008). Indeed, in adopting a similar methodological approach (i.e., daily diary study completed over 30 consecutive days) to that of our study, Diehl and Hay (2010) also observed an absence of age differences in daily stress. However, of note, our sample was small, reasonably well-educated, and had limited diversity in terms of socio-economic characteristics. As such, our results may be idiosyncratic to our sample and replication using larger and more diverse samples would be necessary before results can be more broadly generalised.

Our results indicated that some aspects of daily stress appear more subject to age differences than others. In particular, older adults less frequently reported stress related to a '*Work, volunteer or study related event*', likely due to many of our older participants having retired. Moreover, older adults in our sample rated stress arising from '*Home-related events*' as less severe relative to younger adults. It is possible that within relatively predictable contexts, like the home environment, that older adults are able to selectively structure their activities and interactions in ways that support hedonic wellbeing. In contrast, older adults were more inclined to report an '*Event that happened to others*' which they found stressful, possibly as the peers of older adults (including their spouses) are more predisposed towards

age-related sensory, physical, cognitive, and psycho-social challenges (Cruickshanks et al., 2003; Hébert, 1997; Lövdén et al., 2004; Victor et al., 2000) than those of younger adults. Additionally, older adults may also be more invested in interpersonal relationships and/or more sensitive to others' needs due to the priority of emotionally close relationships with age (Carstensen et al., 2003) and concern for the welfare of others, particularly younger generations (Erikson & Erikson, 1998). Without the assessment of relevant contextual and motivational factors, it is only possible to speculate as to how such developmental shifts may have influenced our findings. Future research may clarify the extent to which age-graded changes in life contexts and social motivation could affect stress exposure, reactivity, and subsequent strategies of emotional regulation.

Of note, compared to older adults, younger adults were almost seven times more likely to anticipate the occurrence of a stressful event in the future. This could be indicative of a positivity bias in expectations among older adults, which has been proposed as a manifestation of enhanced ER (Mather & Carstensen, 2005). An age-related positivity bias could also be reflected in our finding that older adults were more likely to attribute the absence of daily stress (on non-stress days) to not usually encountering stressful events in their daily lives (despite comparable levels of self-reported daily stress exposure across age groups). A potential explanation for the divergence of findings regarding experienced and anticipated stress may reflect the nature of the stressful experiences encountered by younger and older adults. As noted by Urry and Gross (2010, p. 353), 'perhaps as age-related losses accumulate over the years, they have nothing like the impact we think they will have'. We might speculate that as people age and losses accumulate, this relates to more chronic, but less impactful stress in daily life. In contrast, the developmental goals of younger adults (e.g., entering the workforce/establishing a career, forming significant relationships) may bring

potential for more acute types of stressors. The salience of acute stressors may mean that younger adults not only report daily stress exposure but also anticipate future stress, whereas older adults may identify the presence of stress when prompted but may not anticipate future stress in the same way, as chronic issues are ongoing and effectively managed. If the types of issues experienced by older adults reflect more chronic, ongoing stress, this could explain why older adults report more selective ER strategy use. Possibly, through ongoing management, older adults have been able to identify which regulation strategies are most useful in approaching chronic stressors. Positivity biases regarding anticipated stress could also be a means of preserving affective wellbeing in the context of potentially unavoidable stressors. In contrast, if younger adults are faced with more acute stressors, they may cycle quite rapidly through a broader range of regulation strategies or even employ multiple strategies in response to the same trigger in an attempt to address acute stressors as quickly as possible.

Overall, this study represents an important starting point for a comprehensive understanding of how older and younger adults differ in their day-to-day use of ER strategies. Taken together, our findings do not point to enhanced ER with age being a results of older adults more frequently reporting the use of over ER strategies believed to promote hedonic wellbeing. Assessing the degree to which patterns of ER strategy use regarded as either effectively specialised and/or flexible is likely to be important in establishing a more complete understanding of age differences. We have speculated regarding potential explanations for a number of our findings, especially the presence of age differences in anticipated stress in the absence of age differences in reported stress exposure. More direct examination of such discrepancies, and explicitly assessing underlying mechanisms will be

important for establishing a solid understanding of affective experiences and regulatory processes across the lifespan.

Chapter 3 Supplementary Table

ER families, specific ER strategies, & study items, with null multi-level models for daily strategy use

ER Item Description/Classification				ER Use Null Model Results			
Gross (1998b) ER family	Regulation strategy subtype	Item		Estimate	Robust SE	95% CI Lower	95% CI Upper
Situation selection	Situational avoidance[a]	Did you avoid situations that you thought would make you feel negative emotions?[c]	*Fixed effects*				
			Intercept	34.19***	2.29	29.71	38.68
			Random effects				
			Constant	405.96	58.28	306.40	537.87
			Residual	292.45	35.85	229.99	371.86
Situation modification	Humour[a]	Did you use humour to lighten the mood in a tense situation? [d]	*Fixed effects*				
			Intercept	34.68***	2.55	29.68	39.68
			Random effects				
			Constant	497.00	61.19	390.45	632.63
			Residual	477.88	46.98	394.13	579.43
Situation modification	Problem-solving[b]	Did you do something to fix things or think of a way to make things better?[c]	*Fixed effects*				
			Intercept	50.83***	2.12	46.67	54.98
			Random effects				
			Constant	226.58	45.53	152.82	335.93
			Residual	667.81	53.62	570.58	781.62
Attentional deployment	Distraction[b]	Did you keep your mind off things by doing something else?[e]	*Fixed effects*				
			Intercept	44.37***	2.13	40.19	48.54
			Random effects				
			Constant	238.34	52.98	154.16	368.49
			Residual	594.85	54.03	497.84	710.76
Cognitive change	Cognitive reappraisal[b]	Did you tell yourself that it wasn't a big deal or try to think of things in a different way so they didn't seem as bad?[e]	*Fixed effects*				
			Intercept	43.30***	2.40	38.61	48.00
			Random effects				
			Constant	328.86	59.33	230.92	468.35
			Residual	580.93	48.88	492.60	685.09
Cognitive	Acceptance[b]	Did you think that you just have to	*Fixed effects*				

change		live with things the way they are?[e]	Intercept	41.26***	2.49	36.39	46.13
			Random effects				
			Constant	353.27	71.53	237.55	525.35
			Residual	617.12	64.85	502.25	758.25
Response modulation	Expressive suppression[b]	Did you try not to show any visible signs of your negative emotions (e.g., you kept your face calm when angry or tried not to cry when sad)?[d]	*Fixed effects*				
			Intercept	48.12***	2.61	43.01	53.23
			Random effects				
			Constant	402.37	70.59	285.30	567.48
			Residual	567.36	60.87	459.76	700.15

Notes. [a] = presented with the stem '*In the last 24 hours, to what extent …*'; [b] = presented with the stem '*In terms of your unpleasant feelings over the last 24 hours, to what extent …*'; [c]= adapted from Schutte et al. (2009); [d]= created for the purpose of the current study by the authors ; [e]= adapted from Tan et al. (2012).
* $p < .05$; ** $p < .01$; *** $p < .001$.

Chapter 4: Age Differences in the Efficacy of Strategies Derived from the Process Model of Emotion Regulation

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Victoria Allen reviewed the literature, designed the study, collected data, analysed data and prepared the manuscript under supervision of Dr Tim Windsor.

Research design 90%; Data collection 100%; Analysis 90%; Writing and editing 85%.

4.1 Abstract

Objectives: To examine the efficacy of a range of emotion regulation (ER) strategies in the daily lives of younger and older adults.

Method: As part of a 20-day diary study, 38 younger (aged 17-28) and 44 older (aged 62 and over) adults completed measures of ER strategy use, stress, and negative affect (NA). ER efficacy was operationalised as the extent to which ER strategy use buffered against associations of stress with NA.

Results: There was minimal evidence of age differences in ER efficacy at the between- (BP) or within- (WP) persons levels, with one exception - at the BP level, greater use of acceptance related to weaker coupling of stress and NA, particularly among older adults. Cross-level interactions revealed that for younger adults greater habitual expressive suppression and cognitive reappraisal tendencies did not buffer against daily stress-NA associations, while for older adults greater habitual use of these strategies was associated with lower levels of NA and appeared so irrespective of daily stress exposure. Greater habitual distraction use appeared to buffer against stress-related NA for older adults, but related to greater NA on days of stress for younger adults. Two-way interactions revealed that greater habitual problem-solving was associated with lower levels of NA for older but not younger adults. Additionally, whilst habitual humour use demonstrated minimal effect of NA for older adults, greater habitual use of humour related to higher levels of NA for younger adults.

Conclusion: Among older adults, there appears to be generalised benefit associated with greater use of acceptance, cognitive reappraisal, problem-solving, and expressive suppression, lower levels of NA in the context of stress at higher levels of distraction use, and minimal effect of humour on affective outcomes.

4.2 Introduction

In the context of age normative losses (Cruickshanks et al., 2003; Hébert, 1997; Lövdén et al., 2004; Victor et al., 2000), the emotional well-being of older adults appears relatively well-maintained (Charles et al., 2001; Kessler & Staudinger, 2009). Age-related shifts in emotion regulation (ER) have been suggested as one potential explanation of this paradox. While a growing body of research has explored age differences in the *use* of ER strategies (for a review see Allen & Windsor, 2017), less research has examined how age influences the *efficacy* of regulation strategies, particularly in daily life. The current paper examines age differences in the efficacy of ER strategies derived from the process model of ER (Gross, 1998, 2015) among younger and older adults, with specific focus on the downregulation of negative affect (NA) in the context of daily stress.

4.2.1 Emotion regulation.

ER refers to the strategies used to shape which emotions one has, when one has them, and how specific aspects of emotional experience manifest (Gross,). The process model of ER (Gross, 1998, 2015) describes five broad families of ER strategies, each providing a unique pathway for emotion modulation. These families include the *situation selection, situation modification, attentional deployment, cognitive change* and *response modulation*[4]. Theoretically and empirically, there is suggestion of developmental change in ER across the adult lifespan.

4.2.2 Theoretical perspectives regarding ageing and emotion regulation.

Socioemotional selectivity theory (SST; Carstensen, 1993; Carstensen, Mikels, & Mather, 2006; Carstensen et al., 2011) suggests greater investment the in pursuit of

[4] Please see Chapters 1 and 2 for greater details of these ER strategy families.

affective wellbeing and emotional meaning with increasing age.. The extent to which older adults are able to achieve positive affective outcomes may depend on how successfully they navigate and regulate their emotional experiences.

The selection, optimisation, and compensation with ER (SOC-ER) model (Urry & Gross, 2010) proposes that through the use of selection, optimisation, and compensation, successful ER can be achieved at any stage of the adult lifespan. However, age may impact availability of regulatory resources, rendering certain ER strategies more or less effective than others. For instance, cognitive control, which is believed to support use of cognitive reappraisal, declines with age (Urry & Gross, 2010). As such, regulation strategies that may be relatively more cognitively-taxing (e.g., cognitive reappraisal, problem-solving, expressive suppression), may be more effective for younger compared to older adults. In contrast, supportive interpersonal relationships (Urry & Gross, 2010), accumulated life experience, and self-knowledge (Blanchard-Fields, 2007), may represent valuable regulatory resources for older adults supporting the effectiveness of less cognitively demanding regulation strategies such humour, distraction, and acceptance.

4.2.3 Age differences in emotion regulation efficacy.

A growing body of research has examined age differences in ER strategy use (for a review see Allen & Windsor, 2017). However, less attention has been paid to age differences in the extent to which use of ER strategies are effective in meeting regulatory goals. ER efficacy is the focus of the present study.

Existing research suggests that age does not relate to the efficacy of generalised situation selection or modification (Livingstone & Isaacowitz, 2015). However, avoiding arguments (situation selection subtype) relates to lower affective reactivity

among older but not younger adults (Charles et al., 2009). In contrast, humour (situation modification subtype) demonstrates comparable efficacy for younger and older adults (Harm, Vieillard, & Didierjean, 2014) and attentional deployment strategies appear to buffer against negative mood more effectively for older versus younger adults (Beadel, Green, Hosseinbor, & Teachman, 2013; Lohani & Isaacowitz, 2014; Luong & Charles, 2014). Few studies have considered age differences in the efficacy of problem-solving (situation modification subtype) or acceptance (cognitive change subtype). However, problem-solving may align better with the regulatory resources of younger adults (i.e., greater cognitive control) relative to older adults. Moreover, problem-solving might offer practical solutions to challenges faced by younger adults (e.g., achieving an important work deadline) and therefore support the pursuit of future-orientated goals (e.g., resource acquisition and personal development) that tend to be salient among younger adults (i.e., SST; Carstensen, 1993). In contrast, acceptance may be of particular benefit to older adults for a number of reasons. Firstly, acceptance appears to be less cognitively taxing than other cognitive change strategies (e.g., cognitive reappraisal) whilst offering similar regulatory benefits (Wolgast et al., 2011). As such, acceptance may be less subject to ageing-related declines in cognitive resources which may reduce the effectiveness of more resource intensive strategies such as cognitive change. Secondly, the benefit of acceptance may be most apparent when stimuli or circumstances eliciting distress are not amenable to change. This is because unlike other regulatory strategies, acceptance involves acknowledging experience without judgement rather than attempting to change thoughts or circumstances related to emotion eliciting stimuli (Block-Lerner, Salters-Pedneault, & Tull, 2005). Given the realisation of limited time horizons and the potential for irrevocable losses with increasing age (i.e., death of loved ones, onset of chronic illness or functional disability), regulation which allows for

processing of largely unalterable sources of distress is likely to be of greater relevance to older relative to younger adults.

Existing evidence regarding age differences in cognitive reappraisal (a cognitive change subtype) is mixed, with some studies pointing to greater efficacy among older adults (Tucker et al., 2012; Zhang, Ersner-Hershfield, & Fung, 2010) and others to comparable efficacy between younger and older age groups (Hess et al., 2010; Winecoff, LaBar, Madden, Cabeza, & Huettel, 2011). In terms of response modulation, some research suggests that age is not related to the efficacy of expressive suppression (Lohani & Isaacowitz, 2014; Pedder et al., 2016), although one study found expressive suppression was associated with poorer affective outcomes among older versus younger adults (Phillips, Henry, Hosie, & Milne, 2008).

Research to date using laboratory and questionnaire methodologies provides preliminary evidence of age differences in ER efficacy. However, what is currently missing from the literature is examination of age differences in the efficacy of ER strategies in the daily lives of younger and older adults. There is evidence of divergence between ER processes operating within naturalistic settings and those observed within the laboratory or captured by general trait measures of regulation tendency (e.g., Ehring et al., 2010; Quigley & Dobson, 2014). Examining whether age differences in daily profiles of ER efficacy are consistent with current theoretical perspectives (e.g., SST and SOC-ER model) and/or existing laboratory and questionnaire-based research, represents an important extension to ageing and ER literature. The present study aims to address this gap.

