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Emotion Processing in Older Adults

by

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Thesis Abstract

This thesis considers the suggestion that older adult mental health problems are lower than that of younger adults, and positive affect remains constant, whereas negative affect declines with age (Jorm, 2000; Christensen et al., 1999; Lennings, 2000). Emotion processing includes: identifying emotional stimuli, their significance, and producing affective states in response (i.e. emotion activation); and regulating affective states (i.e. emotion regulation) (Phillips, Drevets, Rauch, & Lane, 2003). Age-related changes in emotion activation and regulation are explored as explanatory factors for changes in older adult mental health and affect. Various paradigms have been used within older age emotion processing research. Evidence for the presence of age-related, emotion activation declines and for improved strategic, regulatory factors in older age is mixed. Further research is required, particularly using attention paradigms, which could facilitate differentiation between emotion activation and emotion regulation age differences.

The empirical study examined age-related changes in ability to discriminate ambiguous emotional faces, using morphed facial expressions and a signal detection paradigm. It was predicted that older adults would show reduced discrimination of, and greater response bias against, negative emotional expressions, relative to positive emotional expressions. No age differences in discrimination ability were found but older adults were significantly biased towards reporting less anger (relative to happiness). Neither older adult neurological decline nor strategic emotion regulation accounts of age-related emotion processing differences are supported by these findings.

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The Influence of Emotion Processing on Mental Health Problems in Older Adults.

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The Influence of Emotion Processing on Mental Health Problems in Older Adults.

Abstract

This review considers the reported trend for a decline in mental health problems in older age (Jorm, 2000). The methodological problems associated with current research into older adult mood and mental health are discussed. Taking these factors into account, research findings suggest that positive affect remains constant whereas negative affect declines with age, and is experienced with less frequency, intensity and complexity by older adults (Jorm, 2000; Christensen et al., 1999; Lennings, 2000; Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Karel, 1997). Explanations for age-related reductions in negative affect and mental health problems are explored in terms of the changes in emotion processing that occur with age, specifically, changes in emotion activation and emotion regulation. The findings associated with the different paradigms used in older adult emotion processing research are reviewed. The implications of emotion processing differences in later life on older adult affect and mental health prevalence are discussed.

The influence of emotion processing on mental health problems in older adults.

1. Introduction.

Research into older adult mental health has presented mixed prevalence rates. Declines in physical and cognitive ability with age have been associated with increased emotional and mental health problems (Bee, 1996). Specifically, biological vulnerability to depression may either decrease with age (through reduced emotional reactivity and self-blame, and increased coping mechanisms and feelings of control) or even increase with age (through increased medical and neurological disorders and the side effects of medication) (Karel, 1997). Jorm (2000) reviewed studies of anxiety, depression and general distress across the lifespan (ages 30 to 65+ years) and found no consistent pattern of mental health problem prevalence. However, a trend for an initial rise in mental health problems and then a decline towards older age was noted (Jorm, 2000).

Evidence exists for decreases in anxiety and depression (Christensen et al., 1999), decreases in trait negative and increases in trait positive affect and optimism (Lennings, 2000) and more enduring positive emotions with less stable and less frequent negative emotions among older adults (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Karel (1997) suggests that older adults report less stressful life events and transitions, which reduces their vulnerability to depression (except for very old people who are more likely to suffer chronic illness and disability). Thus, in general, older adults experience negative emotions with less frequency, intensity, complexity and consistency than younger adults.

Age differences in mental health prevalence rates may arise due to age bias in assessing anxiety and depression and the masking effect of risk factors, which vary with age (i.e. marital, socio-economic, employment and financial status, education, life events and social support) (Jorm, 2000). Additionally, the majority of research has been cross-sectional (Jorm, 2000), producing data from only one older adult cohort. Despite taking these factors into account, a review of the findings indicates that positive affect remains constant, whereas negative affect declines with age, and these factors reduce the prevalence of older adult mental health problems.

Changes in emotion processing with age may explain age-related reduction in the risk of mental health problems and negative affect. Emotion processing refers to cognitive operations that deal with emotional stimuli including the recognition and interpretation of, attention to, and memory for emotional stimuli. Age-related changes are considered in terms of: i) emotion activation, i.e. the processes involved in the automatic identification of the emotional significance of a stimulus, and the subsequent production of an emotional state; ii) emotion regulation, i.e. the strategies used to regulate and cope with emotions.

Research into emotion processing differences across the lifespan will be explored according to the different paradigms. Much emotion processing research does not facilitate differentiation between emotion activation and emotion regulation processes. Therefore, support for each of these functions, and how this may impact on reduced negative affect with age, will be discussed following a review of the findings within each paradigm.

2. Methodological problems in older adult mental health research.

Three methodological difficulties appear to give rise to different findings in ageing. These are: i) age biases in the assessment of mental health problems; ii) the masking effect of risk factors which vary with age; and, iii) the impact of cohort factors.

2.1. Age biases in assessment.

Different measurements of depression produce different patterns and severity of symptoms, suggesting that depression assessments are age biased (Newmann, Klein, Jensen, & Essex, 1996). The Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) underestimates depression in older adults (Lyness et al., 1995), The Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988) has high internal consistency with community-dwelling older adults (Morin et al., 1999) but is constrained by the number of physiological symptoms of anxiety, making it less reliable with unhealthy, older adults (Gretarsdottir, Woodruff-Borden, Meeks, & Depp, 2004). The Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel, Dancu, & Stanley, 1989) was shown to be difficult for many older adults to complete due to its length and complexity (Gretarsdottir et al., 2004).

Standardised assessments of anxiety and depression generally rely upon the presence of symptoms *usually* associated with the disorder, but these symptoms may vary with age. Symptoms associated with anxiety or depression show increases and decreases with age (Henderson et al., 1998). For example, self-report depression scales indicate an increased prevalence of depression among older adults due to increased reporting

of somatic items, independently of mood (Bolla-Wilson & Bleecker, 1989)[1]. Additionally, social anxiety occurs less and is associated with different symptoms in older age (Gretarsdottir et al., 2004). Reporting bias is also important, since older adults express distress differently (i.e. describing somatic rather than emotional symptoms) (Karel, 1997). Older adults also report more physical (e.g. sleep problems, fatigue) and psychological (e.g. thinking about death) symptoms of depression, and less physical (e.g. pain, tension) symptoms of anxiety (Christensen et al., 1999).

Age-related factors, such as medications affecting cognition (i.e. painkillers, anti-hypertensives and anti-convulsants), illness (e.g. depressive symptoms presenting in early dementia) and physical problems or disorders (Alexopoulos et al., 2002; Charney et al., 2003) can confuse the assessment of mood by interfering with symptom ascertainment.

The research criteria used for confirming the presence of mental health problems in the studies reviewed by Jorm (2000) included diagnosed mental health problems, the presence of symptoms meeting diagnostic criteria (applied by the researchers), high scores on various standardised assessments of anxiety or depression symptoms, and self-reported symptoms associated with anxiety or depression. This variability, could account for the different prevalence rates reported.

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[1] Although the Geriatric Depression Scale (GDS) (Yesavage et al., 1983) was developed specifically for use with older adults, and has adequate test-retest reliability (Lesher, 1986), strong internal consistency (Rapp, Parisi, & Walsh, 1988), is easy to administer, and does not contain somatic items (Gretarsdottir et al., 2004), there are no younger adult norms. This makes it unsuitable in a study of depression over adulthood.

In summary, mental health problems manifest differently throughout adulthood. Thus, broad assessments that rely on physical symptoms and neglect reporting biases and factors that interfere with symptoms, may not be sensitive to this.

2.2. Age-related risk factors.

The differential distribution of risk factors with age could elevate the assessed presence of depression among older adults. Symptoms of depression increase with age, but decrease when risk factors (i.e. marital status, education, income, employment status and gender ratio) are controlled (Blazer, Burchett, Service, & George, 1991). When Jorm (2000) controlled for age and risk factors, he found decreases in anxiety, depression and general distress with age (not explained by the exclusion of older adults in institutional care). Similarly, Henderson et al. (1998) observed declines in depression and anxiety rates when accounting for risk factors such as poorer financial situation.

2.3. Cohort factors.

The rate of depression has risen for each young adult cohort over past decades, which makes young adults look comparatively worse off than older adults in cross-sectional comparisons (Bee, 1996). Also, the experiences of today's older adults are unique; they lived through at least one World War, which is likely to have impacted on their coping with adversity and distress (Davies, 2001). However, these arguments do not account for the incidence of many other types of emotional disturbance or serious mental illness being lower among those over 65 (Bee, 1996).

There are few longitudinal studies into mental health prevalence in older age. In one 23 year study, Charles, Reynolds, and Gatz (2001) assessed positive and negative affect in adulthood. They found decreases in negative affect with age and stability in positive affect over young and middle ages, with a small decrease in the oldest group (Charles, Reynolds, & Gatz, 2001). These results suggest that cross-sectional results may, nevertheless, be valid (Jorm, 2000).

3. Age-related changes in emotion processing.

Age-related changes in emotion processing may explain how or why negative affect is reduced with age. These changes involve both biological (neurological, autonomic and somatic nervous systems) and psychological factors (experiential, learning and regulatory issues) (Lawton, 2001). Neurological decline may reduce emotion activation and/or regulation abilities, whereas increased emotional experience may improve emotion regulation ability. These are considered in turn.

3.1. Neurological changes with age.

Changes in the ageing brain may underlie changes in emotion processing. Despite an overall reduction in brain volume with age (Raz, 2000; Resnick et al., 2003) specific regions and functions are affected to a greater or lesser extent (Hedden & Gabrieli, 2004; Park et al., 2002; Prull, Gabrieli, & Bunge, 2000). Frontal regions of the brain are thought to be particularly vulnerable, notably the prefrontal cortex (PFC) (Greenwood, 2000; West, 1996) as evidenced by greater neural volume declines in these areas (Hedden & Gabrieli, 2004; Raz, 2000; Tisserand & Jolles, 2003). In addition to frontal changes with age, there are changes in grey and white matter,

density of synapses and in cerebral blood flow (Raz, 2000; Resnick et al., 2003). White matter damage has been associated with slower information-processing speeds (De Carli et al., 1995; De Groot et al., 2000). Additionally, age related declines have been found in the region of the brain associated with the production of dopamine (the striatum) (Gunning-Dixon, Head, McQuain, Acker, & Raz, 1998; Raz, 2000) and in frontal cortex dopamine receptors (Volkow et al., 1998). Early, rapid declines with age have also been reported in the anterior dorsal frontal lobe and the medial temporal lobe, largely due to neuronal loss (Lezak, Howieson, & Loring, 2004).