4.2.4 Current study.

The present study aims to identify age differences in the efficacy of a range of ER strategies including humour, problem-solving, distraction, cognitive reappraisal, acceptance, and expressive suppression in the daily lives of younger and older adults. Daily stress exposure will be factored into our analyses based on previous findings that stress exposure results in higher than usual levels of NA (Sliwinski, Almeida, Smyth, & Stawski, 2009; Stawski et al., 2008), and the assumption that exposure to NA will most typically prompt efforts at affective downregulation (Riediger et al., 2009). Our primary interest relates to how younger and older adults' daily use of ER strategies moderates the within-person (WP) coupling of stress and NA (or stress reactivity as per Sliwinski et al., 2009). More specifically, we operationalise ER efficacy in terms of the relationship between ER strategy use on a given day and stress reactivity. Consistent with previous studies of reactivity to stress (e.g., Sliwinski et al., 2009), rather than examining ER efficacy by assessing changes in discrete negative emotions, we chose to consider ER efficacy by linking a more generalised measure of negative affect (rated in vivo at the end of each assessment day) with stress exposure (measured retrospectively at the end of each assessment day). We made this decision as we believed that lower levels of negative affect at the end of daily assessments would be broadly reflective of an adaptive regulatory response to an external stressor. However, if we were to focus on changes in discrete emotions (e.g., sadness, anger) over the course of a day, we could be less certain about whether variation would be indicative of regulatory success in the context of stress (the main purpose of our study) or alternative processes internal to the individual and independent of stress exposure such as up-regulation of negative emotion in pursuit of contra-hedonic goals (Riediger et al., 2009), or other individual difference variables such as diurnal variations in depressive symptoms.

Drawing on the principles of the SOC-ER model (Urry & Gross, 2010), we predict that age group, ER strategy use, and stress exposure will interact to predict levels of NA. In particular, we expect NA to be greater on days of stress than on days on which stressful events do not occur, however, greater use of regulation strategies is expected to buffer stress reactivity. Moreover, we expect problem-solving, cognitive reappraisal, and expressive suppression to buffer against NA on days of stress more effectively for younger versus older adults. This is because these more complex strategies are cognitively demanding (Buhle et al., 2014), so given age-related decline in cognitive control (Opitz et al., 2014; Opitz et al., 2012), successful use of these strategies would presumably align closest with the regulatory resources of younger adults (Urry & Gross, 2010). In contrast, we expect humour, distraction, and acceptance to buffer against NA on days of stress more effectively for older versus younger adults. We expect these strategies to be relatively more effective in older age as they are somewhat less cognitively demanding and align better with the age-related strengths of older adults such as supportive social networks (Urry & Gross, 2010), accumulated life experience, and self-knowledge (Blanchard-Fields, 2007).

Examining how daily ER strategy use influences the WP coupling of stress exposure and NA is consistent with a state conceptualisation of ER (i.e., ER use at a particular moment in time), however, ER strategy use can also be considered at the trait level (i.e., between-persons [BP] individual differences in habitual strategy use). Although our primary focus is on the WP associations of ER strategy use, stress, and NA, it is possible that associations of these variables are also evident at the broader trait level. Doré et al. (2016) argue that where possible ER research should involve examination of contingencies for ER success at both the WP and BP level.

Consequently, we include the WP and BP associations of age, ER strategy use, stress, and NA in our analyses. Moreover, to further contextualise associations of age, ER strategy use, NA, and stress, we include the remaining cross-level BP and WP ER and stress interactions in analyses, although we do not make specific predictions regarding the nature of these relationships. Following similar research (e.g., Windsor & Anstey, 2010), sex, education, income, and self-reported health status will be included as covariates in analyses.

4.3 Method

4.3.1 Participants.

Thirty-eight younger (17-28, *M* = 20.73, *SD* = 2.46) and 44 older (62-90, *M* = 73.52, *SD* = 6.65) South Australian adults responded to research advertisement flyers displayed at a local university and community centres to participate in the study for up to $80.00 remuneration. Participants were predominantly female (77%), well-educated (M_{years} = 14.78, *SD* = 5.09), had 2.10 (*SD* = 2.31) chronic health conditions at baseline, and a modal household income (*Mo* = 3.00, *SD* = 3.62) of '$20,000 to $29,999' per annum.

Although age groups did not differ in income, $t(59.18) = .178$, $p = .860$, or sex distribution, χ^2 (1, *N* = 82) = 2.17, $p = .141$, older adults (*M* = 15.85, *SD* = 6.28) were more highly educated than younger adults (*M* = 13.57, *SD* = 2.90), $t(60.68) = -2.14$, $p = .036$. Older adults (*M* = 2.70, *SD* = 2.41) also reported more chronic health conditions than younger adults (*M* = 1.39, *SD* = 1.99), $t(80) = -2.66$, $p = .010$

4.3.2 Measures.

Measures were collected as part of a larger study which included a baseline assessment, 20-day micro-longitudinal protocol, and three longitudinal follow-up assessments. Only measures relevant to the current study are described below.

Daily stress, emotion regulation, and NA measures. Each day of the micro-longitudinal protocol, participants were asked 'Did anything stressful occur in the last 24 hours' (yes = 1; no = 0) (Almeida et al., 2002). Participants then completed 11 ER strategy specific items adapted from Schutte, Manes, and Malouff (2009), Tan et al. (2012), and created specifically for the present study, capturing the use of humour, problem-solving, distraction, cognitive reappraisal, acceptance, and expressive suppression in response to unpleasant feelings over the last 24 hours (i.e., 'Did you use humour to lighten the mood in a tense situation?'; see Table 4.1 for details of individual ER items presented to participants). Responses were made on a 100 millimetre visual analogue scale (VAS) anchored at 'Not at All' (0) and 'Extremely' (100), with higher scores reflecting greater use of the given regulation strategy. Additionally, participants rated the extent to which they currently (i.e., at the moment of completing the assessment) felt eight different NA states (e.g., sad, anxious, nervous, irritated, annoyed, overwhelmed, lonely, tired) on a 100 millimetre VAS anchored at 'Not at All´ (0) and 'Extremely' (100). Responses to NA items were averaged to create a daily NA composite score ($\alpha = .90$), with higher scores reflecting greater levels of NA.

Table 4.1

ER families, specific ER strategies, & study items

Gross (1998b) ER family	Regulation strategy subtype	Item
Situation modification	Humour	Did you use humour to lighten the mood in a tense situation?[c]
Situation modification	Problem-solving	Did you do something to fix things or think of a way to make things better?[a]
Attentional deployment	Distraction	Did you keep your mind off things by doing something else?[b]
Cognitive change	Cognitive reappraisal	Did you tell yourself that it wasn't a big deal or try to think of things in a different way so they didn't seem as bad?[b]
Cognitive change	Acceptance	Did you think that you just have to live with things the way they are?[b]
Response modulation	Expressive suppression	Did you try not to show any visible signs of your negative emotions (e.g., you kept your face calm when angry or tried not to cry when sad)?[c]

Notes. [a]= adapted from Schutte et al. (2009); [b]= adapted from Tan et al. (2012); [c]= created for the purpose of the current study by the authors.

Baseline Covariates. At baseline, age in years (younger adults aged 17 to 28; older adults aged 62 and above), sex (0 = female, 1 = male), and years of education were recorded. Participants responded to the item 'What is your total annual household income?' on a 12-point scale (1 = 'Less than $10,000' to 12 = '$150,000 or more'). Additionally, participants were asked 'Do you have any of the following health conditions?' and were provided with a checklist containing 31 chronic health conditions (e.g., 'Arthritis', 'High cholesterol', 'Stroke') adapted from the Midlife in the United States longitudinal study (Brim, Ryff, & Kessler, 2004) and the Health and Retirement

Study (Juster & Suzman, 1995). Participants marked all applicable health conditions and the total number of items selected was summed.

4.3.3 Procedure

Baseline assessment. Participants attended a 90-minute face-to-face baseline assessment at their place of residence or Flinders University. Baseline measures were completed using an Apple iPad device, with web-based, Qualtrics supported questionnaires.

Micro-longitudinal protocol. Participants used an Apple iPad they had been loaned as part of the study to complete a brief ($M_{minutes}$= 15.26, SD = 22.85) web-based, Qualtrics supported questionnaire over 20 consecutive days, between 17:00 on the day the questionnaire was sent out and 02:00 the following morning.

4.3.4 Analysis approach.

Covariates and predictors were grand mean-centred and data was analysed using STATA Version 13.1 (StataCorp. 2013) with maximum likelihood estimation.

Data screening revealed that the NA variable was not normally distributed and demonstrated a significant positive skew. A square-root transformation was used to address the positive skew and robust standard errors were used to reduce the likelihood of biased significance tests as per Hox, Moerbeek, and van de Schoot (2010).

Multi-level modelling (MLM) was used to analyse data. A null model provided an initial estimate of variance in NA occurring between participants (BP level) and occurring within participants over time (WP level). Next, a series of two-level models were constructed, one for each ER strategy, to examine whether age group (*younger*, *older*), stress, and ER strategy (humour, problem-solving, distraction, cognitive

reappraisal, acceptance, expressive suppression) use interacted to predict NA. As assessments were taken over 20 consecutive days, we included day of study and day of study squared in MLMs to control for linear and/or quadratic effects of time. We constructed measures of BP (variance at the individual difference level) and WP (variance at the day-to-day person level) stress and ER strategy use. To create a measure of BP stress, responses to '*Did anything stressful occur in the last 24 hours*' (*yes* = 1, *no* = 0) were averaged across study days, with higher scores reflecting more frequent stress occurrence. To index WP stress, for each completed daily questionnaire, participants' response to '*Did anything stressful occur in the last 24 hours*' (*yes* = 1, *no* = 0) was subtracted from their BP stress score. As such, WP stress reflected the extent to which, stress on a given day of the protocol deviated from the individual's average levels of stress. Similarly, to index BP ER, level of use for each specific regulation strategy was averaged across the 20-day protocol. Each subject's BP ER score was then subtracted from their use of the given ER strategy on each day of the 20-day protocol to index WP ER. As such, BP ER reflected individual differences in levels of ER strategy use averaged across our micro-longitudinal protocol while WP ER reflected the extent to which an individual's use of a specific ER strategy on a given day deviated from their average levels of strategy use (Hoffman & Stawski, 2009). Our series of two-level MLMs included the predictor variables of age group, BP and WP stress, BP and WP ER, in addition to the two and three way interactions of the age group, stress, and ER variables[5]. For addition details see Appendix B which provides an interpretive aid for interactions. Inclusion of a random slope for WP stress did not improve model fit for any of the ER models, and therefore was not included. An autoregressive lag-1 residual

[5]In a step-wise fashion for two- and three- way interactions (starting with highest order interactions with the largest *p* values), non-significant interactions were dropped from models in aid of parsimony and to ensure robustness of significant results.

covariance structure demonstrated superior fit to an unstructured variance-covariance structure and as such was employed across iterations of models for each ER strategy.

Figures were generated to facilitate interpretation of significant two- and three-way interactions which emerged from MLMs. In aid of this, for each MLM where significant interactions emerged, the regression equation was solved for hypothetical individuals of different ages (0 = *younger*, 1 = *older*) with high (+1 SD) and low (-1 SD) values of BP and WP stress and ER strategy use. Specific combinations of these variables depended on the nature of two- and three- way interactions. For example, for a two-way interaction of age with BP distraction, the regression equation was solved by generating hypothetical individuals representative of a younger adult (0) with low habitual distraction (*M* [43.42] - 1 *SD* [20.17]) , a younger adult (0) with high habitual distraction (*M* [43.42] + 1 *SD* [20.17]), an older adult (1) with low habitual distraction (*M* [43.42] - 1 *SD* [20.17]), and an older adult (1) with high habitual distraction use (*M* [43.42] + 1 *SD* [20.17]). Other variables peripheral to significant interactions were held constant in solving equations.

4.4 Results

4.4.1 Sample characteristics & description of variables.

For descriptive statistics and bivariate correlations of study variables see Tables 4.2 and 4.3.

Table 4.2
Descriptive statistics for study variables

		Younger adults			*Older adults*			*Total sample*		
Variables		*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Negative affect (raw variable)[ab]		38	31.69	17.75	44	15.61	12.84	82	23.06	17.22
Negative affect (transformed variable)[ac]		38	5.24	1.69	44	3.50	1.57	82	4.31	1.84
Total number of stress days		677	5.62	4.34	795	6.06	4.81	1472	5.86	4.60
Sex	Male	6 (15.80%)	-	-	13 (29.50%)	-	-	19 (23.20%)	-	-
	Female	32 (84.20%)	-	-	31 (70.50%)	-	-	63 (76.80%)	-	-
Annual household income		33	5.27	4.15	35	5.11	3.10	68	5.19	3.62
Chronic health conditions		38	1.39	1.99	44	2.70	2.41	82	2.10	2.31
Years of education		38	13.57	2.90	43	15.85	6.28	81	14.78	5.09
Situational avoidance[a]		38	32.85	21.63	44	15.45	18.87	82	23.51	21.88
Humour[a]		38	42.82	22.13	44	27.77	21.67	82	34.74	23.02
Problem-solving[a]		37	45.63	15.47	39	58.44	19.83	76	52.20	18.86
Distraction[a]		37	45.13	18.02	30	41.81	22.13	76	43.42	20.17
Cognitive reappraisal[a]		37	45.00	20.58	39	40.67	22.61	76	43.12	21.66
Acceptance[a]		37	45.85	21.41	39	35.86	19.67	76	40.72	21.01
Expressive suppression[a]		37	52.56	19.82	38	42.96	24.39	75	47.70	22.62

Note. [a] = mean across micro-longitudinal assessment; [b] $t(80) = 4.74$, $p < .001$; [c] $t(80) = 4.86$, $p < .001$.

Table 4.3
Bivariate correlations among study variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
1. NA (transformed)	*r*	1.00	-.48***	.22*	-.03	.07	-.25*	.68***	.53***	-.08	.39***	.23*	.40***	.48***
	N	82	82	82	68	82	81	82	82	76	76	76	76	75
2. Age group	*r*	-	1.00	-.16	-.02	.29**	.23*	-.40**	-.33**	.34**	-.08	-.12	-.24*	-.21
	N		82	82	68	82	81	82	82	76	76	76	76	75
3. Sex	*r*	-	-	1.00	-.10	.10	-.31**	.10	-.03	.06	.14	.09	.03	-.03
	N			82	68	82	81	82	82	76	76	76	76	75
4. Annual household income	*r*	-	-	-	1.00	-.02	.04	-.19	-.07	-.15	-.26*	.05	-.24	-.17
	N				68	68	67	68	68	66	66	66	66	65
5. Chronic health condition	*r*	-	-	-	-	1.00	.02	.04	-.08	-.01	.14	.05	.16	.001
	N					82	81	82	82	76	76	76	76	75
6. Years of education	*r*	-	-	-	-	-	1.00	-.26*	-.15	.02	-.10	-.05	-.13	-.11
	N						81	81	81	75	75	75	75	74
7. Situational avoidance[a]	*r*	-	-	-	-	-	-	1.00	.69**	-.05	.36**	.24*	.14	.38**
	N							82	82	76	76	76	76	75
8. Humour[a]	*r*	-	-	-	-	-	-	-	1.00	.12	.49**	.44**	.31**	.48**
	N								82	76	76	76	76	75
9. Problem-solving[a]	*r*	-	-	-	-	-	-	-	-	1.00	.15	.22	-.11	.01
	N									76	76	76	76	75
10. Distraction[a]	*r*	-	-	-	-	-	-	-	-	-	1.00	.55**	.45**	.41**
	N										76	76	76	75
11. Cognitive reappraisal[a]	*r*	-	-	-	-	-	-	-	-	-	-	1.00	.36**	.25*
	N											76	76	75
12. Acceptance[a]	*r*	-	-	-	-	-	-	-	-	-	-	-	1.00	.36**
	N												76	75
13. Expressive suppression[a]	*r*	-	-	-	-	-	-	-	-	-	-	-	-	1.00
	N													75

Notes. [a] = mean use of ER strategy across daily assessments. * $p < .05$; ** $p < .01$; .** $p < .001$.

Consistent with previous research (Mroczek & Almeida, 2004; Windsor & Anstey, 2010; Windsor et al., 2012), older adults reported lower levels of negative affect, averaged across daily assessments, than younger adults. Negative affect was positively correlated with averaged use of situational avoidance, humour, distraction, cognitive reappraisal, acceptance, and expressive suppression, but not problem-solving. With the exception of problem-solving, there were moderate, positive correlations among the use of remaining ER strategies averaged across the study protocol. A null MLM, revealed that 71.57% of the variance in NA was explained at the BP level, B = 4.29, *SE* = .20, 95% confidence intervals = 2.90-4.69, and 28.43% at the WP level, B = 1.28, *SE* = .11, 95% confidence intervals = 1.08-1.52.

4.4.2 Age differences in emotion regulation efficacy.

Our primary aim was to examine age differences in the efficacy of regulation strategies, in particular, the extent to which younger and older adults' use of specific regulation strategies would buffer NA in the context of stress. We were specifically interested in the interaction of age group, WP stress, and WP ER strategy use as predictors of NA. We predicted that greater use of regulation strategies would buffer stress-NA associations, with problem-solving, cognitive reappraisal, and expressive suppression buffering stress-NA associations more effectively for younger versus older adults, and humour, distraction, and acceptance to buffering against NA in the context of stress more effectively for older adults. As seen in Tables 4.4 and 4.5, for the most part, across models, age group was related to daily NA (i.e., older age was associated with lower NA levels) and NA was greater on stress days than days on which stressful events were not reported (i.e., WP stress-NA coupling).

Table 4.4

Unstandardised Estimates (with Standard Errors) for Main Effects and Interactions of Age, Stress, and Strategy Use (Humour Problem-Solving, Distraction) for Negative Affect

	Humour		Problem-solving		Distraction	
	B (SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI
Age	-1.17 (.33)***	-1.82, -.53	-1.81 (.35)***	-2.49, -1.13	-1.38 (.35)***	-2.07, -.70
BP stress	.68 (.84)	-.97, 2.33	1.49 (.78)	-.04, 3.01	1.28 (.71)	-.12, 2.68
WP stress	.67 (.10)***	.49, .86	.47 (.13)***	.23, .72	.66 (.20)**	.27, 1.06
BP ER	.05 (.01)***	.03, .06	.03 (.02)	-.007, .06	.05 (.02)**	.02, .08
WP ER	< .001 (.002)	-.003, .004	.001 (.004)	-.008, .01	.007 (.003)*	< .001, .01
Age x BP stress	-	-	-	-	-	-
Age x WP stress	-	-	-	-	-.35 (.25)	-.83, .14
Age x BP ER	-.03 (.01)*	-.05, -.004	-.05 (.02)*	-.08, -.009	-.02 (.02)	-.06, .01
Age x WP ER	-	-	-	-	-	-
BP ER x BP stress	-	-	.07 (.03)*	.01, .12	-	-
BP ER x WP stress	-	-	-	-	-.03 (.01)**	-.05, -.009
WP ER x BP stress	-	-	-.02 (.008)*	-.03, -.002	-	-
WP ER x WP stress	-	-	-	-	-	-
Age x BP ER x BP stress	-	-	-	-	-	-
Age x BP ER x WP stress	-	-	-	-	.05 (.01)***	.02, .07
Age x WP ER x BP stress	-	-	-	-	-	-
Age x WP ER x WP stress	-	-	-	-	-	-
Null Model						
Pseudo-R^2	*BP*	*WP*	*BP*	*WP*	*BP*	*WP*
	.57	.04	.56	< .01	.62	< .01

Notes. All analyses are controlled for sex, years of education, annual household income, and number of chronic health conditions. ER = emotion regulation, BP = between-persons differences in given variable, WP = within-persons differences in given variable. See Appendix B which provides an interpretive aid for interactions included in the above Table.

* $p < .05$; ** $p < .01$; .** $p < .001$.

Table 4.5

Unstandardised Estimates (with Standard Errors) for Main Effects and Interactions of Age, Stress, and Strategy Use (Cognitive Reappraisal, Acceptance, Expressive Suppression) for Negative Affect

	Cognitive reappraisal		Acceptance		Expressive suppression	
	B (SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI
Age	-1.58 (.66)*	-2.88, -.28	-.57 (.77)	-2.08, .93	-1.20 (.32)***	-1.83, -.56
BP stress	1.35 (1.03)	-.66, 3.37	1.31 (1.07)	-.79, 3.41	.10 (.83)	-1.52, 1.71
WP stress	.73 (.25)**	.25, 1.21	.41 (.41)**	.18, .65	.64 (.21)**	.23, 1.04
BP ER	.02 (.02)	-.006, .05	.02 (.02)	-.02, .07	.03 (.01)**	.01, .06
WP ER	.02 (.008)[a]	< .001, .03	.008 (.003)**	.003, .01	.006 (.003)*	< .001, .01
Age x BP stress	.32 (1.60)	-2.82, 3.46	-1.45 (1.62)	-4.63, 1.73	-	-
Age x WP stress	-.33 (.28)	-.88, .22	-	-	-.29 (.26)	-.80, .21
Age x BP ER	-.01 (.02)	-.05, .03	.05 (.04)	-.02, .12	-.005 (.01)	-.03, .02
Age x WP ER	-.02 (.01)	-.04, .003	-	-	-	-
BP ER x BP stress	-	-	.08 (.08)	-.07, .23	-	-
BP ER x WP stress	-.02 (.01)	-.05, .006	-	-	-.02 (.009)*	-.04, -.003
WP ER x BP stress	-.04 (.02)*	-.08, -.008	-	-	-	-
WP ER x WP stress	-	-	-	-	-	-
Age x BP ER x BP stress	-	-	-.20 (.10)*	-.39, -.01	-	-
Age x BP ER x WP stress	.03 (.02)*	.005, .06	-	-	.03 (.01)**	.01, .05
Age x WP ER x BP stress	.04 (.02)[a]	< .001, .09	-	-	-	-
Age x WP ER x WP stress	-	-	-	-	-	-
Null Model						
Pseudo-R^2	*BP*	*WP*	*BP*	*WP*	*BP*	*WP*
	.51	< .01	.60	< .01	.58	< .01

Notes. All analyses are controlled for sex, years of education, annual household income, and number of chronic health conditions.
ER = emotion regulation, BP = between-persons differences in given variable, WP = within-persons differences in given variable.
See Appendix B which provides an interpretive aid for interactions included in the above Table.
[a] $p < .06$, * $p < .05$; ** $p < .01$; .*** $p < .001$.

Contrary to our hypotheses, across all ER strategies, the interaction of age, WP ER, and WP stress in predicting NA was not significant. Similarly, results did not reveal significant age, BP ER, and BP stress interactions, with one notable exception. As shown in *Figure 4.1*, there was a significant interaction of age, BP acceptance, and BP stress. While the difference in NA between those reporting more frequent compared to less frequent stress appeared marginally greater among older adults, the most salient feature of the interaction was a stronger protective effect for habitual acceptance for older relative to younger adults. Whereas older and younger adults who scored low in use of acceptance reported similarly higher overall levels of NA, NA was substantially lower among older adults (but not younger adults) who reported more frequent use of acceptance.

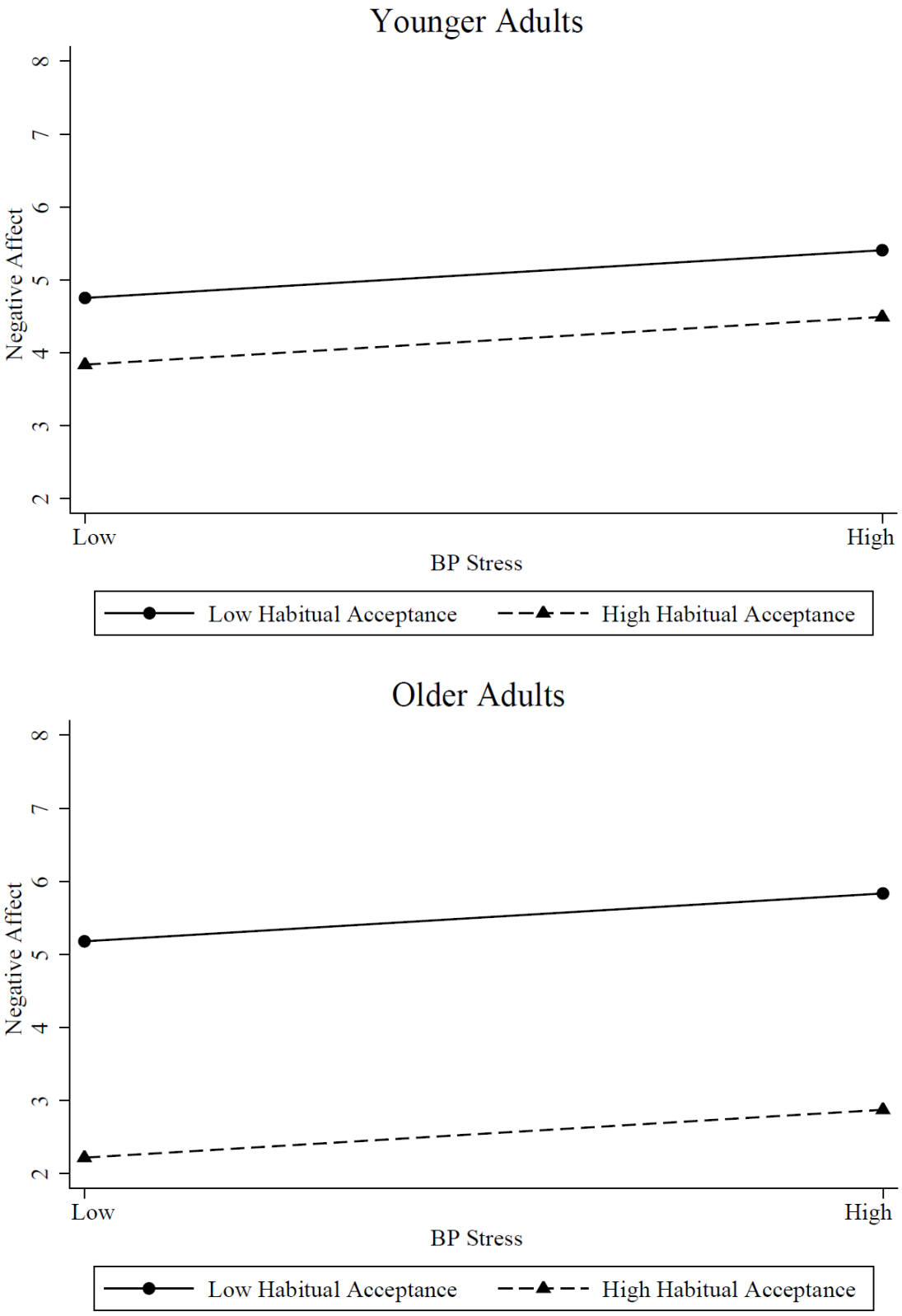


Figure 4.1. Three-way interaction of age, BP (habitual) acceptance, and BP stress in predicting NA

Additionally, results revealed a number of significant two-way and cross-level interactions. The MLM for humour revealed a significant age group by BP humour interaction. As seen in *Figure 4.2*, greater use of humour appeared minimally related to levels of NA among older adults, while greater use of humour by younger adults was related to higher levels of NA.

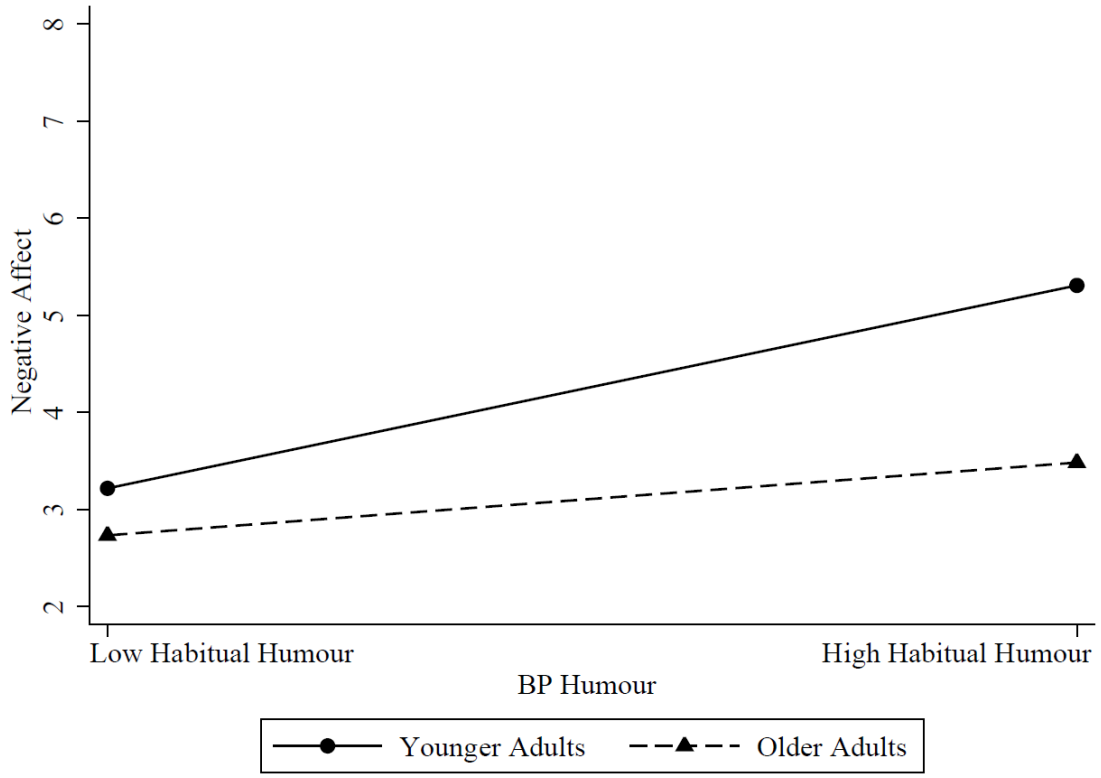


Figure 4.2. Two-way interaction of age and BP (Habitual) humour in predicting NA

Results also revealed two-way interactions for age and BP problem-solving, BP problem-solving and BP stress, and WP problem-solving and BP stress, shown in *Figures 4.3*, *4.4*, and *4.5* respectively.