PFC volume reductions and neurotransmitter changes appear to be jointly associated with declines in cognitive performance. Cognitive functions, that involve the frontal lobes (e.g. working, episodic and prospective memory) show greater deterioration (Hedden & Gabrieli, 2004; Hasher, Zacks & May, 1999; Prull et al., 2000; Raz 2000; West 1996) than automatic or autobiographical memory, theory of mind abilities, vocabulary or semantics (Hedden & Gabrieli, 2004). In particular, executive functions, which involve inhibition, strategic control of memory performance, self-regulation and planning appear to be most affected (Bunge, Ochsner, Desmond, Glover, & Gabrieli, 2001; Kane & Engle, 2002; Rypma, Berger, & D'Esposito, 2002; Wagner, Maril, Bjork, & Schacter, 2001).

Dolcos, Rice, and Cabeza (2002) reviewed research into neurological decline with age and suggested a hemispheric asymmetry reduction in older adults (HAROLD) model, proposing that frontal activity during cognitive performance tends to be less lateralised in older than younger adults (i.e. there is a generalised asymmetry). Low-functioning older adults recruit similar right prefrontal cortex regions as young adults,

whereas high-functioning older adults engage prefrontal cortex regions bilaterally, showing a reduction in hemispheric asymmetry (Cabeza, Anderson, Locantore, & Mcintosh, 2002). Low-functioning older adults may employ similar neural pathways as younger adults but less effectively, whereas high-functioning older adults counteract age-related neural decline by reorganising their neurocognitive networks (Cabeza et al., 2002). Bilateral brain activation in older age, compared with unilateral, younger adult brain activation, could underlie older adult emotion processing differences. However, before considering how emotion activation and regulation processes may change with age, evidence for the neuroscience of emotion processing in normal adulthood will be reviewed.

3.2. Emotion processing neurology in adulthood.

The right brain hemisphere is largely responsible for emotion processing. Right hemisphere patients show severe impairments in ability to judge emotional faces and hand gestures and in producing or describing emotional faces (Blonder, Bowers, & Heilman, 1991; Bowers, Blonder, Feinberg, & Heilman, 1991). Right hemisphere lesion patients were more impaired than left hemisphere patients when matching emotional scenes with other scenes, texts or sounds (Cicone, Wapner, & Gardner, 1980) and when matching pictures of emotional faces (Kolb & Taylor, 1988). However, left frontal and left temporal lobe lesion patients also did badly in matching emotional faces (Kolb & Taylor, 1988) indicating the involvement of multiple regions in emotion processing. Using neuroimaging, Davidson (2004) has shown that emotion processing is governed by circuits including (but not exclusively): the dorsolateral prefrontal, ventromedial prefrontal, and orbitofrontal cortex, amygdala, hippocampus, anterior cingulate cortex and the insular cortex. Furthermore, these

studies suggest that although the right hemisphere is dominant for processing emotions, the left hemisphere also plays a role (e.g. in labelling the emotion and in decoding positive emotions).

Decoding negative facial expressions relies mainly on the right brain whereas decoding positive facial expressions relies on both left and right hemispheres (Adolphs, Jansari, & Tranel, 2001). Responses to sad facial expressions produce left amygdala and right temporal lobe activity, whereas responses to angry facial expressions produce orbitofrontal and anterior cingulate cortex activity (Blair, Morris, Frith, Perrett, & Dolan, 1999). Calder, Lawrence, and Young (2001) suggest that individual emotions are represented and processed separately; in particular fear and disgust are processed by distinct neural substrates. These separate processing systems may undergo differential decline with age, which could influence older adults' processing of negative versus positive emotional stimuli.

The involvement of the frontal and medial temporal lobes in emotion processing is also described. Patients with frontal and medial temporal lobe lesions have reduced vocal and facial emotion recognition and difficulty understanding others' feelings or thoughts (Davidson & Irwin, 1999). Interestingly, these brain areas also show the earliest and most rapid decline with age (Petit-Taboue, Langdeau, Desson, Desgranges, & Baron, 1998).

3.3. Age-related changes in emotion activation and emotion regulation.

Phillips, Drevets, Rauch, and Lane (2003) identify the processes underlying emotion processing as the identification of an emotional stimulus and its significance, and the

production of an affective state in response (i.e. emotion activation); and the regulation of that affective state (i.e. emotion regulation). Possible mechanisms underlying age-related emotion processing changes will be considered: i) emotion activation and regulation, neurological age-related changes and ii) changes in emotion regulation processes that occur with age.

3.3.1. Emotion activation and regulation, neurological age-related changes. Differences in older adults' processing of positive versus negative emotional information may be due to differential deterioration within emotion processing networks. Older adults have difficulty recognising negative facial emotion, possibly due to age-related right hemisphere decline, with the left hemisphere supporting maintained processing of positive emotion as suggested in the right hemi-ageing hypothesis (McDowell, Harrison, & Demaree, 1994). However, the older participants in this study may have regulated their responses, in an unintentional manner.

Research indicates that older adults rely on different areas of the brain to process emotional faces. Thus, maintained functioning in one area may compensate for declines in another. Young adults activate the amygdala and the surrounding areas (the limbic system) but older adults also activate the left frontal areas of the brain (Gunning-Dixon et al., 2003), suggesting that older adults rely on different networks in the brain to process emotions. However, whether this is due to a compensatory effect following decline in areas traditionally used to process emotions, and how this impacts the processing of emotional information, is unclear.

As previously discussed, older adults use bilateral activation, whereas younger adults activate unilaterally (HAROLD model; Dolcos et al., 2002). This has implications for functional compensation when processing emotion (e.g. older adults may maintain their ability to process negative and positive emotions by employing different brain regions). However, HAROLD applies only to prefrontal regions, whereas the right hemi-ageing hypothesis applies to the right hemisphere generally.

When considering right and left prefrontal lobe changes in adult emotion processing, ageing appears to impact on the dorsolateral (front and outer brain) (DL) prefrontal area earlier and more severely than the ventromedial (lower, central surface of the brain) (VM) prefrontal area (Phillips, MacPherson, & Della Sala, 2002b; MacPherson, Phillips, & Della Sala, 2002). In fact, the presentation of normal ageing is most similar to the deficits in DL prefrontal lesion patients (i.e. executive and problem-solving dysfunction) (Phillips et al, 2002b). Whereas VM prefrontal lesion patients demonstrate social and emotional dysfunctions indicative of emotion processing and social decision-making difficulties, which are not typically present in normal ageing (Phillips et al., 2002b). Therefore, changes in older adults' emotion processing may not be due to age-related neurological decline alone, since the area known to support emotion processing (particularly cognitive emotion regulation) and social decision-making does not commonly show marked deterioration with age (Salat, Kaye, & Janowsky, 2001; MacPherson et al., 2002).

Evidence for frontal cognitive ageing is not accompanied by evidence for reduced frontal control of emotions, such as in emotion regulation. In fact, older adults are impaired on frontal lobe mediated strategic tasks (Prull et al., 2000) but are not

impaired in regulating social behaviour and emotion, which appear to be frontally mediated (Mather, 2004). Different frontal subregions may be affected differentially by ageing (MacPherson et al., 2002). Ochsner and Gross (2005) argue that the cognitive regulation of emotions depends on the interaction between the PFC and cingulate control systems. Since older adults tend to have poorer cognitive control, due to frontal neurological changes, poorer emotion regulation may also be expected as a result. By contrast, Mather and Carstensen (2005) suggest that older adults are better at emotional regulation because they focus their remaining cognitive control capacities on this task. The proposed motivation to do so will be discussed later.

3.3.2. Changes in emotion regulation processes that occur with age.

Emotion regulation refers to what a person *can do, if they wish*, when faced with emotionally arousing events. This process encompasses numerous, distinct skills by which people voluntarily modify their subjective experiences or behavioural expressions associated with emotion (Gross et al., 1997). Emotion regulation includes attempts to influence which emotions are experienced, when this occurs and how they are experienced or expressed (Gross et al., 1997).

Older adults regulate their emotions by using strategies, gained experientially, and through the development of motivational and cognitive processes (Lawton, 2001). Additionally, emotion regulation may be behavioural (e.g. suppressing expressive behaviour) or cognitive (e.g. attending to or interpreting emotional stimuli or situations so as to control responses) (Gross, 2002). Therefore, emotion regulation in ageing will be discussed in terms of experiential processes (i.e. emotion regulatory abilities gained through learning and repeated exposure to emotional stimuli);

motivational processes (i.e. the underlying motivations for regulating emotion in older age); cognitive processes (i.e. the cognitive strategies and skills used by older adults to regulate emotions); and behavioural processes (i.e. the behaviours that assist in emotion regulation).

The role of experience in emotion regulation could be related to cognitive processes such as learning (i.e. extinction of emotional responses may occur following repeated exposure to emotional cues over the lifespan). Henderson (1994) describes psychological immunisation, in which people develop resistance to adverse life events through repeated exposure. However, there is no evidence to suggest that stressful life events are responded to with less negative emotions on subsequent occasions. Experiential theories of emotion regulation seem to imply that a subconscious process is occurring, which could be contradictory to emotion regulation strategies. In fact, although the term strategy suggests intentional and deliberate implementation of emotion regulation techniques, these may be so well rehearsed that they are relatively automatic (Phillips et al., 2003). Psychological immunisation may be an emotion activation process since it produces reduced emotional responses, but the learning involved also supports emotion regulation if the older person subsequently demonstrates increased coping skills.

A motivational process underlying emotion regulation is presented in socioemotional selectivity theory (SST; Carstensen, Fung, & Charles, 2003). SST states that older adults reorganise their goals to increase emphasis on emotion regulation and the motivation for this contributes to developing emotion regulatory ability (Carstensen et al., 2003). By selecting positive and deselecting negative emotions the older person

can influence their mood and emotional reactions. Older adults may not have diminished arousal and intensity of affect but may be more selective about objects and goals in order to self-regulate emotion (Carstensen et al., 2003). SST also argues that older adults shift their goals and motivation in relation to the perceived amount of time they have left in life. Young adults are seen as future-oriented as they perceive many years of life left. Older adults, by contrast, see that an end is approaching, so shift their goals to focus on emotional well-being and emotionally meaningful aspects of life (Carstensen et al., 2003).

Similarly, younger adults value knowledge-acquisition in social relationships, but older adults value emotional rewards of social relationships (Lawton, 2001). Therefore, older adults make choices with these rewards in mind rather than the novelty and stimulation of new relationships. By optimising emotion functioning and meaning, older adults increase positive and decrease negative affect, which improves emotion regulation. Arguably, this is a highly functional approach to the multiple losses common in older age.

Early ageing is characterised by increased complexity of emotional understanding and self-descriptions (Labouvie-Vief, 1998). Therefore, emotional knowledge about self and others shows greater complexity with age, so that older adults can differentiate, organise, and integrate information about self and others more effectively (Labouvie-Vief, 1998). In this way, cognitive processes such as increased complexity of emotional knowledge may maintain or improve older adults' emotion regulation ability. In addition, regulating emotional autonomic arousal, responsiveness, and

intensity of affect, may conserve cognitive resources during a time when biological resources are decreasing (Lawton, 2001).