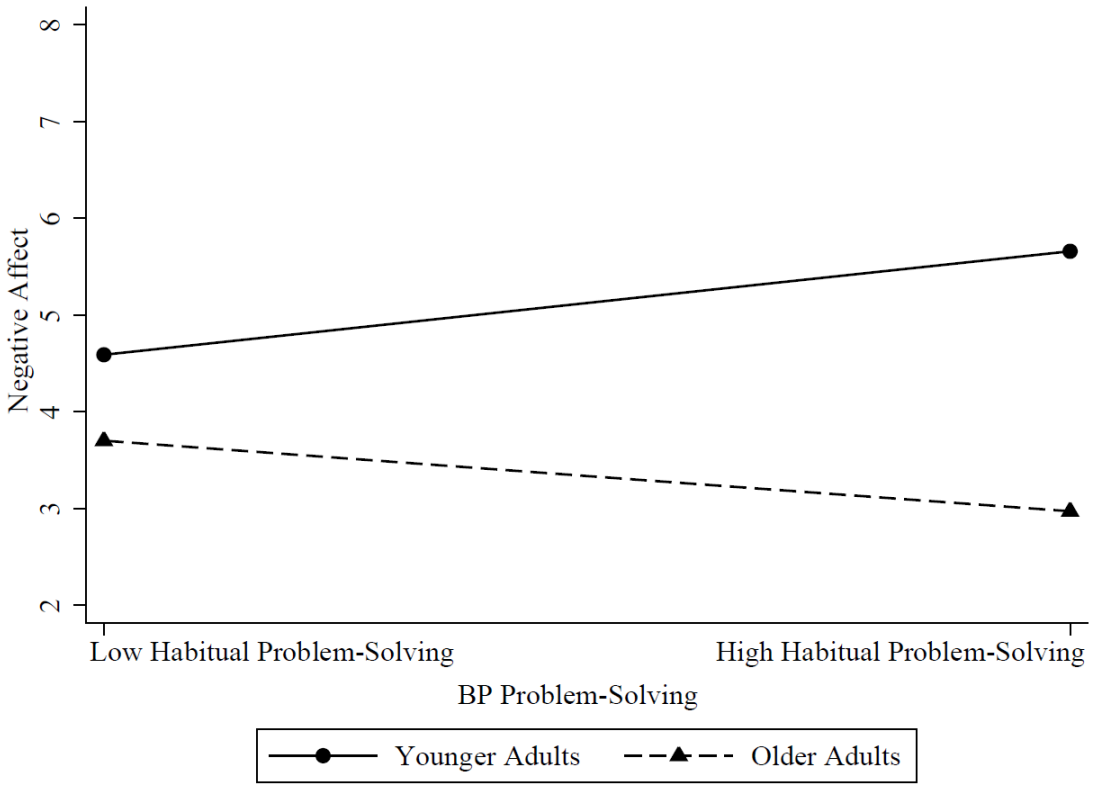


Figure 4.3. Two-way interaction of age and BP problem-solving in predicting NA

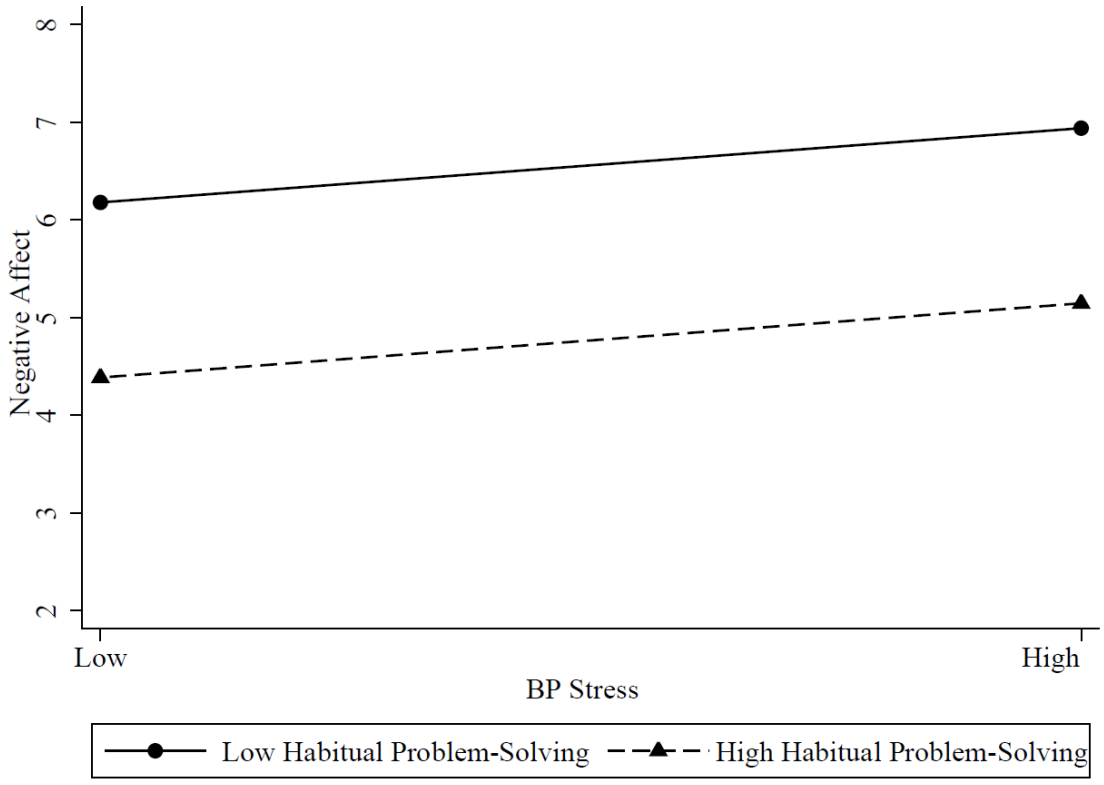


Figure 4.4. Two-way interaction of BP stress and BP problem-solving in predicting NA

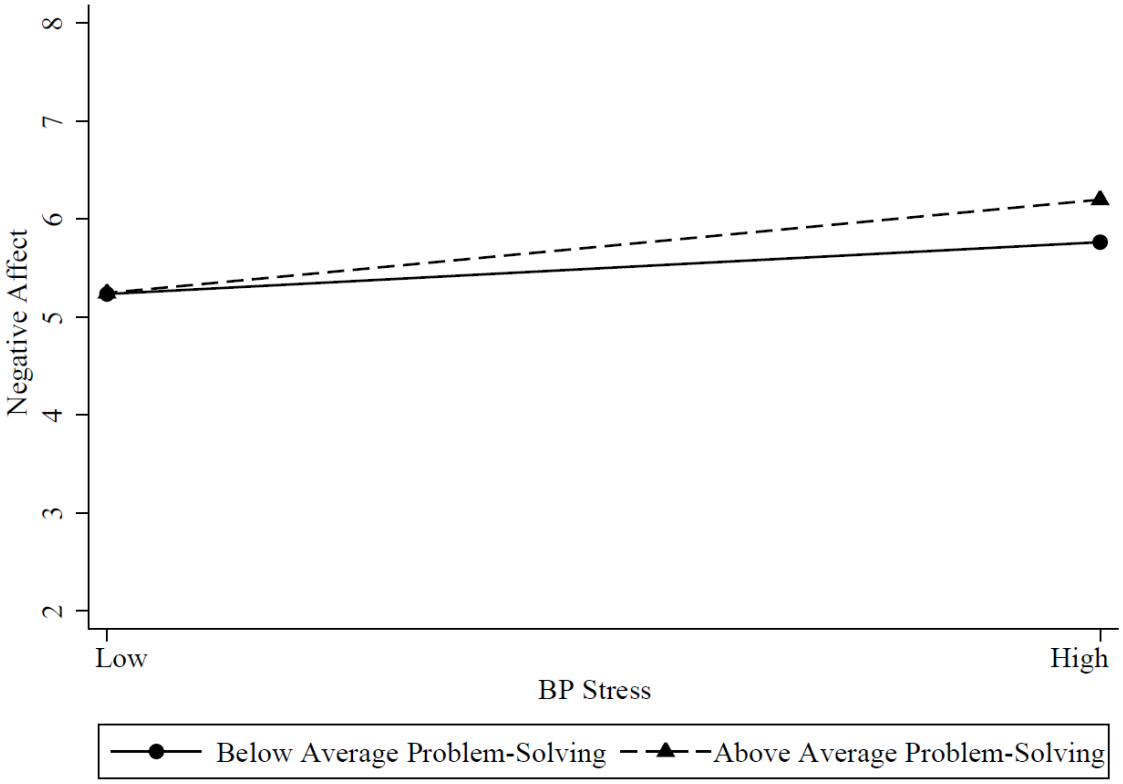


Figure 4.5. Two-way interaction of BP stress and WP problem-solving in predicting NA

As seen in *Figure 4.3*, higher versus lower levels of habitual problem-solving use among younger adults were associated with slightly higher levels of NA. In contrast, older adults reporting greater habitual use of problem-solving demonstrated lower levels of NA than older adults that reported lower levels of habitual problem-solving use. Additionally, the interaction of BP problem-solving and BP stress (*Figure 4.4*) highlighted marginal increases in NA with increasing levels of general stress for those with both low and high habitual problem-solving tendencies, with the interaction driven by a slightly stronger positive BP stress-NA association among those with tendencies towards lower use of problem-solving strategies. Interestingly, the two-way interaction of WP problem-solving and BP stress (*Figure 4.5*), suggested that among those who reported more stress, NA tended to be higher on days when they engaged in higher than average levels of problem-solving. WP problem-solving appeared largely unrelated to NA among those reporting low levels of stress.

Our distraction model highlighted a significant interaction of BP distraction use and WP stress and more importantly a significant three-way interaction of age group, BP distraction, and WP stress (*Figure 4.6*). For younger adults with lower habitual distraction use, levels of NA were similar on stress days and non-stress days, whereas for younger adults with greater use of distraction, NA was greater on stress days than non-stress days. In contrast, older adults with lower habitual distraction use reported marginally greater levels of NA on stress days than non-stress days, whereas older adults with higher habitual use of distraction reported similar levels of NA on stress and non-stress days.

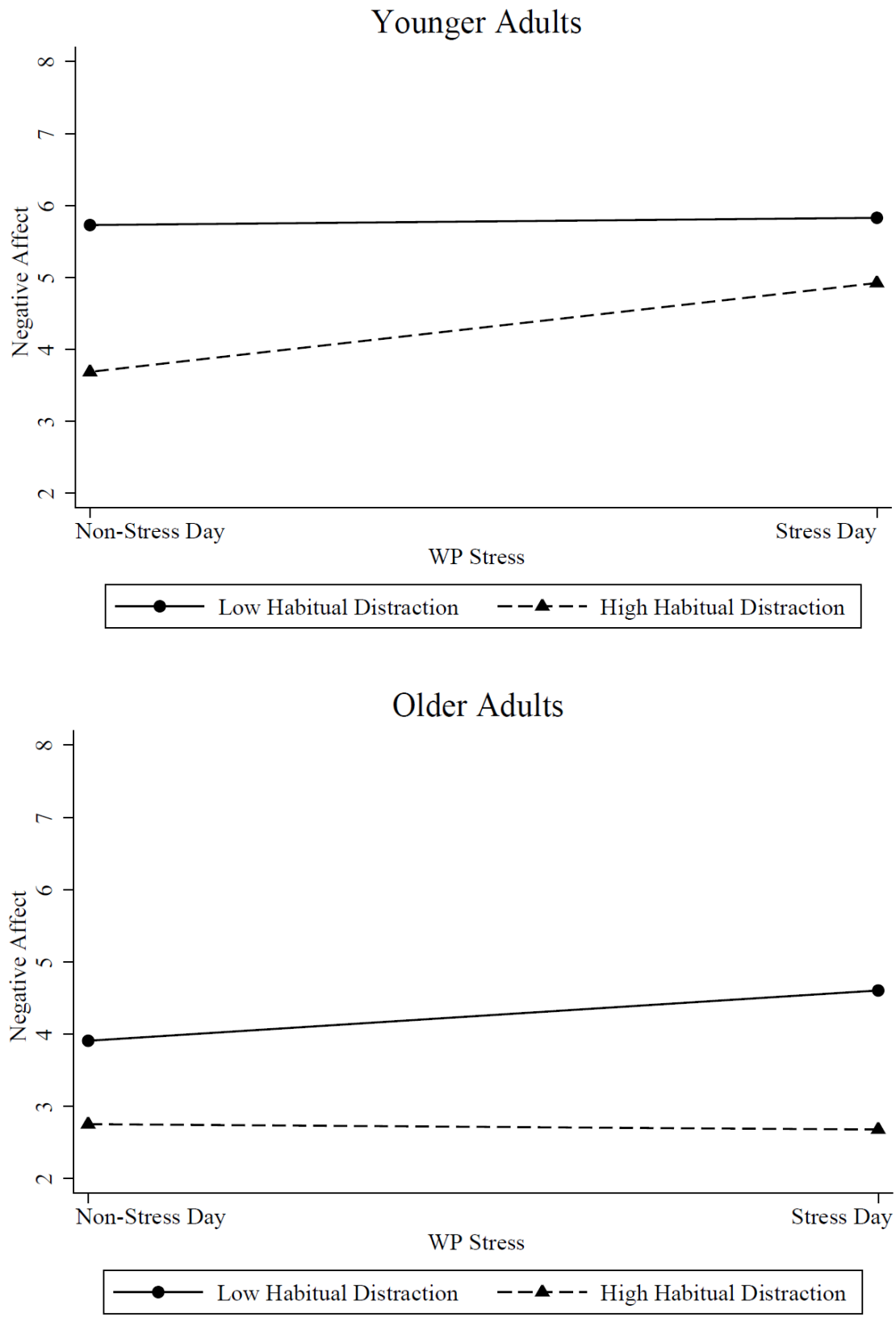


Figure 4.6. Three-way interaction of age, BP (habitual) distraction, and WP stress in predicting NA

As per Table 4.5, WP cognitive reappraisal and BP stress interacted to predict NA (see *Figure 4.7*), whereby among participants who reported above average cognitive reappraisal use, there was a positive association between general stress levels and NA, whereas among participants who reported below average cognitive reappraisal use, levels of NA were more weakly associated with general stress levels.