Behavioural processes in emotion regulation include the suppression of emotionally expressive behaviour (Gross, 2002). Emotion regulation produces affective, cognitive, and social consequences. In behavioural emotion regulation, the consequences are limited expression of emotion (but not reduced unpleasant experiences), possible memory difficulties and increased physiological responses (Gross, 2002). These undesirable consequences contrast with cognitive emotion regulation, which appears to reduce negative experiences and physiological arousal, without damaging memory (Gross 2002; Jackson, Malmstadt, Larson & Davidson, 2000). Therefore, behavioural emotion regulation may be linked to a change in activation through extinction. However, such behavioural strategies have been linked to poor health outcome (Gross & Munoz, 1995).

3.4. Summary.

Overall, the earliest and most rapid declines are reported in frontal and temporal lobes, which are the areas known to be involved in emotion processing (both emotion activation and emotion regulation). Additionally, asymmetrical declines in the right and left hemispheres could offer an explanation for differences seen in older adult emotion processing and may suggest that a compensatory effect in emotion processing pathways could be occurring in older age. Maintained functioning in one area may compensate for deterioration in another. Similarly, deterioration in differential emotion processing networks could be responsible for the different patterns of processing for separate emotions in older age.

In terms of emotion regulation, research suggests that older adults have increased life experience and may develop resistance to adverse life events through repeated exposure. Motivational changes may occur with age, in that older adults show increased emphasis for emotional goals. They avoid attending to negative emotional information and have a bias towards neutral and positive emotional information. Older adults have increased complexity of emotional knowledge about themselves and others, which could also assist emotion regulation. Each of these approaches tends to support the theory that cognitive processes, motivated by conscious, strategic, self-preserving rationales are affecting older adults' emotion processing, and specifically emotion regulation.

4. Research into emotion processing abilities across the lifespan.

This next section reviews evidence for emotion processing abilities across the lifespan according to the paradigms used. For each, evidence supporting emotion activation and/or regulation process changes with age will be considered. The methodologies do not usually facilitate differentiation between emotion activation and emotion regulation functions and, many cannot indicate whether age differences in processing abilities are due to emotion activation or regulation differences. For example, responses to emotional cueing tasks (i.e. attention, memory, autonomic reactions, etc.) reflect a combination of emotion activation and regulation processes. Indeed, there are few paradigms that present specific conditions under which these processes may be disentangled.

4.1. Self-reported emotional experience.

Evidence is presented from studies that ask older adults to describe their subjective emotional experience (for reviews, see Carstensen, Isaacowitz, & Charles, 1999; Mather, 2004; Mroczek, 2001). Older adults report less negative affect than younger adults when describing their current emotions at random intervals throughout one week (Carstensen, Pasupathy, Mayr, & Nesselroade, 2000). They report that they focus more on controlling their emotions and have improved emotion regulatory skills (Lawton, Kleban, Rajagopal, & Dean, 1992). They also report being less likely to use destructive behavioural responses (e.g. shouting) when dealing with upsetting interpersonal situations (Birditt & Fingerman, 2005).

In a self-reported emotion study using questionnaires, older adults were shown to be more likely than younger adults to use mature, emotional defences such as giving an abstract meaning to an event or reversing that meaning (Diehl, Coyle, & Labouvie-Vief, 1996). Similarly, Gross et al. (1997) found that older community living participants reported fewer negative emotional experiences, greater emotional control and reduced expressivity. Likewise, older adults report experiencing negative emotions less often, for shorter time periods, whilst positive emotions last longer (Carstensen et al., 2000; Charles et al., 2001). These results have each been interpreted as evidence of increasing competence in emotion regulation over the lifespan.

Regarding differences in stress coping patterns between older and younger people, Folkman, Lazarus, Pimley, and Novacek (1987) compared self-report of daily hassles and the different kinds of coping employed between age groups. They found clear

differences in types of stresses and ways of coping throughout age. This supports a developmental interpretation, such that there are inherent, stage-related changes in the ways in which people cope as they age. Evidence was also presented for a contextual interpretation of the findings, in which coping results from changes in what people must cope with, which also changes with age (Folkman et al., 1987).

However, Felton and Revenson (1987) looked at the self-reported use of coping strategies among middle-aged and older, chronically ill adults. These older adults reported using less emotional expression, positive reconstruction, wishful fantasies or information seeking and more minimising of the threat of their illness (Felton & Revenson, 1987). This suggests that age differences in emotional expression may be due to age-related shifts in the types of stresses experienced, whereas age differences in information seeking may be more strongly linked to cohort factors. That is, today's older adults may be less likely to request information due to shared experiences or factors among their generation that influence this behaviour.

Other studies ask participants to report their responses to emotional stimuli in terms of emotional valence (i.e. behaviourally responding by approaching or avoiding a stimulus) and arousal (i.e. the magnitude of the response, and how excited or relaxed they are feeling) (see Bradley & Lang, 2000, for a review of this distinction). Despite finding age-related differences in skin conductance and cardiovascular responses (discussed later), older adults report behavioural or subjective emotional responses as strong as those of younger adults (Levenson, Carstensen, & Gottman, 1994; Levenson, Carstensen, Friesen, & Ekman, 1991; Tsai, Levenson, & Carstensen, 2000).

Overall, these studies suggest that the emotion processing differences seen in older people are driven by changes in emotion regulation abilities rather than emotion activation abilities. However, these self-report studies have examined beliefs about emotion regulation or subjective reports of emotional responses rather than measuring actual emotion regulatory skill. A problem with this is that people's subjective evaluations of what they do or feel often do not accurately reflect their objective competencies or physiological responses (Taylor & Brown, 1988).

4.2. Emotional expression and recognition (facial and prosodic).

These studies typically show participants emotional faces or play emotional voices. Participants are asked to identify or recognise the target emotion(s). Following mood inductions, older adults were less able than younger adults to communicate emotion through facial expression, and were poorer at recognising emotional facial expression for positive and negative emotions (Malatesta, Izard, Culver, & Nicolich, 1987). However, they were slightly better (but not as good as younger adults) at interpreting the facial expressions of their peers, suggesting age-interaction effects in emotion communication (Malatesta et al., 1987). This study suggests that decline in emotion activation processes is impacting on older adults' processing of emotional stimuli. However, age differences in emotion expression could have been due to age-related structural changes in the face (e.g. loss of muscle tone and increased wrinkles) rather than an actual decline in emotion expression ability.

In a study of judgments of emotional prosody, participants (older adults and adults with Alzheimer's disease) were presented with conflicting emotional prosody (i.e. the semantic content of spoken sentences conflicted with the emotional tone) (Bucks & Radford, 2004). Older adults were less accurate at judging the emotional prosody for

incongruent (e.g. 'all the puppies are dead' said in a happy tone) than for congruent (e.g. 'all the puppies are dead' said in a sad tone) stimuli. This suggests that older adults are more confused by multiple emotion stimuli and have reduced ability to process both positive and negative emotional information when presented with dual cues. This suggests that declines in older adult emotion activation are causing reduced emotion processing ability. However, emotion regulation would involve managing dual emotional cues. Therefore, contradictory to suggestions that older adults are more emotionally complex (Labouvie-Vief, 1998), emotion regulation deficits could also be impacting on emotion processing differences.

When shown emotional facial photographs, older adults were less able to identify negative facial expressions (anger and sadness) and Theory of Mind (ToM) from eyes depicting emotion (Phillips, MacLean, & Allen, 2002a). However, their recognition and rating of emotions in verbal stories did not differ from younger adults' (Phillips et al., 2002a). Reduced recognition of anger and sadness was probably not due to general deficits in identifying negative emotions since both younger and older adults equally misidentified fear (Phillips et al., 2002a). Additionally, the ToM results were not due to age-related reductions in empathy since age effects on the Empathy Scale (Mehrabian & Epstein, 1972) were eliminated when intelligence and education were covaried (Phillips et al., 2002a). This suggests that age-related changes in identifying negative facial emotion and emotion from eyes, do not equate to global changes in emotion processing.

It is not possible to differentiate between emotion activation and recognition functions in order to decipher which are influencing the emotion processing explored in Phillips

et al. (2002a). However, Phillips et al. (2002a) suggest that decreased experience of negative emotions leads to decreased recognition, raising questions about the circularity of these factors when attributing causation; they also suggest a neuropsychological explanation for the results. Perception of anger and sadness involves the frontal cortex and right temporal pole (Davidson & Irwin, 1999), therefore, changes in experience and recognition of these emotions could be due to differential age-related decline in these areas, suggesting possible interactions in emotion regulation and activation factors. Phillips et al. (2002a) propose that since anger and sadness seem to involve the frontal cortex and right temporal pole, age-differences in recognition abilities of these emotions could reflect age-related changes in these brain structures. However, an alternative interpretation may be that older adults employ emotion regulation strategies in order to avoid attending to negative emotional stimuli.

Age-related increased right cerebral hemisphere decline (compared with the left hemisphere) was explored using a facial recognition test in a tachistoscopic paradigm (McDowell, Harrison, & Demaree, 1994). Consistent with Phillips and colleagues' argument, older adults were less accurate in identifying negative and neutral facial expressions but showed accuracy consistent with younger adults in identifying positive facial expressions (McDowell et al., 1994). Additionally, older adults showed heightened cerebral asymmetry for facial emotion processing compared to younger adults (McDowell et al., 1994).

Calder et al. (2003) also explored facial emotional expression recognition abilities across the lifespan and found reduction in older adults' recognition of fear, a slight

reduction in recognition of anger, stability in happiness, but some evidence of increases in recognition of disgust. This supports, in part, age-related decline in processing selected negative information, but the disgust results present a challenge. The apparent improvement in recognition of disgust, when other negative emotion recognition declined, suggests that distinct emotion processing systems exist. Equally, a social perspective may suggest that heightened sensitivity to disgust is functionally important in older age. Calder et al. (2003) take a neurological view, that the results reflect differential effects of ageing on the different brain regions involved in processing these emotions. They argue that improved disgust recognition is due to the absence of ageing effects on the insula and basal ganglia and increased recognition of fear is due to age-related deterioration in the medial temporal poles and the amygdala (Calder et al., 2003). However, the VM areas of the prefrontal cortex show less deterioration than the DL areas (Phillips et al., 2002b) making it unlikely that observed declines in fear recognition are due to prefrontal cortex pathology.

Despite these explanations, any benefits of better disgust recognition with age, over other negative emotions in social situations, could equally be evidence of experiential, emotionally goal driven processing change. Indeed, Calder et al. (2003) also recognise that reduced expression and experience of some negative emotions could be interpreted from a sociocognitive perspective, in that strategic attentional bias preserves positive affect. However, they propose that neurological aetiology may underlie these changes (Calder et al., 2003). This study, and the varied conclusions drawn, illustrates the difficulty inherent in many emotion processing paradigms differentiating between emotion activation and regulation explanations.