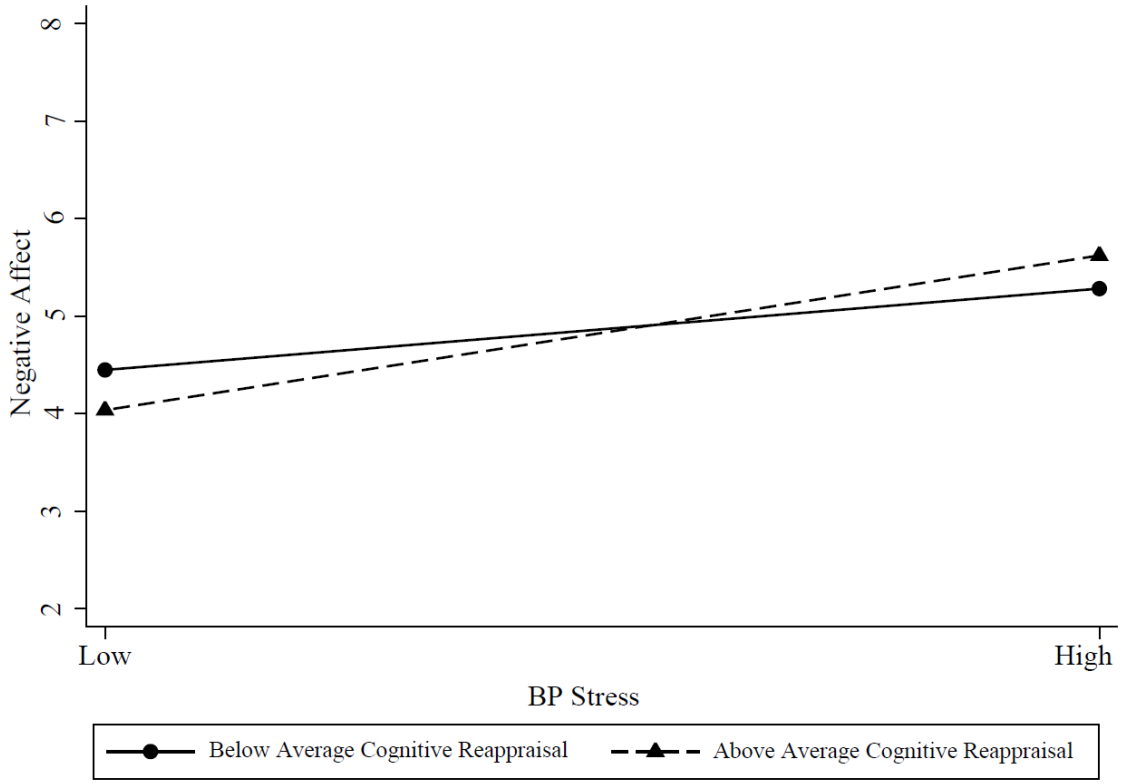
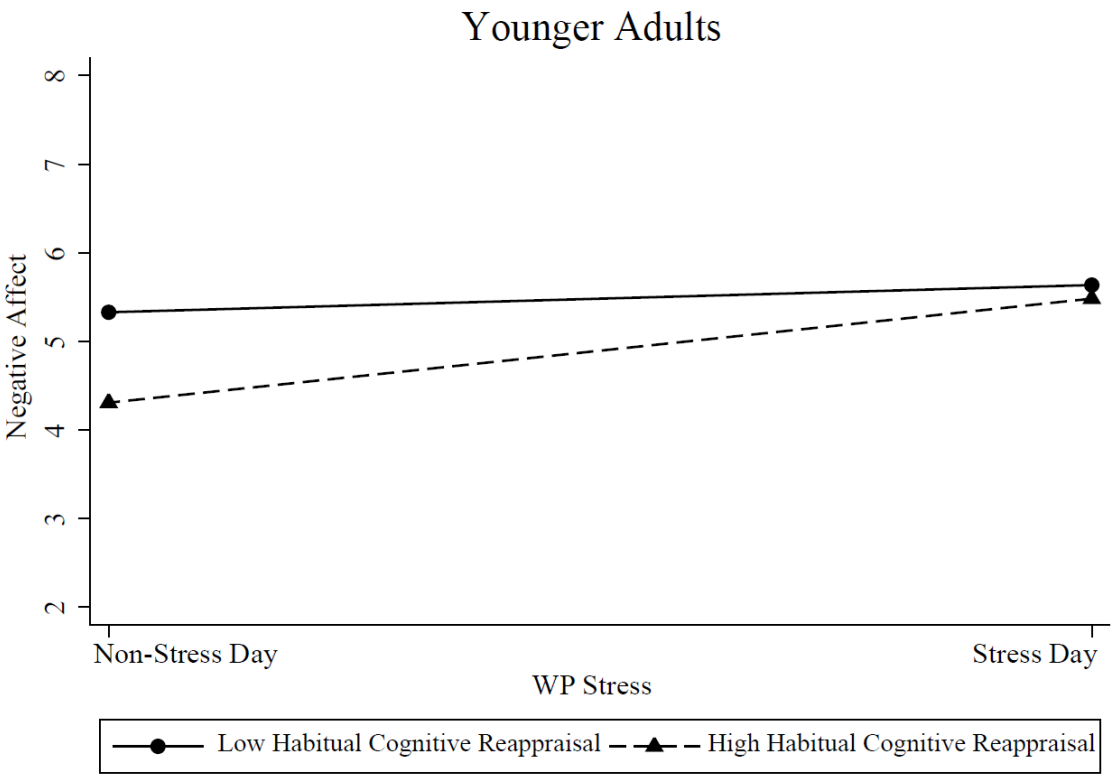


Figure 4.7. Two-way interaction of WP cognitive reappraisal and BP stress in predicting NA

The interaction of age group, BP cognitive reappraisal, and WP stress was also significant. As seen in *Figure 4.8*, for younger adults, those with lower habitual use of reappraisal show similarly high levels of NA on stress days and non-stress days, while those with higher habitual reappraisal reported lower levels of NA on non-stress days. For older adults, higher habitual reappraisal was associated with consistently low NA on both stress and non-stress days, whereas older adults reporting lower levels of habitual reappraisal reported higher NA on stress days compared to non-stress days.



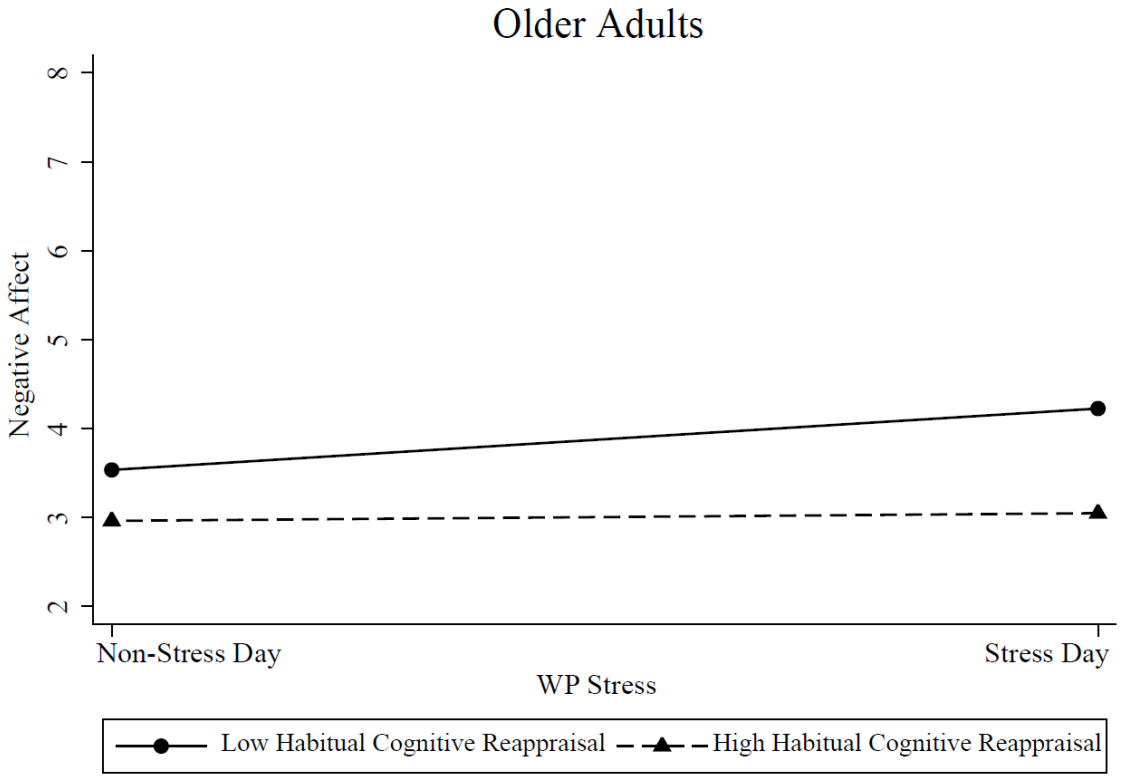


Figure 4.8. Three-way interaction of age, BP (Habitual) cognitive reappraisal, and WP stress in predicting NA

Lastly, results revealed a three-way interaction of age group, BP expressive suppression, and WP stress (*Figure 4.9*). Among younger adults, for those reporting lower habitual expressive suppression use levels of NA were relatively high and comparable across stress and non-stress days, while greater habitual expressive suppression use related to higher NA on stress days versus non-stress days. In contrast, for older adults, higher habitual use of expressive suppression was associated with consistently lower NA irrespective of stress exposure, whereas lower use of expressive suppression related to higher NA overall and marginally higher NA on stress days relative to non-stress days.

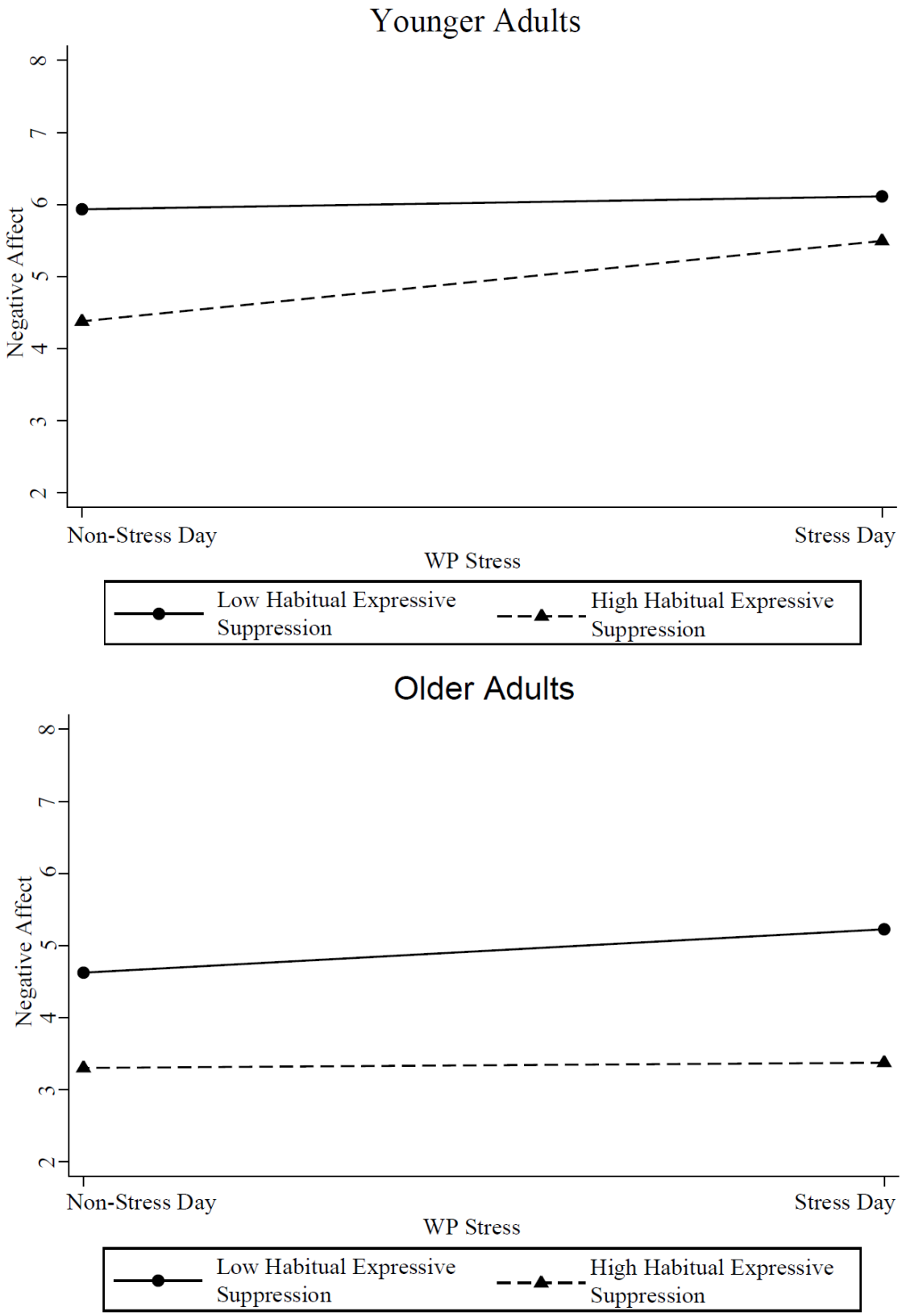


Figure 4.9. Three-way interaction of age, BP (habitual) expressive suppression, and WP stress in predicting NA

4.5 Discussion

The present study examined age differences in the efficacy of a range of ER strategies in the daily lives of younger and older adults. ER efficacy was operationalised as the extent to which ER strategy use buffered against stress reactivity, primarily the WP coupling of stress and NA (Sliwinski et al., 2009). We predicted that the extent to which greater use of different ER strategies buffered against NA on days of stress exposure would vary as a function of age. Specifically, we expected that problem-solving, cognitive reappraisal, and expressive suppression would serve as more effective buffers against stress-NA coupling for younger adults, and that humour, distraction, and acceptance would buffer against stress reactivity more effectively for older adults. Contrary to our predictions, results suggested minimal evidence of age differences in the efficacy of humour, problem-solving, distraction, cognitive reappraisal, and expressive suppression, at the intra- (WP) or inter- (BP) individual levels. One exception concerned a significant interaction of age, BP acceptance, and BP stress, where the most salient feature was a protective effect of habitual acceptance buffering against NA which was stronger for older relative to younger adults.

Although primary predictions regarding age differences in ER efficacy at the BP and WP level appeared largely unsupported, a number of findings pointed to more complex associations of age, strategy use, stress exposure, and NA[6]. In particular, results suggested that greater habitual use of cognitive reappraisal and expressive suppression related to a weaker association of daily stress and NA but only among older adults. In fact, greater habitual use of these strategies appeared related to stable levels of NA with fluctuating levels of stress. Additionally, our BP interaction of age, stress, and acceptance appeared to be predominately driven by the association of greater levels of habitual acceptance use with

[6] Given the developmental focus of our paper, significant interactions involving age provide the focus for the discussion.

lower levels of NA, with this effect being somewhat more pronounced for older adults. Together these results suggest more generalised benefit of habitual expressive suppression, cognitive reappraisal, and acceptance among older versus younger adults, possibly given the increasing priority of emotional wellbeing with increasing age (Carstensen et al., 2003). More specifically, theories of lifespan development (Carstensen et al., 2003; Charles, 2010; Labouvie-Vief, 2003; Urry & Gross, 2010) suggest that given the realisation of limited time remaining with advancing chronological age, older adults are motivated to optimise meaningful and positive emotional experiences, leading to the chronic activation of ER goals. As such, older adults may be predisposed to manage any situation they enter into with the aim of preserving emotional experience, resulting in a more generalised benefit of ER strategies such as expressive suppression, cognitive reappraisal, and acceptance. In contrast, younger adults may be relatively less motivated to down-regulate negative emotion (Riediger et al., 2009), only doing so when specific situations call for it (i.e., in times of stress).

Moreover, it may be that expressive suppression, cognitive reappraisal, and acceptance are broadly beneficial among older adults given the unique features of these strategies. For instance, as acceptance involves acknowledging experience without judgement or effort to change circumstances, this strategy may be useful for managing changes in sensory capacities, physical health, cognitive functioning, and social networks associated with increasing age (Cruickshanks et al., 2003; Hébert, 1997; Lövdén et al., 2004; Victor et al., 2000). These age-normative changes are largely irrevocable and may increase susceptibility to emotional distress. Accordingly, acceptance may represent a mechanism for adapting to the unique challenges of older adulthood whilst minimising emotional distress.