If neurological decline underlies emotion processing decline then changes in other cognitive process, associated with similar brain areas, might be anticipated. However, Mather and Carstensen (2005) explain that frontal changes that affect general cognition (e.g. inhibition, working memory) in healthy ageing do not appear to affect emotion regulation. Sullivan and Ruffman (2004) explored older adult emotion recognition and whether any emotion recognition deficits were independent of declines in fluid and perceptual ability, processing speed, basic face processing abilities and reasoning about non-facial stimuli. Older adults were impaired when recognising anger and sadness, when judging which of two faces was more angry, sad or fearful and when matching emotion sounds to angry, sad and disgusted faces (Sullivan & Ruffman, 2004). Age-related decline in recognition of some emotions was independent of general cognitive declines with age (Sullivan & Ruffman, 2004). Therefore, whilst neurological decline may be involved in decline in negative emotion processing, alternative explanations, such as goal driven attentional bias, must also be considered.

4.3. Attention.

These studies attempt to identify whether attention is drawn to one emotional stimulus over another. Increased focus on emotion regulation could be evidenced through differences in older adults' attention to stimuli. Attention paradigms offer the possibility of differentiating between age differences due to emotion activation and those due to emotion regulation. Younger adults show that emotionally arousing stimuli rapidly engage attentional resources (see Ohman, Flykt, & Lundqvist, 2000, for review) and that attention is automatically oriented towards threatening stimuli (Mogg & Bradley, 1999; Ohman, 2002). A number of studies has explored age-

related reductions in the ability to process negative emotional information using attentional paradigms.

In a dot probe study using emotional and neutral faces, older adults responded faster to a dot on the same side as a neutral face than an emotionally negative face, whereas younger adults did not demonstrate this attentional bias (Mather & Carstensen, 2003). Older adults showed no attentional bias for positive faces but did remember positive over negative faces (Mather & Carstensen, 2003). These findings suggest that older adults avoid attending to negative emotional information relative to emotionally neutral information.

Interestingly, age differences in attention to negative emotional stimuli do not reflect decline in threat detection abilities. When shown a series of neutral faces with occasional emotional faces, both younger and older adults were faster to detect discrepant faces when they showed anger rather than sadness or happiness, indicating that the detection advantage for threatening stimuli is maintained with age (Mather & Knight, 2006). The differentiation between initial and sustained attention is illustrated in an eye-tracking study; when a negative and a neutral picture were shown together, younger adults attended to the negative picture for longer than older adults (Rosler et al., 2005). These studies suggest that goal-directed emotion control processes may influence selection of the emotional stimuli attended to, but threatening stimuli are still preferentially attended. Therefore, emotion regulation goals may direct attention but automatic, emotion activation processes can override this in some circumstances.

Alternatively, Wong (2004) suggests that some impairments in older adult emotion identification may be due to age-related frontal lobe degeneration, including the frontal eye fields using for visual scanning. Given that patterns of visual scanning of emotional faces predict identification in normal ageing (i.e. more fixations improve accuracy), older adults make fewer fixations for all emotions and made more fixations to the lower face, which negatively correlated with accuracy (Wong, 2004). Therefore, some emotion processing deficits may be specific to the visual domain, suggesting, again, that emotion regulation may not direct all emotional attention.

4.4. Memory.

Emotionally arousing events are better remembered than neutral ones (Buchanan & Adolphs, 2003; Dolan, 2002). Consistent with this, studies have shown preserved memory for emotional over neutral information in older adults (see Mather, 2004, for review). Similarly, Carstensen and Turk-Charles (1994) explored age differences in recall of a narrative, which contained emotional and neutral phrases; with increased age a greater proportion of emotional information was recalled. Denberg, Buchanan, Tranel, and Adolphs (2003) assessed memory (after 24 hours) for emotional images coupled with one-sentence descriptions. Older adults recalled fewer images, however, recall of emotionally arousing stimuli was enhanced across all ages (Denberg et al., 2003). Similarly, Kensinger, Anderson, Growdon, and Corkin, (2004) and Kensinger, Brierley, Melford, Growdon, and Corkin (2002), showed memory enhancement effects for emotional pictures and verbal stimuli in older and younger adults.

D'Argembeau and Van der Linden (2004) assessed older and younger adults' memories for faces and their emotional expressions by showing emotional followed by neutral faces (including those previously seen). Older adults identified fewer previously seen faces, but when cued to repeated faces, recalled as many emotional expressions of happy and angry faces as younger adults (D'Argembeau & Van der Linden, 2004). Therefore, cognitive processes may underlie age-related emotion processing differences (i.e. only when older adults were cued to the target faces, could they recall the emotions previously expressed). Facial identity recall difficulties may partly explain age related difficulties with recalling emotional expressions. That is, the emotional memory deficit may have been, partially, secondary to facial recognition difficulties (Reuter-Lorenz, 2002).

Additionally, older adults are less able to differentiate between levels of emotional intensity for both positive and negative emotional information (Thompson, Aidinejad, & Ponte, 2001). Younger and older adults watched videotaped emotional verbal discourse followed by emotional, nonverbal information expressing anger, happiness or fear, in prosody or facial expression, at conflicting intensity with the videotaped scene. Older adults more often recalled the intensity of the videotaped scene at the same level as the nonverbal content, for happiness and anger (Thompson et al., 2001). Therefore, older adults may be less able to differentiate between levels of emotional intensity and more likely to reconstruct verbal emotional information to coincide with nonverbal content (i.e. facial expressions and prosody). In this way, they may be regulating emotional responses by simplifying emotional stimuli, due to being more confused by multiple emotion stimuli and having reduced processing ability for both positive and negative emotional information simultaneously. This is supported by the

study findings, previously discussed, in which older participants were confused by conflicting emotional prosody (Bucks & Radford, 2004). However, older adult memory deficits could relate to neurological and emotion activation declines, possibly differentially for different emotion forms.

It is possible that older adults use emotion regulation strategies selectively to process positive emotions and deselect processing negative emotions. In fact, SST is based on study findings in which older individuals recalled and recognised fewer negative images compared to positive or neutral images, whereas younger adults recalled and recognised similar numbers of each (the numbers of positive images recalled and recognised by both groups was comparable) (Carstensen, Fung, & Charles, 2003). However, these differences in recall may have been due to emotion activation processes between the two groups.

Therefore, older adults may use memory in emotion regulation (i.e. remembering more positive than negative emotional information) or possibly age effects on memory are equivalent for both positive and negative emotional information indicating general degeneration not related to regulation. Research in this area has shown that older adults avoid attending to negative information (Mather & Carstensen, 2003), they recall negative emotions less intensely (Levine & Bluck, 1997), and remember past choices more positively (Mather & Johnson, 2000). Charles, Mather, and Carstensen (2003) showed that the number of negative images recalled and recognised (compared with positive and neutral images) decreases with age; they then suggest that this supports SST (i.e. older adults preferentially encode positive and neutral images to memory but to disregard negative images). However

these findings may also have been due to differential deterioration in the neural pathways involved in the emotion activation of negative versus positive emotional stimuli.

Within autobiographical memory studies support exists for a positivity effect with age when recalling personal information, which suggests emotion regulatory functioning. Kennedy, Mather, and Carstensen (2004) asked participants (aged 47 – 102 years) to recall personal information that had originally been reported 14 years previously. Some participants were primed to focus on their current emotional state, some on the accuracy of their recollections, and the rest were not prompted. Mood assessments were also conducted following recall. Regardless of age, those primed to focus on emotional states recalled memories more positively and showed more positive mood afterwards, whereas those primed to focus on accuracy recalled memories more negatively and showed more negative mood afterwards (Kennedy et al., 2004).

The most interesting group were those who recalled without prompts. Older adults recalled memories more positively than they had 14 years previously and more positively than the younger adults; they were also in more positive mood after recall than before (whereas the youngest adults had a negativity effect when unprompted) (Kennedy et al., 2004). Therefore, older adult positivity effects can be explained by the individual's motivational state (i.e. focussing more on emotion rather than accuracy), suggesting that older adults have emotionally motivated patterns of memory for autobiographical information, which enhances their mood.

Emotion may also facilitate rather than hamper memory (i.e. mood congruence). For example, emotional cues can facilitate recall of similar memories, such as word lists (Clark & Teasdale, 1985), and autobiographical memory (Levine & Burgess, 1997). Knight, Maines, and Robinson (2002) induced neutral and sad mood in older and younger adults prior to delayed word recall, an autobiographical memory task, and spelling homophones (e.g. pain / pane, where one word has negative connotations). In neutral conditions, older adults recalled and spelt fewer negative words but equivalent positive words to younger adults (Knight et al., 2002). The older adults may have attended to the negative stimuli less than the younger adults so reducing recall of negative stimuli. This is partially consistent with SST predicting reduced negative recall with age. However, SST also suggests that older adults have *enhanced* positive recall, which was not observed. Age equivalent recall of positive stimuli suggests that the decreased recall in negative stimuli was not due to a general memory deficit.

Following sad induced mood, both groups showed enhanced negative word recall, in delayed recall and autobiographical memory tasks (i.e. some mood congruence occurred in both age groups), but older adults gave more negative word spellings and recalled fewer positive words than younger adults (Knight et al., 2002). This suggests that emotion processing is more affected by sad mood with age and that mood congruence does not occur equally across the age groups. Taken together, these findings suggest that older adults' ability to regulate negative emotional information is negated if their mood is also negative. Thus maintaining positive or neutral mood may be more important to older adults' functioning. This could be a motivational reason for their increased emotion regulation abilities.

4.5. Studies that measured physiological responses.

These studies explored the physiological and autonomic responses (e.g. skin conductivity, cardiovascular and respiratory rates, blood pressure, etc.) and brain metabolism (using functional magnetic resonance imaging - fMRI) of older adults during emotion processing tasks.

Older adults appear to show less autonomic reactivity (skin conductance, and cardiovascular and respiratory rates) when induced into various emotions. In a 60-day study, older adults showed associations between positive emotions and cardiovascular outcomes, which were linked to individual differences in social connectedness, and social connectedness predicted extended positive emotion and reduced blood pressure (Ong & Allaire, 2005). Therefore, positive affect may be protective against the functional and physical declines associated with age, and may even be good for the heart (Ostir, Ottenbacher, & Markides, 2004).

Levenson, Carstensen, Friesen, and Ekman (1991) measured baseline autonomic activity (heart rate, skin conductance, finger temperature, general muscle movement) on non-emotional cognitive tasks for younger and older adults, and autonomic activity changes within groups during emotion simulation (different group baselines meant that between group autonomic activity comparison was unsuitable). Both groups produced similar emotion-simulation action; although older adults' autonomic activity during emotion simulation changed less than younger adult activity (Levenson et al., 1991). Similarly, older adults show lower cardiovascular responses (but not subjective or behavioural responses) than younger adults to sad and amusing film clips (Tsai et al., 2000) suggesting that intensity of subjective reactions to emotional

stimuli remains stable with age whilst the magnitude of autonomic reactions declines. Older adults also report fewer autonomic symptoms accompanying emotional events than middle and younger aged adults (Lawton et al., 1992), but age differences in reporting style could account for this.