Considering expressive suppression, research has established that there are affective (e.g., greater subjective experience of emotion one is trying to suppress the expression of),

cognitive (e.g., impaired memory and cognitive performance when attempting to conceal emotion expression), and interpersonal (e.g., less close and genuine relationships with others due to masking one's feelings) costs associated with use of this strategy (Gross, 1998, 2001; Richards & Gross, 1999, 2006; Roberts et al., 2008). It is possible that this strategy is less beneficial among younger adults, particularly in situations of stress, as being less experienced regulators due to their age, younger adults may be more susceptible to the adverse costs of expressive suppression (e.g., less experience in using this regulation strategy may render younger adults at greater risk of the adverse costs of expressive suppression such as impairment in cognitive performance). In contrast, one might venture that older adults obtain greater benefit, with less associated costs, from use of expressive suppression given greater experience in using this strategy throughout their lives. This remains an open empirical question to be tested in future studies.

In terms of cognitive reappraisal, we speculate that perhaps the age-related deficits in cognitive control (e.g., Opitz et al., 2014; Opitz et al., 2012) believed to compromise cognitive reappraisal, are offset by gains in other areas such as enhanced regulatory motivation (i.e., SST; Carstensen, 1993) and knowledge of oneself, emotions, and how to effectively employ strategies like cognitive reappraisal, accumulated across the lifespan (Blanchard-Fields, 2007). Alternatively, given our sample of older adults was quite young and healthy, levels of regulatory resources like cognitive control may be relatively well-preserved leading to a distortion of results regarding age differences in ER efficacy for strategies such as cognitive reappraisal. As such, it is possible that contrary to our predictions, cognitive reappraisal does not deteriorate in efficacy up until very late adulthood (e.g., 85 or above), when age-related changes in regulatory resources are likely to be more pronounced (Baltes & Smith, 2003).

Interestingly, based on the results of the current study habitual distraction may buffer against negative affect, in the context of daily stress, for older adults, whilst habitual use of distraction may be less effective for younger adults. It is possible that the types of stressful situations encountered by younger adults require proactive management, particularly if they concern pursuit of goals centred on self-development and resource acquisition as per SST (Carstensen & Lockenhoff, 2003). In this case, distraction may be a form of avoidance and reinforce negative feelings. In contrast, the stressors encountered by older adults may be irrevocable (i.e., chronic health condition, passing of a loved one) so distraction may offer some respite via disengagement when stressors are largely uncontrollable. Once again, these interpretations represent open questions and possible avenues for future studies to explore.

Similarly, in general, greater problem-solving tendencies appear to protect against NA among older adults but may relate to greater levels of NA for younger adults, possibly reflecting differences in the regulatory goals of younger and older adults. It is often assumed that the primary goal of ER is the downregulation of NA. Indeed, this appears predominately the case for older adults (i.e., pro-hedonic motivation; Riediger et al., 2009), explaining why problem-solving supports lower levels of NA among older adults. However, under certain circumstances, persons may seek to maintain or even up-regulate NA (i.e., contra-hedonic motivation; Riediger et al., 2009), particularly if this assists with the pursuit of utilitarian or instrumental goals (Tamir et al., 2008). It is argued that this contra-hedonic motivation may better align with the developmental goals of younger adults (i.e., contra-hedonic motivation; Riediger et al., 2009). As such, the problem-solving efforts employed by younger adults may be more pragmatic facilitating pursuit of instrumental goals, having less effect on or even marginally increasing levels of NA.

Of note, habitual use of humour appears to play minimal role in supporting older adults' affective wellbeing. As humour comprehension appears to be supported by cognitive processes subject to age-related decline (Mak & Carpenter, 2007), it is possible that use of humour as a regulation strategy becomes less effective in the context of cognitive ageing. Among younger adults, greater habitual humour was associated with *higher* levels of NA. This could relate to a preference towards 'negative humour' (i.e., creating emotional distance through hostility and putting others down) which is associated with poor mental health and affective outcomes (Martin, Puhlik-Doris, Larsen, Gray, & Weir, 2003; Samson & Gross, 2012). Alternatively, it may be that increasing levels of NA trigger regulatory efforts and that a higher threshold of NA is needed to trigger regulation by humour, perhaps as a last resort, when more proactive efforts at managing a stressor have proved ineffective. However, this is purely speculative as due to using end-of-day assessments, we do not have pre- and post-regulation measures of affect. As such, we cannot establish whether higher levels of NA result from ineffective regulation or whether greater regulation strategy use coincides with or is triggered by elevated NA. Ecological momentary assessment (EMA) protocols (e.g., Riediger et al., 2009) allow for repeated assessment of behaviours and experiences in real-time. Such approaches would be valuable for future researchers to employ to facilitate more sophisticated modelling of the temporal relationships among ER strategy use, stress, and NA.

Methodologically, our study is high in ecological validity and represents an important extension to existing literature regarding ageing and ER. Extant literature provides preliminary insights regarding affective outcomes associated with general regulatory tendencies (i.e., cross-sectional, questionnaire studies examining affective correlates of habitual strategy use) and capacity for effective regulation (i.e., laboratory studies in which affective outcomes of instructed strategy use are measured). However, our results provide

unique insights regarding ER efficacy when younger and older adults are *free to choose* how to regulate emotion in their daily lives. It is this latter approach which is most informative regarding whether effective day-to-day use of ER strategies supports the typically high levels of emotional wellbeing reported by older adults. Our results do not suggest uniform shifts in the efficacy of different ER strategies with age, although we have described a number of other intriguing results.

A number of factors may explain the absence of anticipated age differences in ER moderating the coupling of stress and NA at the daily (WP) level. Possibly more subtle ER processes are at play. For instance, automatic ER (i.e., nonconscious regulation of emotion; Mauss, Bunge, & Gross, 2007) is suggested to be pervasive in daily life, and self-report measures may not fully capture the operation of such processes, even when participants are asked directly to reflect on their use of ER. Moreover, it may be the accumulated effects of selectivity (i.e., social network pruning, preferential engagement in personally meaningful activities; Carstensen et al., 2003; English & Carstensen, 2014) or broader changes in life context (e.g., the availability of more discretionary time in retirement), rather than deliberate ER, that is critical for supporting daily hedonic wellbeing among older adults. It is also possible that a more fine-grained approach is needed to adequately model developmental change in ER. For instance, certain emotions appear to be more evocative for younger and older adults than others (i.e., themes of sadness related to loss are more emotionally evocative for older versus younger adults; Kunzmann & Grühn, 2005) and ER efficacy could vary according to the emotion that regulatory efforts are being directed towards. For the present study, a composite NA measure was used, however, it is possible that this could mask more subtle age differences in ER efficacy across specific negative emotions (e.g., sadness, loneliness, anxiety, irritation). Examination of age differences in ER efficacy in more varied

circumstances, across specific negative emotions, and in light of different regulatory goals would allow for person-situation and strategy-based contingencies for ER success to be identified as recommended by Doré et al. (2016).

Given the complexity of daily life, the extent to which a range of ER strategies can be employed to meet contextual needs (i.e., ER flexibility; Aldao et al., 2015) may be more useful in supporting hedonic wellbeing than effective use of individual strategies. Indeed, there are established links between rigid emotional responding and psychopathology (Kashdan & Rottenberg, 2010). If priority of emotional wellbeing increases with age as per SST (Carstensen & Lockenhoff, 2003), perhaps this is not supported by use of specific ER strategies that might be expected to become more effective in the context of changing resource profiles, but rather by enhanced flexibility in the selection of strategies that best fit the demands of a given situation or use of multiple strategies to optimise regulation in response to a specific emotional trigger. Due to the methodology we have employed in conducting this research, our study cannot rule out use of multiple ER strategies in response to stressors on a given day or provide information regarding the efficacy of using multiple ER strategies in the context of a single stressor. As such, examining whether younger and older adults differ in ER flexibility represents an important step in determining both if and how age differences in ER support developmental change in affective wellbeing.

4.5.1 Conclusions

Results suggest that developmental change in ER efficacy across the adult lifespan is complex, reflecting the interplay of habitual (BP) tendencies and daily (WP) processes. Among older adults, there appears to be generalised benefit associated with greater use of acceptance and problem-solving, possibly a weaker association between levels of stress and NA among those with strong habitual use of cognitive reappraisal and expressive

suppression, lower levels of NA in the context of stress at higher levels of distraction use, and indication of minimal effect of humour on affective outcomes. Further examination of the intersection of between- and within- person processes and delineating how the interplay of person-, situation-, and strategy- specific factors shape contingencies for ER efficacy among younger and older adults are intriguing avenues for future researchers to pursue.

Chapter 5: General Discussion

5.1 Summary of Findings

Given global trends of population ageing (Beard et al., 2012), understanding mechanisms which support emotional wellbeing among older adults is imperative (Bryant, Corbett, & Kutner, 2001). One such factor, which has been of increasing interest to researchers in recent years, is emotion regulation (ER; Gross, 1999). This thesis provides novel insights regarding profiles of ER strategy use and efficacy in the lives of younger and older adults by synthesising extant literature (**Chapter 2**) and drawing on the results of a new micro-longitudinal study (**Chapters 3 & 4**). Together, the results of this thesis highlight the complexity of developmental change in ER across the adult lifespan, and point to the centrality of changing life contexts and moderating factors in shaping age differences in the use and efficacy of different ER strategies.

The systematic review reported in **Chapter 2** (Allen & Windsor, 2017) included 23 empirical studies and provided a much needed synthesis of previous research regarding age differences in ER strategy use among younger and older adults. The review highlighted that age differences in strategy use were more likely to be evident within particular contexts; for example in situations of interpersonal conflict. Additional moderator variables, including levels of self-efficacy beliefs and the specific type of emotion that regulatory efforts were directed towards, also played a role in revealing age differences. For example, relative to younger adults, older adults were inclined towards greater use of situation selection, but only in situations of conflict or at high levels of perceived control and ER self-efficacy beliefs. Additionally, compared to younger adults, older adults employed greater levels of general situation modification to downregulate negative feelings, while age differences in use of specific subtypes of situation modification like help-seeking and problem-solving were contingent upon the emotion that regulatory efforts were directed towards. In terms of

attentional deployment, review results were consistent with a positivity bias in attention among older adults, provided minimal evidence of age differences in use of distraction, highlighted greater habitual rumination tendencies among older adults despite an absence of age differences in self-reported use in laboratory settings, and pointed to greater use of thought suppression among younger adults. Within the cognitive change family, use of mediality and acceptance was, under particular circumstances (e.g., situations of moderate emotional intensity or anxiety provoking situations), greater among older adults. In contrast, literature was indicative of an absence of age differences in the more cognitively effortful strategies of cognitive reappraisal and cognitive refocusing. Lastly, consistent age differences in the response modulation subtype of expressive suppression did not emerge, while younger adults reported greater use of emotionally expressive coping relative to their older counterparts, but only in regulating feelings of sadness. Together, the results of the systematic review suggest that profiles of ER strategy use reflect the dynamic interaction of person- (e.g., age, perceived control, and ER self-efficacy beliefs), situation- (e.g., type and intensity of emotion eliciting regulatory efforts), and strategy- (e.g., particular regulation strategy subtype) specific factors. This is consistent with recent suggestion that more sophisticated and contextualised approaches are needed to delineate contingencies for ER strategy use and efficacy (Doré et al., 2016).

The central aim of this dissertation in terms of its empirical contribution to the literature was to examine age differences in the *use* and *efficacy* of ER strategies representative of the *full range* of Gross' (1998) regulatory families in the *daily lives* of younger and older adults, and this was achieved through use of micro-longitudinal protocol. This represents a novel contribution to study of ER across the adult lifespan for a number of reasons. Firstly, to our knowledge, at the time of conducting the micro-longitudinal study, no

existing study had examined age differences in ER strategies spanning the full range of Gross' (1998) regulatory families. Rather, studies had examined age differences in a single ER strategy or made comparisons between two or three strategies (e.g., Denson et al., 2011). As individual studies employ different methodologies, contain unique participant samples, and adopt different approaches to the operationalisation of ER strategies, comparison of regulation strategies across studies is complicated by these methodological inconsistencies. Examining use and efficacy of ER strategies spanning Gross' (1998b) five families of regulation strategies within a single participant sample reduces the impact of these methodological inconsistencies and allows firmer conclusions to be drawn regarding regulatory profiles. As such, this design was adopted for the empirical study which forms the foundation of this thesis.

Secondly, prior studies have largely examined differences in either the use *or* efficacy of ER strategies. As more frequent or greater use of ER strategies may not necessarily equate to superior strategy efficacy (Urry & Gross, 2010), it is important to consider both aspects of ER to provide a thorough examination of developmental change in ER. Thirdly, our use of a daily diary approach provided data high in ecological validity. Indeed, to our knowledge, this thesis provides the first examination of age differences in ER strategies use and efficacy in the *daily* lives of younger and older adults. Consequently, our micro-longitudinal study allows us to explore whether the theoretical predictions of influential lifespan theories and results of laboratory and questionnaire style studies apply in the context of daily life. Lastly, using sophisticated statistical modelling, the micro-longitudinal study incorporated in this thesis facilitates examination of within-person (WP) and between-person (BP) data and cross-level interactions, which provides a more nuanced and complex picture of developmental change in ER relative to cross-sectional questionnaire and laboratory studies.

To summarise, the aims of the two empirical papers (**Chapters 3 & 4**) were to (i) identify potential age differences in ER strategy use in the context of daily stress and (ii) consider how age differences in strategy use relate to affective outcomes in the context of daily stress as an index of ER efficacy. Results of the empirical papers pertaining to each of Gross' (1998b) five families of ER strategies are summarised below in turn. Additionally, given the centrality of stress to our investigation of ageing and ER, a sub-section summarising results regarding stress and related daily processes, is also presented below.

5.1.1 Situation selection.

Micro-longitudinal data suggest that younger adults engage in greater situational avoidance (i.e., avoidance of situations anticipated to elicit negative emotional outcomes) relative to older adults, although age differences in use of this strategy were not predictive of positive affective outcomes (i.e., the absence of daily stress).

5.1.2 Situation modification.

Use of the situation modification subtype, problem-solving, was greater among older relative to younger adults, with higher levels of habitual problem-solving use related to lower levels of negative affect (NA) among older adults. In contrast, greater habitual use of problem-solving related to higher levels of NA among younger adults.

Regarding the situation modification strategy of humour, younger adults reported greater levels of habitual humour compared to their older counterparts. Of note, greater habitual use of humour related to stronger negative feelings among younger adults, while differences in habitual use of humour demonstrated minimal effect on NA among older adults.

5.1.3 Attentional deployment.

In terms of attentional deployment, age differences in use of distraction appeared minimal. Moreover, for our participant sample overall, greater habitual use of distraction appeared maladaptive in terms of responses to daily stress. However, contrary to sample-wide results, among older adults, stronger tendencies towards use of distraction related to a weaker association of daily stress and NA.

5.1.4 Cognitive change.

Within the ER literature, cognitive reappraisal is one of the most extensively researched cognitive change strategies. Our data suggest that use of cognitive reappraisal is largely comparable across age groups. However, in terms of efficacy, greater cognitive reappraisal tendencies were associated with age-related gains in terms of more positive emotional outcomes for older adults in the context of stress (i.e., a weaker association between daily stress and NA).

Concerning acceptance as another strategy within the cognitive change family, although younger adults appear to employ greater levels of acceptance relative to older adults, both age groups appear to demonstrate benefits from greater habitual use of this strategy at high levels of stress, although this effect is stronger among older adults.