These studies suggest that autonomic reactivity may be reduced with age. That is, older adults may experience lower levels of physiological change with emotion processing and/or have lowered affective responses to emotion processing tasks. However age-differences in the type of event selected for these studies (i.e. the emotional content and intensity of the event) may be relevant. Similarly, short films and pictorial facial expressions are not necessarily personally meaningful, or may not illicit physiological responses reflective of emotion processing.

Kunzmann and Grun (2003, 2005) used films of highly coherent, integrated event sequences, intended to encourage identification with the characters and their emotions. Older adults showed greater reactivity and reported more sadness than younger adults, whilst autonomic responsiveness was equivalent (Kunzmann & Grun, 2003). Older adults also reported greater sadness to films covering age relevant themes (e.g. the loss of loved ones) than younger adults, but did not differ in autonomic reactions (Kunzmann & Grun, 2005). Thus these studies show greater subjective responses to personally meaningful emotional stimuli with age, than previous research suggests, coupled with autonomic responses equivalent to younger adults rather than lower.

In another study, Turk-Charles (2005) found greater heterogeneity in emotions in older than in younger adults when viewing film clips showing scenes of injustice. Heterogeneity was defined as the co-occurrence of negative emotions. Carstensen et al., (2000) view this research as evidence of more complex, deeper emotional reactions to events, whereas, Feldman-Barrett, Gross, Christensen, and Benvenuto (2001) suggest this is due to the inability to identify a primary emotional response, which is maladaptive. Larson, McGraw, and Cacioppo (2001) argue that being able to experience co-occuring emotions is neither inherently adaptive nor maladaptive. The value of this ability depends on the context (e.g. in aversive situations, single dominant responses are helpful, but in situations with multiple stimuli, processing may be more adaptive if sequential rather than heterogenous).

In summary, emotional reactivity may be dependent on the emotional relevance of the stimuli and the nature of the emotion processing task. Older adults may use well-rehearsed, robust emotion processing pathways and highly developed emotion regulation strategies when processing familiar emotional tasks. However, older adults may be unlikely to use emotion regulation when presented with novel emotional stimuli, which makes them more vulnerable to the effects of age-related neurological declines. Effective emotion regulation, and subsequent reduced physiological reactivity, may only occur when older adults rely on well-rehearsed and integrated schemas in predictable, regular, emotional situations. By contrast, emotion regulation abilities may be diminished in unique, unpredictable and emotionally complex situations.

Studies investigating age-related differences in brain activation (using fMRI) during emotional face recognition have shown that age affects central nervous system activity associated with emotion processing (Gunning-Dixon et al., 2003; Iidaka et al., 2002). Using faces depicting neutral, anger and disgust, where participants identified the gender of the model, older adults showed greater change in bilateral amygdala activation for anger and disgust than younger adults (relative to baseline activations for neutral) (Iidaka et al., 2002). Similarly, in a mainly negative emotional face-discrimination task, older adults activated the frontal cortex more, whereas younger adults activated the right amygdala (Gunning-Dixon et al., 2003). Therefore, age-related changes in amygdala activation for negative emotion processing appear to occur. However, using fMRI, Fischer et al. (2005) showed that perception of negative facial expressions caused greater activation in the right anterior-ventral insula cortex in older than in younger adults; they suggested that Iidaka et al.'s (2002) and Gunning-Dixon et al.'s (2003) results may have been linked to the cognitive processing involved in labelling the facial emotions or the model gender.

Neuroimaging facilitates the investigation of the relationship between differences in amygdala activation and affective style. Affective style is the capacity to regulate negative emotion and decrease the duration of negative affect (Davidson, 2004). Connections between the prefrontal cortex and the amygdala are important to the regulation of negative emotion (Davidson and Irwin, 1999). Davidson (2004) suggests that a resilient affective style is associated with high levels of pre-frontal activation and effective modulation of activation in the amygdala. Consequently, individual differences in prefrontal activation may be important for emotion regulation abilities. Therefore, reporting of less negative mood and more positive

mood with age may result from increased ability, due to differences in prefrontal cortex and amygdala connections, to regulate and modulate the intensity of negative affect.

5. Discussion.

This paper has reviewed research into the prevalence of mental health problems and the occurrence of negative affect among older adults. Despite methodological difficulties, research suggests that these appear to diminish with age. It is not clear, however, whether older adults become happier or whether they become less emotionally responsive in general. Some evidence suggests that emotion processing (including emotion activation and regulation) of both negative and positive emotional stimuli is impaired with age. By contrast, many studies report that positive affect and the emotion processing of positive emotional stimuli remains constant with age, whilst negative emotions become more difficult to interpret or are afforded less processing. It is likely that both strategic, regulatory factors and age-related, emotion activation declines have an impact on these age differences in emotion processing abilities. It is also possible that these factors are combined.

This raises a question regarding the possible direction of causation, in terms of whether older adults' emotion processing skills are having a positive impact on their affect or whether the experience of reduced negative affect, the conscious drive to maintain positive affect or physical and neurological deterioration, are impacting on their emotion processing skills. For example, older adults do not appear to have well rehearsed strategies for processing and responding to unique, unpredictable and

emotionally complex stimuli and, in these circumstances, become more vulnerable to age-related neurological declines in emotion processing ability.

In terms of a combination of the emotion activation and regulation processes in older age, it is possible that changes in physiological and autonomic responsiveness to emotional stimuli (Lawton, 2001) are actually assisting older adults in achieving their reported higher levels of mental health. That is, it could be that reduced physiological reactivity to emotions and emotion processing could make emotions easier to control, so assisting emotion regulation and coping. Alternatively, reduced autonomic activity may be a result of successful emotion regulation and coping ability among older adults. Krantz and Manuck (1984) suggest that older adults may regulate their emotions so that they are less physiologically demanding. In this way they can buffer themselves from the negative effects of intense cardiovascular reactivity on physical health. A view that emotion regulation and positivity increase health and lifespan is supported by Levy, Slade, Kunkel, and Kasl (2002) who found that older adults who had demonstrated more positive self-perceptions of ageing (as measured 23 years earlier) lived on average 7.5 years longer than those who had demonstrated less positive self-perceptions. Likewise, in a seven year study into frailty in older adults, high positive affect was found significantly to lower the risk of frailty (i.e. although there was a general increase in frailty with age, those older adults who demonstrated high positive affect over the seven years showed a 3% decreased risk of frailty after other risk factors were taken into accounted) (Ostir et al., 2004).

In addition to physical health benefits, the use of strategic, regulatory processes to reduce emotional experience may also help to preserve cognitive functioning.

Phillips, Smith, and Gilhooly (2002c) looked at the effects of induced positive and negative mood on planning and found that older adults were significantly more impaired than younger adults on planning tasks in both positive and negative mood conditions. Consequently, when emotion regulation requires considerable cognitive effort, a decline is seen in older adults' ability to use not only their well-rehearsed coping strategies but also other cognitive functions. For example, when older adults are in situations that evoke strong emotional responses this could interfere with their executive functioning.

Therefore, a reduction in or increased regulation of emotion processing and a reduction in the complexity and intensity of emotion subsequently experienced may enable other cognitive processes to occur without ageing effects inhibiting these functions. Arguably, it is in the interest of older adults to reduce, simplify and regulate their emotions in order to, in turn, preserve cognitive and executive functioning. Similarly, evidence for declines in cognitive and neurological complexity with age could be interpreted as making older adults less emotionally complex, which could manifest as reduced physical responsivity to emotions and simplified emotion regulation strategies.

Despite the strong positions taken by many of the researchers' whose work is reviewed here, however, it seems improbable that either emotion activation or regulation factors are solely responsible for the differences reported in emotion processing. A combined contribution of both these factors is likely to be causing age differences in emotion processing and decline in negative affect and mental health problems.

Furthermore, although negative affect appears to decline and positive affect to remain stable with age, it is less clear whether this constitutes actual improved mental health. For example, perpetual positive mood may indicate that an individual has difficulty in coordinating positive and negative emotions into flexible and differentiated views of reality. The research reviewed has highlighted that strategic theories of older adult emotion processing support the notion that older adults regulate emotions by simplifying the emotional content of stimuli and by representing primarily positive rather than integrated positive and negative emotions in memory and cognitions. Similarly, age-related neurological decline accounts of older adult emotion processing show greater ability to process positive versus negative emotional information, simplified representations of emotional information in recognition and recall, and reduced responsivity to emotional stimuli. Therefore, older adults may have achieved higher levels of mental health than younger adults by maintaining predominantly positive mood but through the restructuring of reality to promote positive illusions. This means that older adults may be interpreting their world using manipulated representations of that world which could reduce their ability to respond appropriately or accurately in certain circumstances (e.g. when responding to others' negative feelings).

5.1. Clinical implications.

Overall, the studies reviewed indicate that changes in emotional experience occur during the adult life span and that older adults experience negative emotions with less frequency, intensity, complexity and consistency than younger adults. However, whilst these findings present an optimistic view of older age, further factors must be considered regarding the mental health of the older adult population today. For

example, an increase in life expectancy, coupled with the realisation that older adults represent the fastest growing population within Western countries, has led to concern regarding whether mental health assessments are accurate and whether mental health care provision for this age group is adequate (Charney et al., 2003).

The evidence has implications for older adult health care provision in terms of the accuracy of self-report measures and the need to develop these to accommodate differences in emotion, attention and memory and the increased effects of mood congruence for older adults. The use of coping strategies among older adults should be explicitly recognised within health care provision so that treatment models for older adults with mood problems can reflect and enhance these skills. Older adults' diminished ability to regulate negative emotional information if in negative mood is also very important for the assessment and treatment of depression. For example, if an older person is likely to be experiencing sadness, worry or anger, professionals should be aware of the impact of these feelings on their ability to communicate information in an unbiased way (e.g. in assessment) or to receive negative information (e.g. in reporting a potentially distressing healthcare diagnosis).

Similarly, reduced physiological responsiveness to emotion processing should be recognised within health care settings, particularly in assessments of mental health and in considering the well-being of individuals within residential care. For example, a lack of noticeable responses to emotional cues should not be taken as indication of an absence of low mood or distress. The neurological changes that occur with age also have implications for how the older person may reflect or report on emotional well-being in the clinical setting and consideration should be given to providing older

adults with models of treatment which do not present complex, unfamiliar, emotional information requiring multiple cognitive strategies to implement.

5.2. Future research.

Future research should be mindful of the methodological issues that have been raised. These difficulties include reporting biases, the confound effect of age-related risk factors, and age-biases within standardised assessment tools. It is important that research employs methodologies that do not rely solely on self report, control for age-related risk factors, and use assessment tools that are suitable for use across the age range. Given the difficulties of identifying cohort variables in cross-sectional studies, further longitudinal studies would be advantageous. Future research should also consider how personally meaningful are emotional tasks before drawing conclusions about the generalisability of results. An introduction to this area of study could be achieved through comparing personally meaningful and personally non-meaningful stimuli across age groups.

As discussed, research has identified age-related deficits in the recognition of negative emotions that were independent of decline in fluid and perceptual ability, processing speed and basic face processing abilities (Sullivan & Ruffman, 2004). This suggests that although neurological decline may be involved in ageing effects on negative emotion processing, strategic processes are also likely to be involved. However, it is not clear if these maintained older adult cognitive functions are sufficient to compensate for negative emotion processing deficits in social situations. Therefore, future research could investigate whether negative emotion processing deficits are having a significant impact on older adults' daily interactions.

For example, the impact of negative emotion processing deficits on older adult social interactions in potentially socially difficult situations could be explored using an observational paradigm and an emotional faces recognition task. Older and younger adults could be assessed using an emotional faces recognition task and, separately, asked to participate in role-plays, with an actor partner (a member of the research team), where pre-planned, awkward, unusual, emotionally charged or puzzling social situations are presented. The order of completion of the task and the role-plays could be alternated between participants to account for the impact of one task on the results of the second. The researchers could assess participants' responses in the role-play according to predetermined criteria: for example, participants' awareness of the social difficulty presented, their response type (was it socially appropriate, did it demonstrate empathy and awareness, etc.), how long their initial response took (the use of a video recorder would assist this), and so on. Analysis of the associations between the role-play and task results would indicate whether there is a link between negative emotion processing deficits and social skills deficits in normal ageing.

Age-related effects on attentional bias for positive and neutral over negative emotional stimuli could be explored in numerous ways. Emotional information could be presented in pictorial form (e.g. facial expressions, body posture, simple representations of interactions, or stories involving emotion), prosody, spoken and written language and semantics, videotaped emotional scenarios and footage, moving and/or complex emotional stimuli (morphed facial expressions or emotional representations where two or more emotions are presented). The paradigm chosen should allow the use of both positive, negative and neutral emotional stimuli. The number and type of emotions used could be varied; the most primary emotions

(happiness and sadness) should be represented and the instinctive, survival-related emotions (anger and fear/anxiety) would be important inclusions. Disgust and surprise are more complex, higher-order emotions, which could provide insight into the specificity of attentional biases. Paradigms used to assess emotion processing in younger adults could be extended to research into older adults. For example, the presentation of two emotions simultaneously (either side by side or in an emotionally morphed face) would facilitate comparison of the attention given to each stimuli (e.g. using an eye-tracking device) (see Mogg & Bradley, 1998, for review).

It may also be interesting to investigate whether older adults have a response bias for emotional information. This could be of importance when considering age differences in emotion processing, in terms of whether older adults manipulate reality to promote positive illusions. Comparison of participants' interpretations of negative and positive emotional stimuli presented simultaneously (e.g. through an emotional morphed facial task in which participants classify the emotions depicted) could reveal whether older adults show an interpretive bias for positive and negative information, as has been shown in participants with social anxiety (Garner, Mogg, & Bradley, in press). This would be of particular interest when considering the role of bias in ageing; for example, whether bias towards positive emotional information assists older adults in forming positive representations of reality in order to encourage good mental health.

5.3. Overall summary.

This paper has discussed the potential reasons for the observed decrease in mental health problems and negative affect with age. These findings were considered in

terms of the changes in emotions processing abilities that occur with age from both an emotion activation and from an emotion regulation, taking into account neurological declines and strategic arguments. The research findings supporting these perspectives have been explored according to the individual paradigms used. The implications for clinical practice and future research have been highlighted.

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Discrimination and Response Bias of Emotionally Ambiguous Faces in Older Adults.

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Discrimination and Response Bias of Emotionally Ambiguous Faces in Older Adults.

Abstract.

Objectives:

Research has suggested that there is a decline in the processing of negative emotional information, a reduction in the frequency of negative emotions expressed and experienced, and an increase in the frequency of positive emotions expressed and experienced, by older adults (Calder et al., 2003; Sullivan & Ruffman, 2004). These age-related emotion processing differences may, at least partially, be responsible for the reported decline in mental health problems in older people. This study aimed to investigate the effect of normal ageing on the ability to discriminate ambiguous emotional expressions, while using a signal detection paradigm.

Design:

High functioning older (n = 30) and younger adults (n = 30) took part in a cross-sectional study exploring performance on a task assessing interpretation of ambiguous emotional facial expressions.

Method:

Participants were presented with emotional, ambiguous, morphed facial expressions. Each face contained two of three emotions (happy, sad and angry) in a 60%-40% blend and participants indicated which emotion they recognised. They also completed measures of anxiety, perceptual ability and cognitive functioning.

Results:

There were no age differences in discrimination ability over the three emotion pairs. Response bias measures indicated that older adults were significantly biased towards reporting less anger in the angry-happy morphed faces.

Conclusions:

These results support neither older adult neurological decline or strategic emotion regulation accounts of age-related emotion processing differences. Future directions are discussed.

Discrimination and Response Bias of Emotionally Ambiguous Faces in Older Adults.

1. Introduction.

A decrease in depression, anxiety and general distress in older adults has been reported within many studies (Jorm, 2000). These decreases may relate to differences in older adult emotion processing. Older adults have been shown to process a range of emotional information differently to younger adults. For example, older adults have different subjective experiences of emotion (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000), they exhibit different expressions of emotion (Malatesta, Izard, Culver, & Nicolich, 1987) and they demonstrate different physical and psychological responses to emotion evoking tasks (Levenson, Carstensen, Friesen, & Ekman, 1991). Older adult memory for, recognition and regulation of different emotions have also been identified as different to that of younger adults (Thompson, Aidinejad, & Ponte, 2001). Overall, studies have found a reduction in the frequency of negative emotions, and an increase in the frequency of positive emotions, expressed and experienced by healthy older adults (Calder et al., 2003).

Various theoretical reasons for these differences in emotion processing have been proposed. One argument is that older adults have learnt to use different, strategic emotion regulation and coping mechanisms in order to reduce processing of negative information, which in turn reduces susceptibility to negative affect (Lawton, 2001; Gross et al., 1997). Another view is that there may be physiological and neurological age-related decline that impacts on emotion processing. For example, the brain systems underlying processing of negative information (e.g. right frontal regions) may

be more impaired than those underlying processing of positive information (e.g. left frontal regions) (McDowell, Harrison, & Demaree, 1994), or frontal activity during cognitive performance may be less lateralised in older than younger adults (Dolcos et al., 2002). Either view might account for reduced processing of negative information in older adults.

There is growing evidence that older adults perform less well than younger adults when identifying emotions. Early studies (e.g. Malatesta et al., 1987) used naturalistic video footage to explore recognition of anger, sadness and fear, finding that older adults were significantly poorer than younger adults. However, this methodology did not allow comparison of the different emotions. In studies that have explored different facial emotions, impairments have been found in older adults' ability to recognize sadness (McDowell et al., 1994; MacPherson, Phillips, & Della Sala, 2002; Phillips, MacLean, & Allen, 2002; Calder et al., 2003), anger (McDowell et al., 1994; Phillips et al., 2002; Calder et al. 2003) and fear (McDowell et al., 1994; Calder et al., 2003). Less consistency has been found with surprise or disgust for which some studies have shown improved recognition with age (Calder et al., 2003). Fewer studies have explored non-facial emotional stimuli. Brosgole and Weisman (1995) also explored participants' recognition of happiness, sadness, and anger in vocal prosody and in music and found that recognition of all three of these types of stimuli was negatively affected by age.

Two studies have used morphed facial expressions, i.e. computer-generated amalgamations of different facial expressions of emotion, to explore age differences in emotion processing (Sullivan & Ruffman, 2004; Calder et al., 2003). The use of

morphed facial expression blends, of differing proportions, facilitates the exploration of the ability to recognise facial emotion. For example, pure facial expressions of emotion (e.g. happiness, sadness and anger) could be too simple for high functioning older adults to recognise and would, therefore, produce a ceiling effect. Additionally, the use of morphed blends of facial emotion allows the researcher to manipulate the proportions of the blends in order to produce facial expressions containing a dominant emotion mixed with another less depicted emotion. In this way it is possible to explore whether older adults show a bias in their recognition of one emotion over another, within varying emotion combinations and proportion blends.

Sullivan and Ruffman (2004) used three different morphed facial expression paradigms to explore which emotions older adults had difficulty recognising. They also explored whether emotion recognition deficits were independent of decline in fluid and perceptual ability, processing speed, basic face processing abilities and reasoning about non-facial stimuli. The first paradigm required participants to recognise a facial emotion as it morphed, over 12 seconds, from another facial emotion. The second paradigm required participants to identify which of two morphed facial expressions demonstrated the greatest target emotion (e.g. which of two faces looked more angry). The third task required participants to identify which of six facial pictures (five of different pure facial emotion images and one morphed facial blend containing the target emotion as dominant) matched an emotional soundtrack. The findings suggested that older adults were impaired when recognising anger and sadness, when judging which of two faces was more angry, sad or fearful and when matching emotion sounds to angry, sad and disgusted faces. Additionally,

age-related decline in the recognition of some negative emotions was not explained by general cognitive decline with age (Sullivan & Ruffman, 2004).

Calder et al. (2003) also used a morphed facial expression paradigm in order to explore facial recognition abilities across the adult life span. In the first task, participants were required to identify the emotional expressions of facial photographs of six different pure emotions. In the second task, participants identified the emotion expressed in morphed facial images of varying blend proportions and expression pairs. The findings suggested that there was a reduction in older adults' ability to recognise fear and a slight reduction in their ability to recognise anger.

As mentioned earlier, research has shown that decoding negative facial expressions relies mainly on the right brain hemisphere, whereas decoding positive facial expressions relies on both left and right hemispheres (Adolphs, Jansari, & Tranel, 2001) and that the right hemisphere declines more rapidly than the left (McDowell et al., 1994). Therefore, older adults may have more difficulty processing negative emotions due to asymmetrical neurological decline, in the right hemisphere, whilst their ability to process positive emotion remains intact. Indeed, Calder et al. (2003) argued that their results were indicative of the differential effects of ageing on the different neural systems involved in recognising emotions.

However, recent research into neurological decline with age (particularly in memory functions) supports a hemispheric asymmetry reduction in older adults (HAROLD) model (Dolcos et al., 2002), in which frontal activity during cognitive performance tends to be less lateralised in older than younger adults. Cabeza, Anderson,

Locantore, and Mcintosh (2002) found that low-functioning older adults recruited similar right prefrontal cortex regions as young adults, whereas high-functioning older adults engaged prefrontal cortex regions bilaterally (Cabeza et al., 2002). Cabeza et al. (2002) conclude that low-functioning older adults employ similar neural pathways as younger adults but do so less effectively, and high-functioning older adults compensate for age-related neural decline by reorganising their neurocognitive networks.

Whatever the theoretical explanation, overall, the findings suggest changes in older adults' processing of negative emotional information, particularly sadness and anger, with preservation of positive emotions such as happiness. This provides support for the notion that differences in emotion processing are, at least partially, responsible for the decline in mental health problems with advancing age.