5.1.5 Response modulation.

Data highlighted that younger adults used the response modulation strategy of expressive suppression to a greater extent than older adults. However, use of this strategy appeared less beneficial in terms of counteracting levels of NA in the context of stress, particularly for younger adults.

5.1.6 Daily and habitual stress.

Although use of specific ER strategies (e.g., acceptance) appeared to be of benefit in the context of stress, levels of stress exposure were comparable among younger and older adults and the emergence of age differences in ER strategy *use* did not appear contingent upon levels of daily or average stress exposure. However, older adults appear to make more positive stress-related appraisals than younger adults. In particular, older adults were more likely to attribute the absence of daily stress to the appraisal that situations were handled before they became stressful and the belief that stressful events are infrequent, and younger adults were almost six times more likely than older adults to anticipate the occurrence of daily stressors in the future.

Together our empirical findings suggest that age differences in ER strategy use are not accompanied by concurrent age differences in ER efficacy. Age differences in ER strategy use suggest that in daily life younger adults demonstrated more diversified regulation (e.g., use greater levels of a greater range of strategies) while older adults may be more specialist regulators (e.g., show a preference for higher levels of problem-solving). Additionally, there was largely an absence of age differences in associations of ER strategy use, stress, and NA at BP or WP levels, rather it is the interplay of habitual BP tendencies and more dynamic WP processes which appears underlie age differences in ER efficacy where they are apparent.

5.2 Extension to Current Knowledge.

There is recent suggestion within the field of ER, that regulatory success is highly contextual, reflecting a dynamic interplay of person-, situation-, and strategy- specific factors (Doré et al., 2016). The systematic review and empirical results detailed in this thesis are consistent with the notion that individual's use of different ER strategies is highly context

specific; highlighting the complexity of profiles of ER strategy use and efficacy across the adult lifespan. Uniform patterns of age differences are not apparent, rather the results of the present thesis suggest that in a similar vein to Doré et al. (2016), that the emergence of age differences in ER among younger and older adults is contingent upon the interactive effects of person-, situation-, and strategy- specific factors. Examples of these factors (see Table 5.1) are discussed below.

Table 5.1
Person, Situation, and Strategy factors which may interact to predict age differences in use and efficacy of ER strategies

Person	Situation	Strategy
Socioemotional motivation & future time perspective Hedonic versus instrumental regulatory goals Regulatory resources Personality & individual difference variables ER flexibility	Macro-level • Broader life context Micro-level • Type and intensity of emotion eliciting regulatory efforts • Interpersonal features of situation prompting regulation • Daily stress/hassles)	Subtypes of strategies within broader regulatory families

Socioemotional theories of lifespan development (e.g., STT; Carstensen, 1993) suggest that the shortening of future time perspective associated with advancing chronological age is related to a shift in motivation towards the pursuit of personally meaningful goals and optimisation of emotional wellbeing. Pursuit of these goals is believed to be facilitated through use of emotion regulation strategies (particularly proactive, antecedent regulation strategies which act early in the emotion generative process), biases in attention and cognition, and processes of selectivity (e.g., cutting ties with peripheral social partners whilst maintaining closer and more meaningful associations) among older adults

(Sims et al., 2015). Accordingly, researchers note that older adults are predisposed towards chronic activation of emotion regulatory goals, while among younger adults ER only becomes salient when circumstance demands (Knight et al., 2007; Mather & Carstensen, 2005).

The inconsistent findings in the literature to date regrading older adults' preferences for antecedent strategy use is likely to reflect a complex interplay among person and situation factors. More specifically, in some situations the influence of socioemotional goals is likely to be stronger than others in directing ER strategy use. For example, older adults prioritise personally meaningful experiences, including close and supportive relationships, and they may find interpersonal conflict highly distressing as it threatens their socioemotional goals. Therefore older adults may be highly motivated to de-escalate situations of conflict as proactively and rapidly as possible, prioritising use of antecedent ER strategies like situation selection or modification. Simultaneously, older adults typically inhabit social worlds that are relatively more free of interpersonal stressors (Birditt & Fingerman, 2003; Birditt, Fingerman, & Almeida, 2005) as a result of the cumulative effects of the motivational factors mentioned above (Fingerman, Hay, & Birditt, 2004; Fingerman, Miller, & Charles, 2008) and changing lifespan contexts (e.g., retirement from work, no longer having dependent children at home). Taken together, this could mean that although older adults have a greater relative preference for certain types of ER strategies (e.g., situation selection), in daily life their use of these strategies may be less evident relative to younger adults, who may have more interpersonally challenging life contexts, and as a result need to draw on a more diverse range of strategies, and to do so more often.

Regulatory goals and motives may also be considered in terms of the target of regulatory efforts. Tamir (2016) provides a taxonomy for classifying ER motives, whereby

people can employ regulatory efforts in the service of hedonic or instrumental goals. Hedonic goals may involve efforts to increase feelings of pleasure (i.e., pro-hedonic motives) or painful emotions (i.e., contra-hedonic motives). In contrast, instrumental ER goals may be orientated towards performance, knowledge-acquisition, social, or eudaimonic goals. Functional accounts of emotion suggest that positive emotions serve an approach function while negative emotions facilitate the avoidance of threat (Mauss, Tamir, Anderson, & Savino, 2011; Tamir et al., 2007). Accordingly, both positive and negative emotions may have benefit depending on one's regulatory goals. For instance, a combination of positive and negative emotions may assist with pursuit of long-term goals and serve instrumental functions. In contrast, the upregulation of positive emotions and downregulation of negative emotion is more consistent with pro-hedonic goals. SST (Carstensen, 1993) suggests that the socioemotional motives of younger and older adults relates to a pro-hedonic orientation among older adults and possibly a more instrumental regulatory focus among younger adults given their motivation towards knowledge and resource acquisition.

The interplay between age-related regulatory resources and situations may also impact the emergence of age differences in the use and efficacy of specific ER strategies. The SOC-ER model (Urry & Gross, 2010) suggests that the emergence of age differences in ER is contingent upon levels of regulatory resources subject to the influence of age. Consistent with this perspective, the systematic review included within this dissertation suggested that certain regulatory resources may be necessary for age related preferences in ER strategies to emerge. In particular, older adults were predisposed towards greater use of situation selection but only at high levels of perceived control and ER self-efficacy beliefs (Rovenpor et al., 2013). Extending this, we speculate that other resources such as social support, cognitive control, and affective forecasting might also be important moderators in shaping the interplay of

person and situation factors for younger and older adults. As a regulatory resource, age differences in cognitive control may have more or less of an impact on strategy use and efficacy depending the specific type of regulation strategy use and features of the emotion eliciting regulatory efforts. For instance, it is established that higher levels of cognitive control are apparent among younger versus older adults and that cognitive control supports use of cognitive change strategies such as reappraisal. As such, one would expect that cognitive change strategies are employed to a greater extent among younger adults, however, this may once again be highly dependent on other contextual factors. For instance, it may be that under situations of low arousal and cognitive load, that lower levels of cognitive control are still sufficient for use of cognitive reappraisal among older adults so age differences in use of this strategy are not apparent. However, at higher levels of emotional salience, arousal, and cognitive load, greater levels of cognitive control may be needed to combat the strains of situational demands and ensure the success of regulatory efforts. As such compromised cognitive control in this circumstance may render use of cognitive change less effective for older adults given age related changes in this resource and age differences may emerge. On the other hand, other strategies within the cognitive change family that are potentially less resource-intensive, such as acceptance may, under the same circumstances, represent an adaptive response for those with limited cognitive capacity.

The pathways through which the person and situation factors outlined in Table 5.1 might combine to influence ER strategy use and efficacy are illustrated in *Figure 5.1*. Characteristics of the person (e.g., their age) will influence the situational contexts in which emotions are experienced, and where resources that may facilitate (e.g., supportive network members) or inhibit (e.g., unsupportive network members) ER use are available to different degrees. The extent to which the combination of person and situation factors then leads to

selection of a given strategy may be further moderated by additional person factors (e.g., regulatory goals, individual differences in the ability to apply strategies flexibly) and aspects of the situation (e.g., the degree to which it elicits high or low arousal emotions). Finally, the extent to which a strategy is effective may also vary as a function of person factors such as regulatory goals. The model presented here highlights the complex interplay of multiple factors that impact on ER strategy use. Future research concerned with developmental differences in ER may need to explicitly recognise this complexity in order to maximise opportunities to move the field forward.

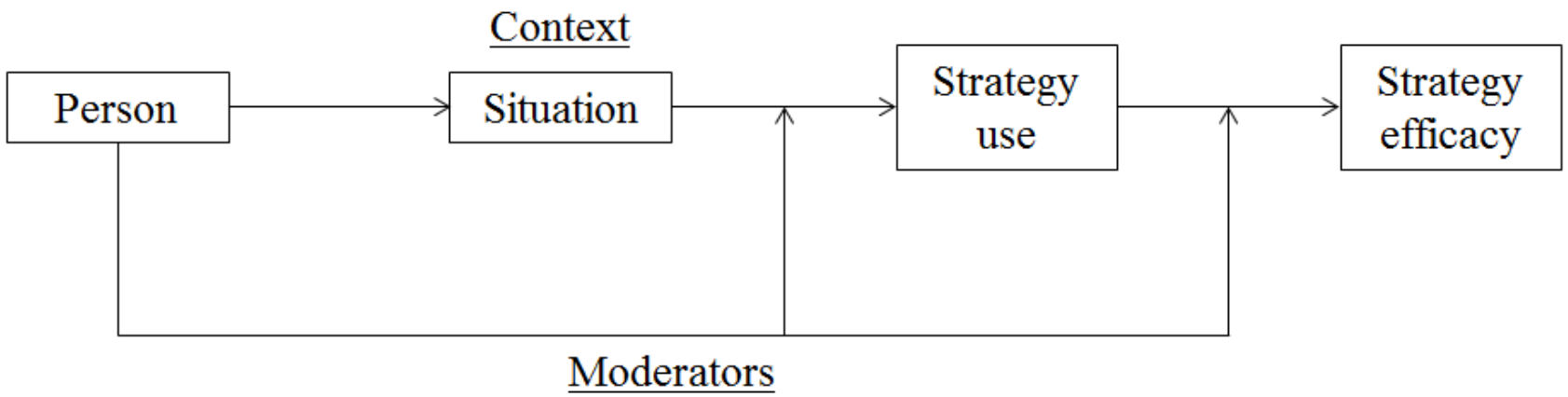


Figure 5.1. Model showing how person and situation factors interact to determine ER strategy use, and in turn efficacy. Moderating variables influence strategy selection, and impact on whether or not strategy use is effective in serving regulatory goals.

5.3 Clinical Implications

The development and implementation of interventions to facilitate ageing well requires an understanding of mechanisms which support emotional health and account for the ecological context in which individuals are embedded (Ong & Bergeman, 2004). Clinically, the results of this thesis suggest that under particular circumstances (e.g., the presence or absence of stress), cognitive reappraisal, problem-solving, and expressive suppression may relate to lower levels of negative affect among older, but not necessarily younger, adults. As such, results point to the potential benefit of these regulation strategies among older adults. A number of established psychological therapies incorporate aspects of these regulatory strategies. For instance, acceptance is an important component of mindfulness-based therapies, dialectical behavioural therapy, and acceptance and commitment therapy. Additionally, cognitive reappraisal is consistent with the concept of cognitive restructuring which is a key component of cognitive behavioural therapy, while problem-solving is an important aspect of many skills-based therapies. As researchers suggest that therapeutic interventions are most beneficial when they align with the strengths of individuals (Padesky & Mooney, 2012), these therapeutic modalities may build on the regulatory strengths of older adults and optimise therapeutic outcomes. Consideration of age-specific strengths in the selection of therapeutic modalities aimed at modulating emotional experience is also consistent with suggestion of the SOC-ER model (Urry & Gross, 2010) that ER is most effective when persons employ strategies which align with the resources at their disposal. This information may be useful in guiding the selection of therapeutic interventions for clinicians working with older adults.

Of note, greater habitual use of acceptance, cognitive reappraisal, problem-solving, and expressive suppression related to lower levels of negative emotion among older adults both on days of stress and in the absence of daily stress. As such, among older adults these regulation strategies may not only assist with managing stress but also facilitate flourishing in day-to-day life.

In discussing effective ER among older adults, two specific regulation strategies merit further consideration. Firstly, problem-solving is of particular note as both use *and* efficacy of this strategy was greater among older adults. Problem-solving is a proactive and solution-orientated form of situation modification which involves individuals deconstructing problems or challenges that they are faced with, generating achievable solutions, then actively selecting and implementing preferred solutions (Mynors-Wallis, Gath, Day, & Baker, 2000). By definition, all forms of situation modification involve the use of direct effort to change circumstances and modify emotional outcomes, however, problem-solving may be uniquely beneficial given that a focus on solving immediate problems establishes clear, highly specified, and concrete pathways to resolve emotionally evocative situations. The increasing priority of emotion regulatory goals with age (Carstensen et al., 2003) may therefore predispose older adults towards this highly effective regulation strategy.

Consistent with the results of the current thesis, previous research suggests that with age, the capacity to successfully use problem-solving skills to regulate emotion in specific life domains (e.g., interpersonal functioning) is enhanced (Artistico, Orom, Cervone, Krauss, & Houston, 2010; Blanchard-Fields, 2007; Blanchard-Fields, Chen, & Norris, 1997). Additionally, as a structured therapeutic approach, problem solving therapy (i.e. teaching individuals skills to overcome problems which contribute to either the development or maintenance of psychopathology; Areán, 2009) appears more effective than other therapies (e.g., reminiscence therapy) commonly used by clinicians working with older adults with depression (Areán et al., 2010). Indeed, problem-solving therapies have been proposed to allow older adults to draw on their skills and abilities to solve age-related challenges (e.g., negative emotions and social isolation as a result of age-related driving cessation; Windsor & Anstey, 2006) Moreover, problem-solving treatment appears to be of benefit even amongst older adults with comorbid mental health and cognitive challenges (e.g., depression and executive dysfunction; Areán et al., 2010), which can be a complex presentation for clinicians

to navigate. Together the results of present thesis, in the broader context of extant literature, provide quite robust evidence of positive outcomes resulting from problem-solving use among older adults. As such, promoting the use of problem-solving among older adults may be a particularly effective means of supporting emotional wellbeing into older adulthood.

Secondly, the only regulation strategy which showed a consistent stress buffering effect and was associated with positive emotional outcomes (i.e., lower levels of NA) across both age groups was acceptance, although the benefit of acceptance was more pronounced among older adults. Acceptance and commitment therapists propose that acceptance is an immensely useful regulatory approach as it involves a shift away from efforts intended to improve emotional experience through changing situations, thoughts, or behaviours, towards adopting a mind-set of actively experiencing emotions, thoughts, and memories as they are (Berking & Schwarz, 2014; Blackledge & Hayes, 2001). Acceptance is believed to reduce emotional distress, expand adaptive behavioural repertories, and when used therapeutically promote positive outcomes (Williams & Lynn, 2010). Moreover, there is evidence that acceptance-based therapies are even effective when working with some of the most complex and challenging clinical populations (e.g., persons with borderline personality disorder and deliberate self-harm; Gratz & Gunderson, 2006).