Although previous studies using morphed faces have been informative, a number of methodological problems limit interpretation of their findings:

1.1. Contrasting emotion within the morphed pair.

A criticism of both the Sullivan and Ruffman (2004) and the Calder et al. (2003) studies concerns the pairing of emotions. Both studies used six emotions (happy, sad, anger, fear, surprise and disgust) paired so that each emotion was contrasted with two other emotions. Although both studies balanced the number of times each emotion was a target, they did not balance the contrasting emotions (i.e. each emotion was not contrasted against every other emotion). For example, anger was contrasted with disgust and sadness, sadness with fear and surprise, and happy with anger and disgust

(Sullivan & Ruffman, 2004). Likewise, Calder et al. (2003) contrasted happy with surprise and anger, sadness with fear and disgust, and anger with disgust and happy, in two morph blends of 90%-10% and 70%-30. Additionally, in the analysis, Calder et al. (2003) combined the pairing trials (e.g. the responses for a 90% target emotion with those for a 70% target emotion, for each of the two pairings on each emotion; e.g. their results for 'happy' combined responses for 90%happy-10%surprise, 70%happy-30%suprise, 90%happy-10%anger, and 70%happy-30%anger). Both of these studies clearly raise problems in determining whether the response findings represent age related deficits in recognition of the target emotion or whether they reflect differential effects of the contrasting emotion. In the case of Calder et al. (2003), it is not even possible to determine to which of the two contrasting emotions the response findings relate.

1.2. Potential labelling difficulties associated with forced-choice tasks.

Performance on emotion recognition tasks may be determined by the capacity to generate, or recall, the correct label rather than purely recognition. In Sullivan and Ruffman (2004), participants were given six emotion labels from which to choose. The authors suggest that any difficulties in labelling were counteracted by ensuring that each participant provided correct responses during the training session and by having the six emotion labels visible throughout the task. Similarly, Calder et al. (2003) required participants to identify emotions from pictures of pure and morphed facial expressions whist the six potential labels were visible. Calder et al. (2003) stated the six visible emotion labels eradicated older adult labelling difficulties.

The current study aimed to reduce the potential impact of labelling difficulties by providing only two emotion label choices during each block. In addition, six practice faces before each block were provided to familiarise participants with the labels and corresponding keys.

1.3. Number of emotional face types.

The range of emotions presented within each task is a further complicating factor. Sullivan and Ruffman (2004) and Calder et al. (2003) explored recognition abilities for six different emotions. These included primary emotions (such as happiness, sadness, anger and fear) and also emotions that could be considered to be more complex (such as disgust and surprise). The current study used three primary emotions (happiness, sadness and anger), for which research has shown relative consistency in age related impairment (Sullivan & Ruffman, 2004).

1.4. Task difficulty.

In Sullivan and Ruffman's (2004) second task, participants were asked to decide which of the faces expressed the stronger emotion (i.e. 'Which face is angrier?'). 'Easy' items were morphed faces with 20% difference in emotion intensity, and 'hard' items were morphed faces with only 10% difference. The difference in the 'hard' faces may have been too small for participants reliably to make a judgement. Arguably, if the task is so hard that older participants perform at or near chance it would be difficult to interpret their ability to discriminate both between the emotions in the blend and between different emotion blends. The current study attempts to avoid task difficulty problems by using blends of 60%/40% or 40%/60%, presented alone, not in comparison to any other blended emotional face.

1.5. Number of trials per condition.

There is considerable variability in the number of trials offered per emotion or condition, but in general the numbers are low, from as little as 4 trials per emotion. Sullivan and Ruffman (2004) used only 2 trials of the 4 target emotions in their first task and only 2 easy and 2 hard trials per emotion in their second and third tasks. Calder et al. (2003) provided 10 trials per emotion in their first task and 20 trials per emotion in their second task. In contrast, the current study used 48 trials per emotion in each condition, in order to maximise the sensitivity of the task and to allow signal detection analysis.

In summary, the current study explores the effect of ageing on facial recognition abilities whilst seeking to avoid the methodological problems identified in previous research. In addition, it takes a novel approach to the analysis of recognition performance by using signal detection measures. Signal detection analysis is useful because it can assess discrimination ability separately from response bias. Neither Sullivan and Ruffman (2004) nor Calder et al. (2003) used signal detection analysis. The current study presented participants with ambiguous faces comprising of two morphed emotional expressions of differing proportions (using the Classification of Emotionally Ambiguous Morphed Faces test: CEAMF). This allowed the results to be analysed using signal detection analysis to establish whether the responses were due to the ability to discriminate between emotional expressions or to response bias.

1.6. Hypotheses:

1. In comparison with younger adults, older adults will show reduced discrimination of negative (i.e. angry and sad) faces, relative to happy faces.
2. In comparison with younger adults, older adults will show a greater response bias against negative (i.e. angry and sad) faces, relative to happy faces.

2. Method.

2.1. Design.

To test hypothesis 1, a discrimination score (A') was calculated form the hit and false alarm rates for each emotion continuum (that is, which two facial expressions were blended together). Emotion continuum was a within-subjects independent variable with 3 levels (happy-sad, angry-happy, sad-angry). There was one between-subjects variable of group with two levels (older, younger). The dependent variable was A'.

To test hypothesis 2, the dependent variable was response bias score (B"D) which were calculated from the hit and false alarm rate for each continuum. Due to specific features of the B"D scores (discussed later), the two groups were compared on their scores from each of the three continua using a series of independent t-tests.

2.2. Ethics.

The guidelines outlined in 'The Code of Conduct, Ethical Principles and Guidelines, BPS' (November 2000), section 'Ethical principles for conducting research with human participants' (p8-11) were followed. Ethics Committee approval was obtained from the Southampton University, School of Psychology Committee (see Appendix B).

2.3. Participants.

Thirty healthy, high functioning older adults, aged 61-92 years old, were recruited from a non-clinical, community population. Advertisements and information presenting an overview of the study and the type of participants required (see Appendix C) were given to local community and social clubs frequented by older adults and placed in a local theatre Newsletter. Those interested were requested to contact the researcher for more information. Appointments were made with those older adults who, having received an Information Sheet (see Appendix E), agreed to participate in the study.

Thirty young adults, aged 18-30 years old, were recruited from a non-clinical, student population. An advertisement for the study was placed on 'Psychobook' (see Appendix D). Psychobook is an internal University intranet site for students to view, request further information, and register for participation in a wide range of psychological studies in order to earn points as part of their psychology course or module. Students who indicated interest in this study were sent an Information Sheet (see Appendix F) and booked an appointment via Psychobook.

2.4. Materials and Procedure.

2.4.1.1. CEAMF: Materials.

This task is based on that used in an unpublished thesis (Garner, 2005). Prototype angry, happy and sad expressions from four male and four female models were selected from the NimStim Face Stimulus Set (http://www.macbrain.org/faces/index.htm). These stimuli were used to create three emotion continua (per model): Happy-Sad, Angry-Happy and Sad-Angry. Prototype

images were combined to create two emotional facial expressions that differed in emotionality (e.g. for the happy-sad continua one face was 60% happy:40% sad, and the other 40% happy:60% sad) (see Table 1).

The preparation of each continuum used Gryphon Morph v2.5 software (Gryphon Software Corporation, 1994) and Inquisit 1.33 computer software (2002) and is similar to image manipulation techniques used in studies investigating categorical perception of emotional expression (e.g. Young et al., 1997). In addition, prototype (un-morphed) angry, happy, sad and neutral expressions from two additional male and female models were used in practice trials. Stimuli were 150 mm high and 115 mm wide, presented in colour using Inquisit version 1.33 (2002) on a Sony Vaio Pentium III laptop. Participants' responses were collected via an external keyboard.

Table 1. The CEAMF task.

Emotion Continuum Blocks	Emotion Proportion Blends
Happy/Sad	40%/60%
	60%/40%
Angry/Happy	40%/60%
	60%/40%
Sad/Angry	40%/60%
	60%/40%

2.4.1.2. CEAMF: Procedure.

Task instructions were presented on screen in large print at the beginning of the task; the participant had unlimited time to read these and ask any questions. Each continuum was presented in a separate block (order was counterbalanced across participants). At the beginning of each block, brief instructions introducing the continuum and response options for that block were displayed on the screen. These instructions were added to by the researcher as required. Participants were asked to classify each face, using 1 of 6 response options (e.g. very / moderately / slightly happy OR very / moderately / slightly sad), as accurately and as quickly as they could. Each trial began with the presentation of a face which was displayed until response (for a maximum of 20 s for practice trials and 15 s for morphed face trials). The inter-trial interval was 1000 ms. Response labels, indicating the emotions, were placed on the keyboard at the beginning of each block to provide a reminder to the participant during testing. In addition, a graphic displaying the response scale was presented at the base of the screen throughout the block. Following block instructions, practice prototype expressions for that block (e.g. happy, sad) and neutral faces, were each presented once in six randomly presented practice trials. This format encouraged participants to practice considering the full range of the six responses they would be using in the task block and to ensure that they had adequate opportunity to familiarise themselves with each new response option layout (i.e. the changing response choices for each of the three blocks). Following a 6 second rest-interval all 16 morphed ambiguous expressions (for that block) were presented 3 times across 48 randomly ordered trials. The entire task (three blocks) took approximately 20 minutes to complete.

2.4.2. The Health Questionnaire.

Participants completed questions relating to demographic information (i.e. age, gender, handedness, occupation and years in education) and to health issues (i.e. whether the participant was taking medication, had a physical or mental health problem, and if they had ever received a head injury) (see Appendix G). The health questions were used to identify any participants whose performance may have been confounded by significant health or pharmacological effects. No participants were excluded for these reasons.

2.4.3. The Matrix Reasoning and Vocabulary subtests of the Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999).

Vocabulary is a measure of crystallised ability, whilst Matrix Reasoning assesses non-verbal fluid intellectual ability. The latter assessment was used to ensure that any age related declines in emotion recognition ability were not due to changes in fluid intelligence (Levy & Goldman-Rakic, 2000). In addition, although healthy ageing is not generally associated with decline in crystallised abilities (Salthouse, 2001), it is important to determine that no age group differences could confound the findings. Normative data are available for ages 6 – 89 years for both genders. The researcher administered these assessments according to the WASI Manual.

2.4.4. The Incomplete Letters subtest of the Visual Object and Space Perception Battery (VOSP) (Warrington & James, 1991).

This is a standardised assessment of visual perception. Participants identify a capital letter from a degraded image of that letter. Normative data are available for ages 20 –

69 years. It was included in order to rule out general, non-emotional, perceptual disturbance as an explanation for any age group differences found.