Extant literature and results of the current thesis speak to the broad benefits of acceptance, however, the utility of acceptance appears even more pronounced among older adults. Lifespan scholars suggest that effective self-regulation across the adult lifespan involves a flexible balance between methods of coping which facilitate achievement of goals (assimilative coping) and the capacity to accept the reality of one's circumstances and disengage with unachievable goals (accommodative coping). In light of this information, acceptance is touted as an adaptive means of responding to insurmountable challenges within the coping literature (Carver & Connor-Smith, 2010) and is suggested to be highly relevant to the lives of older adults. Motivated by this

reasoning, in recent years scholars have examined use of acceptance-based therapeutic approaches among older adults. One such approach is mindfulness which involves the non-judgemental acceptance of thoughts, feelings, and sensations in the present moment. Research suggests that mindfulness, is related to lower levels of chronic pain (Morone, Greco, & Weiner, 2008), enhanced attention (Morone et al., 2008), improved sleep quality and reduction in daytime impairment related to poor sleep (Black, O'Reilly, Olmstead, Breen, & Irwin, 2015), and cognitive function (Moynihan et al., 2013) among older adults. As such, the results of this thesis add to the body of evidence highlighting the emotional benefits of acceptance, particularly among older adults, and reinforce the value of therapeutic approaches which strengthen the skill of acceptance.

We have speculated that acceptance may be an important regulation strategy among older adults given reasoning that acceptance may promote regulation in the context of largely unalterable, emotionally-charged situations associated with age-related loss. Whilst not included within the present thesis, researchers have identified other regulation strategies that may function similarly. In particular, Nowlan, Wuthrich, and Rapee (2015b) note that positive reappraisal may enable adaption to irreparable challenges that accompany old age. Consistent with this notion, positive reappraisal has been shown to aid with coping in response to chronic illness in older adults (Nowlan, Wuthrich, & Rapee, 2015a), may assist older adults with finding meaning in negative experiences (Nowlan et al., 2015b), and can be taught to older adults and part of a single-session intervention to facilitate coping and levels of positive emotion (Nowlan, Wuthrich, Rapee, Kinsella, & Barker, 2016). Like acceptance, positive reappraisal, may represent an important method of accommodative coping among older adults. Therefore it may be valuable for lifespan researchers to turn their attention to a more extensive examination of regulation strategies which promote accommodative coping, such as acceptance and positive reappraisal, in the future.

Another important finding which emerged from the systematic review undertaken in preparation of this thesis was that age differences in a number of ER strategies were dependant on the presence of moderator variables. In particular, general and regulatory self-efficacy beliefs emerged as an important resource supporting use of situation selection among older adults. This aligns with the perspective of the SOC-ER model (Urry & Gross, 2010) which suggests that use of ER strategies reflects the capacity to draw on important regulatory resources. Accordingly, interventions designed to support use of ER strategies believed to be particularly beneficial to certain age groups, could consider targeting the development of regulatory resources. Such an approach would involve examining which ER strategies align with the socioemotional goals of younger and older adults, then identifying the cognitive, social, and physical resources which support effective use of these strategies. This information would highlight where gaps exist between ER preferences and skills/resources necessary to implement the strategy effectively. Interventions could then be designed and implemented which bridge these gaps. For example, situation selection is believed to align with the socioemotional goals of older adults and use of situation selection among older adults appears contingent on high levels of perceived control and regulatory self-efficacy beliefs. Therefore, it follows that interventions which build perceived control and regulatory self-efficacy beliefs (e.g., Lee, Cohen, Edgar, Laizner, & Gagnon, 2006; Salbach et al., 2005) among older adults may assist with optimising use of situation selection. Similarly, research has shown that self-compassion enhances the efficacy of cognitive reappraisal following mood induction among depressed individuals (Diedrich, Hofmann, Cuijpers, & Berking, 2016). As such, self-compassion may be a valuable resource supporting effective use of cognitive reappraisal and could be the target of future interventions designed to support ER. Our discussion of self-efficacy beliefs and self-compassion provides two examples of how knowledge of resources which support ER strategy use could be used to inform development of interventions to facilitate effective ER.

5.4 Methodological Contribution and Future Directions

Questions regarding the course of human development lie at the heart of lifespan psychology. The temporal dynamics inherent in developmental processes are complex and require sophisticated methodological approaches such as daily process designs (e.g., daily diary studies, ecological momentary assessment protocols). A significant strength of this thesis was the use of a daily diary design which provided WP and BP data for variables of interest. This allowed the coupling of key variables to be examined at more stable (i.e., habitual) and dynamic (i.e., day-to-day) levels, as well as the temporal features and cross-level interactions of variables to be explored. While this provides novel insights which we have discussed above, daily diary designs remain limited in the sense that the use of end-of-day diary assessments does not account for or control the occurrence of intervening events. Such exposures may dilute the links between use of regulation efforts earlier in the day and ratings of end-of-day affect. Moreover, although likely to impact most self-report designs, end-of-day diary assessments may be subject to memory and other cognitive distortions (e.g., affective valence effect, the mood congruent memory effect, and duration neglect) due to the retroactive recall of events (Ebner-Priemer & Trull, 2009). Accordingly, we recommend that use of ecological momentary assessment (EMA) protocols is the next step logical step in advancing naturalistic studies of ageing and ER. Use of EMA protocols would reduce the potential for the results of studies to be compromised by memory biases and would provide an opportunity to examine current affect and recent regulatory efforts closer to how these processes unfold in real-time. As such, EMA protocols represent a more accurate and temporally sound tool for assessing development change in affective and regulatory processes.

The present thesis provides an important albeit preliminary step in establishing profiles of ER across the adult lifespan. However, the sample of older adults who participated in our research was relatively young, physically healthy, and presumably high functioning. As such, our results cannot be generalised to or considered representative of the experiences of the "oldest old". The

"oldest old" or the "fourth age" refers to the "most elderly of the older generation" (Gwozdz & Sousa-Poza, 2010, p. 397), generally persons aged 85 and over (Isaacowitz & Smith, 2003). The "fourth age" is a period of adulthood is characterised by declines in functional capacity, onset of disease and disability, the experience of frailty, and psychological alterations in terms of loss of sense of self, autonomy, and sense of control (Baltes & Smith, 2003) . It is also noted that social policies, science, and interventions for this population are limited and that processes of optimisation (e.g., use personal skills and resources to facilitate adaptation and regulation) become increasing difficulty (Palmore & Cleveland, 1976). As noted by Baltes and Smith (2003), this contrasts more positive perceptions of the "young old". Changes in profiles of health and wellbeing between the "young old" and "oldest old" are often discussed in the context of terminal decline. Terminal decline theory proposes proximity to death among the "oldest old" relates to a robust decline in functioning in the period preceding death (Palmore & Cleveland, 1976). Terminal decline typically occurs three to five years prior to death and involves the regulatory and motivational mechanisms which preserve wellbeing among the "young old" becoming overwhelmed by the mortality-related changes which characterise the "oldest old" (e.g., deteriorating health or mortality related changes preceeding death; Gerstorf et al., 2010). Areas of functioning which may be affected by terminal decline include health, cognition/intelligence, and activity engagement (Hassing et al., 2002; Johansson & Berg, 1989; Wilson, Beck, Bienias, & Bennett, 2007; Wilson et al., 2012). There is also evidence of terminal decline in life-satisfaction and emotional wellbeing as older adults approach death (Gerstorf et al., 2008). As such, the "oldest old" are presented with a number of unique challenges which are likely to affect their emotional experiences. Moreover given accelerated age-related loss across multiple domains of functioning (including resources likely to support ER), the regulatory capacity of the "oldest old" may be significantly compromised. To support the emotional wellbeing of an age group likely to experience substantial loss and stress,

understanding trajectories of ER among the "oldest old" will be an important avenue for future research to explore.

Lastly, perhaps one of our most intriguing findings was that younger adults appeared to employ greater levels of a more diverse selection of regulation strategies in daily life, while older adults seemed to be more specialised regulators drawing on greater levels of problem-solving. According to Aldao et al. (2015), over recent years ER research has become progressively more focused on the extent to which effective implementation of ER strategies relates to person and situational factors. Indeed, person-situation interactionist models highlight the importance of a dynamic interplay between persons and situation to inform regulation. This perspective suggests that the benefits of regulation will vary across persons and situations, with the most adaptive regulatory approach likely to be most flexible (Bonanno & Burton, 2013). ER flexibility has been operationalised in a number of different ways, however, perhaps the most influential and pervasive conceptualisation reflects the extent to which variation in use of ER strategies (i.e., ER variability or use of a variety of different ER strategies within a given time period) corresponds to fluctuating environmental demands (Aldao et al., 2015). Moreover, the qualification is made that ER flexibility is only adaptive to the extent that use of different ER strategies in various situations is consistent with motivation and facilitates achievement of meaningful goals rather than posing an obstacle to goals (Aldao et al., 2015). Indeed flexible use of presumably adaptive regulation strategies like reappraisal and acceptance appear to be related to fewer mental health symptoms (Aldao & Nolen-Hoeksema, 2012a), however, the benefits of flexible use of adaptive regulation strategies only emerged for participants with a broad repertoire of regulation strategies including supposedly adaptive *and* maladaptive strategies (Aldao & Nolen-Hoeksema, 2012b). This has been interpreted to mean that selecting among a broad range putatively "adaptive" and "maladaptive" regulation strategies is likely the key to being able to flexibly respond to contextual demands reflecting different emotional, cognitive, and motivational factors.

Thesis results outlined in **Chapter 3** are consistent with greater ER variability among younger versus older adults. However, as the extent to which use of different strategies related to contextual variation was not examined, we can only speculate that this may indicate greater ER flexibility among younger adults. However, a very recent publication, that has just become available, examined ER flexibility using a methodological approach similar to that of the present thesis and observed that older adults use of ER strategies in daily life was less variable than that of younger adults, which was taken as a possible indication of lower levels of regulatory flexibility with increasing age (Eldesouky & English, 2018). Consequently, an important next step for researchers examining ageing and ER will be to rigorously examine age differences in ER flexibility and begin to delineate if and under what circumstances ER flexibility is beneficial for younger and older adults.

5.5 Conclusion

Socioemotional theories of lifespan development (Carstensen, 1993) suggest that enhanced ER may be one mechanism which supports emotional wellbeing into old age. However, in reviewing existing empirical literature (**Chapter 2**) and conducting our own study of age differences in ER strategy use (**Chapter 3**) and efficacy (**Chapter 4**) in the daily lives of younger and older adults, it appears that the reality of age differences in ER is not so straightforward. In particular, results of this thesis highlight the importance of context and moderator variables (e.g., ER self-efficacy beliefs) in shaping age differences in ER strategy use. For our micro-longitudinal study we focused on daily use and efficacy of situational avoidance, problem-solving, humour, distraction, cognitive reappraisal, acceptance and expressive suppression. Results revealed that older adults employed greater levels of problem-solving, while younger adults utilised greater levels of situational avoidance, humour, acceptance, and expressive suppression, and use of distraction and cognitive reappraisal was comparable across age groups. These finding add to the growing literature on ER flexibility (Bonanno & Burton, 2013), pointing to the possibility of more

flexible or diversified use of regulation strategies among younger adults, which is consistent with the recent findings of Eldesouky and English (2018). In terms of ER efficacy, again consistent between- and within- person age differences were largely not apparent. The exception appears to be acceptance, which may offer particularly benefits for older adults. The findings also provided preliminary evidence for positive affective outcomes being associated with habitual use of ER strategies such as acceptance, problem-solving, and cognitive reappraisal among older adults. As such, use of therapeutic modalities such as mindfulness- and acceptance- based therapies among older adults may align with age-related changes in ER. Given our findings, we have argued that to understand contingencies for the emergence of age differences in ER strategy use and success, a highly contextualised, interactionist approach is necessary, which recognises the interplay of person-, situation-, and strategy- specific factors. We believe that this thesis represents a significant contribution to the field of ageing and ER, provides important insights regarding clinical implications of developmental change in ER, and outlines a number of important avenues that merit further investigation by researchers in the future. We hope that this thesis stimulates interest in an important and fascinating field of research which is highly relevant given recent global trends of population ageing.

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Appendix A

Allen, V. C., & Windsor, T. D. (2017). Age differences in the use of emotion regulation strategies derived from the process model of emotion regulation: a systematic review. *Aging & Mental Health*, 1-14. doi:10.1080/13607863.2017.1396575

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Appendix B

Guide to Interpreting Main Effects and Interactions of Between- Persons (BP) and Within-Persons (WP) Emotion Regulation (ER) and Stress on Negative Affect (NA) in Chapters 3 & 4 of Thesis

Interpretation of Main Effects

1. BP ER: the main effect of BP ER on NA highlights the extent to which an individual's average or general usage of a particular ER strategy relates to their experience of NA. For example, greater usage of a particular ER strategy may be associated with lower levels of NA.
2. WP ER: the main effect of WP ER on NA highlights the extent to which a person's intra-individual variability in ER strategy use (i.e., fluctuations in ER strategy use from one day to another over our study period of 20 days for the same individual) relates to their experience of NA. For example, compared to days on which an individual's use of ER strategies are low, on days on which ER strategy use is higher, an individual's levels of NA may be lower.
3. BP Stress: the main effect of BP Stress on NA highlights the extent to which an individual's average or general stress exposure relates to relates to their experience of NA. For example, people who are on average exposed to greater levels of stress may experience higher levels of NA than people who on average have lower rates of stress exposure.
4. WP Stress: the main effect of WP stress on NA highlights the extent to which a person's intra-individual variability in daily stress (i.e., fluctuations in the presence of absence of daily stressors from one day to another over our study period of 20 days) relates to the extent to which they experience NA. For example, people may experience greater levels of NA on days where a stressor is present versus absent.

Interpretation of Interactions

5. BP ER × BP Stress: the interaction of BP ER with BP stress in predicting NA highlights how average ER strategy use relates to levels of NA in the context of average stress exposure. For example, this interaction could highlight whether people who generally use

greater levels of ER strategies are more protected again increases in NA at high versus low levels of average stress exposure compared to people with lower average levels of ER strategy use.

6. BP ER × WP Stress: the interaction of BP ER with WP stress highlights how greater average ER strategy use relates to levels of NA on days of stress versus days on which stressors are absent. For example, in comparison to people whose usage of ER strategies is generally low, people who on average use greater levels of ER strategies might experience lower levels of stress-related NA at the daily level.
7. WP ER × BP Stress: the interaction of WP ER with BP stress highlights how intra-individual variability in ER strategy use (i.e., fluctuations in ER strategy use from one day to another over our study period of 20 days for the same individual) relates to the experience of NA in the context of average levels of stress exposure. For example, at higher versus lower levels of average stress exposure NA may be lower for individuals who at a daily level are using greater levels of ER than they are compared to other days across the study period.
8. WP ER × WP Stress: the interaction of WP ER with WP stress highlights how intra-individual variability in ER strategy use (i.e., fluctuations in ER strategy use from one day to another over our study period of 20 days for the same individual) relates to the experience of NA on days of stress exposure compared to days on which the presence of a stressor is absent. For example, in the presence (versus absence) of stress, NA affect may be lower for individuals whose use of ER strategies is greater on that day relative to other days over the study period.

Interpretation of Above Interactions with Addition of the Age Variable

The addition of age as a further variable to the main effects and interactions above highlights whether the described relationships (1 through 8) vary between younger and older adults.