2.4.5. Benton's Test of Facial Recognition 2nd ed. (Benton, Sivan, Hamsher, Varney, & Spreen, 1994).

This standardised assessment of facial perceptual ability uses photographs of unfamiliar, non-emotional faces. Participants were asked to match a facial stimulus with 1 of 6 faces, when both the stimulus and distractors were presented simultaneously and without delay. There were no memory or emotion components to this test, which was important for ensuring that the older adults' results were not confounded by these factors. The matched pairs included identical front views, front with three-quarter views and front views under different lighting conditions. Normative data are available for ages 16 – 74 years. This test allowed us to ensure that general facial identity difficulties were not impacting on emotional face recognition performance.

2.4.6. The State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

This is a standardised measure of state- (STAI-S) and trait-anxiety (STAI-T). Normative data are available for ages 19 – 69 years for both genders. Participants were asked to complete both sections. High trait anxiety has been associated with attentional bias towards fearful and angry facial expressions (Fox, Russo, & Georgiou, 2005; Fox, 2002; Mogg & Bradley, 1998) and with a bias to interpret ambiguous information in a negative manner (Richards et al., 2002). As a result, it

was important to assess age differences in anxiety levels, which might confound findings.

2.4.7. The Social Anxiety Measure of the Fear Questionnaire (Marks & Matthews, 1979).

The Fear Questionnaire is a standardised assessment of phobia. The Social Anxiety section of this questionnaire (see Appendix H) asks participants to rate how much they avoid specified social situations. Evidence suggests that social anxiety affects participants' attention to negative and positive emotional faces (Garner, Mogg & Bradley, in press; Juth, Lundqvist, Karlsson, & Ohman, 2005). Thus, this study assessed for age differences in social anxiety, which might influence performance in the CEAMF task.

2.4.8. The short form of the Marlowe-Crowne Social Desirability Scale (Fischer & Fick, 1993).

This is a standardised assessment of social appraisal (see Appendix I) which contains statements concerning personal attitudes and traits centred around universal truths. Given that facial stimuli are social stimuli it is possible that a high social desirability score (i.e. a stronger than average desire to report in a biased manner in order to invite positive social appraisal from others) might affect responses, and that this might impact differently in the two age groups.

2.4.9. Procedure for session.

Appointment times were flexible to encourage older adults to choose the time of day when they were most alert. Older adults were given the option of meeting at the

University campus, in a private experimental room or at an alternative venue, so as to ensure that they were comfortable with the testing environment. Where alternative venues were arranged the researcher made sure that the environment would be private, quiet, free from interruption or distraction, was well lit and had a table and two chairs. Of the 30 older adults tested, 29 requested to be seen at their homes whilst 1 participant requested meeting at the University (this participant had worked within the University prior to retiring and was familiar with the testing environment). The younger adults booked their appointments using Psychobook; they were able to choose from a large range of times available over a three-week span. The venue for the younger adult testing was an experimental room in the University campus that was, similarly, familiar to them.

The testing conditions for both older and younger participants were as similar as possible (i.e. familiar, distraction free, well lit rooms; an upright chair and table; the distance and height of the laptop images presented was also controlled). A script (see Appendix J) was used during the appointment to ensure that the introduction, outline of testing, experimental procedure and issues regarding consent were consistent, for each participant, throughout data collection. Participants gave written informed consent prior to participation (see Appendix K). Participants were familiarised with the testing equipment before the CEAMF test commenced.

The order of the experimental tasks was as follows:

1. Classification of Emotionally Ambiguous Morphed Faces test (CEAMF).
2. State-Trait Anxiety Inventory (STAI; state and trait anxiety (STAI-S, STAI-T).
3. The Vocabulary Subtest of the WASI.

4. The Matrix Reasoning Subtest of the WASI.
5. The Fear Questionnaire of the Social Anxiety Measure.
6. The Incomplete Letters Subtest of the VOSP.
7. The Social Desirability Scale.
8. Benton's Test of Facial Recognition (2nd ed).
9. The Health Questionnaire.

Following testing, participants were debriefed (see Appendices L and M).

3. Results.

3.1. Participant characteristics.

The descriptive characteristics of the participants are provided in Table 2. There were no significant differences between groups in gender, χ^2 (1, N = 60) = 2.44, p = .192, years of education, t(36.67) = 0.72, p = .479, State, t(54.72) = 0.77, p = .445, or Trait anxiety, t(58) = 0.59, p = .561. Nor were there group differences in Social Desirability, t(58) = 0.86, p = .395, or in facial recognition performance, t(58) = 0.36, p = .720. Thus, there were no significant differences between older and younger adults in gender distribution, mood, education, self-presentation bias or general facial recognition ability.

There were, however, significant differences between groups in vocabulary performance, WASI: Vocabulary, t(58) = 5.02, p < .001, and in non verbal reasoning, WASI: Matrix Reasoning, t(58) = 2.94, p = .005. Older adults had significantly higher levels of verbal knowledge and nonverbal reasoning than younger adults.

There were also significant group differences on the VOSP: Incomplete Letters subtest, U (N1 = 30, N2 = 30) = 2.04, p = .041. However, all of the older adults scored above the cut-off (17 for younger adults; 16 for older adults); that is, no participants demonstrated abnormal visual perceptual performance. Finally, there were significant differences on the Fear Questionnaire, $t(58) = 2.89$, p = .005. Older adults reported significantly lower levels of social anxiety than younger adults.

Table 2. Descriptive variables.

Variable M(SD)	Young Adults $N = 30$	Older Adults $N = 30$
Age (yrs)	20.27 (2.74)	72.43 (8.17)
Gender (M : F)	10 : 20	16 : 14
Years of education	14.87 (1.20)	14.45 (3.00)
WASI: Vocabulary Subtest (t score)	62.40 (4.10)	67.33 (3.50)
WASI: Matrix Reasoning Subtest (t score)	55.40 (5.66)	61.00 (8.78)
VOSP: Incomplete Letters Subtest (Max. 20)	19.73 (0.45)	19.20 (1.06)
Benton's Test of Facial Recognition (raw score)	48.07 (3.45)	47.73 (3.70)
STAI: State Anxiety (STAI-S)	36.50 (7.88)	34.70 (10.12)
: Trait Anxiety (STAI-T)	11.87 (2.97)	11.37 (3.63)
Fear Questionnaire	11.90 (6.43)	7.30 (5.89)
Social Desirability Scale	4.30 (2.12)	4.77 (2.10)

Note. WASI = The Wechsler Abbreviated Scale of Intelligence; VOSP = Visual Object Space Perception Battery; STAI = State-Trait Anxiety Inventory.

3.2. Signal Detection Analysis of the CEAMF test results.

Signal detection analysis, as outlined by Donaldson (1996), was carried out on the data from each continuum. A hit (H) denotes an accurate classification of the dominant emotion (e.g. in a 60%sad-40%happy face a classification of that face as 'sad' would be a hit). A false alarm (FA) denotes the classification of the non-dominant emotion and therefore an incorrect classification (e.g. in a 60%sad-40%happy face a classification of that face as 'happy' would be a false alarm). Using the distribution-free non-parametric model, the discrimination index A', and bias index B"D were computed using the formulae:

(i) For $H \geq FA$: $A = 0.5 + [(H - FA)(1 + H - FA)] / [4H(1 - FA)]$

(ii) For $FA > H$: $A = 0.5 - [(FA - H)(1 + FA - H)] / [4FA(1 - H)]$

The bias index B''_D was calculated using the formula:

$$B''_D = [(1 - H)(1 - FA) - (H)(FA)] / [(1 - H)(1 - FA) + (H)(FA)]$$

Discrimination scores range between 0 and 1. When H = FA (i.e. performance is at chance) A' = 0.5. A score above 0.5 indicates above chance discrimination between emotions. Response bias ranges between –1 and +1. Positive values indicate conservative response bias (a tendency *not* to see the target emotion, irrespective of dominance) and negative values indicate liberal response bias (a tendency to see the target emotion, irrespective of dominance). A zero value indicates neutral bias.

3.2.1. Removal of outliers.

Data from two participants were removed before signal detection analysis. One participant, a younger adult, was removed due to computer error causing incomplete data collection. The second participant, an older adult, was removed following their

identification as an outlier. This participant reported every angry-happy image as angry and every happy-sad image as sad, even those that were happy dominant. This participant's failure to identify any happy dominant images as 'happy', in two separate continua comparisons, led to their classification as an outlier.

Following the removal of these participants, descriptive group comparisons were re-analysed. There were no changes to the group comparisons reported.

3.2.2. Discrimination.

The means and standard deviations of the discrimination index A', for each continuum, are shown in Table 3. A 3 x 2 ANOVA was carried out on A' scores, with continuum (happy-sad, angry-happy, and sad-angry) and group (younger, older adults) as independent variables. Results revealed no significant main effect of age group, $F(1,56) = 0.31$, $p = .577$. There was, however, a significant main effect of continuum, $F(2,112) = 13.93$, $p < .001$, and a near significant trend towards an interaction between group and continuum, $F(2,112) = 2.62$, $p = .077$.

To clarify the latter results, separate one-way ANOVAs were carried out for each group with continuum as the within-subjects IV. Although there was no significant main effect of continuum for younger adults, $F(2,56) = 1.84$, $p = .169$, there was a significant effect for older adults, $F(2,56) = 18.79$, $p < .001$.

Pairwise comparisons indicated that older adults were poorer in discriminating between the two negative faces (sad versus angry: *Mean* A' = .75) in comparison with their ability to discriminate between sad and happy faces (*Mean* A' = .84), $t(28) =$

5.80, $p < .001$, or between angry and happy faces (*Mean* A' = .82), $t(28) = 3.98$, $p < .001$. There was no significant difference in their ability to discriminate between happy versus sad faces, relative to happy versus angry faces, $t(28) = 1.75$, $p = .090$.

Finally, independent t-tests were carried out to compare the two groups on their discrimination scores for each emotion continuum. No significant age group differences were found in these comparisons: for happy-sad, $t(56) = -1.51$, $p = .137$; for angry-happy, $t(56) = -1.01$, $p = .315$; or for sad-angry, $t(56) = 1.01$, $p = .318$.

Table 3. Discrimination (A') for younger and older adults, by continuum.

Continuum	Younger adults $N = 29$		Older adults $N = 29$	
	M	SD	M	SD
Happy-Sad	.812	.085	.841	.065
Angry-Happy	.798	.082	.818	.072
Sad-Angry	.774	.108	.750	.069

3.2.3. Response bias.

The means and standard deviations of the response bias index (B"D) are shown in Table 4. The response bias scores were analysed using a series of independent t-tests[2]. For angry faces, relative to happy faces (Angry-Happy continuum), younger adults produced, on average, a more negative response bias score (-.42) in comparison

[2] It was not possible to include response bias scores in an overall 3 (continuum) x 2 (group) ANOVA because, for each continuum, two response bias scores could be calculated which have the same absolute value, but which have opposite signs. E.g., the Angry-Sad continuum could yield one response bias score for angry faces, and the identical response bias score with the opposite sign for reporting sad faces. Thus, the results from a 3-way ANOVA would vary depending on which of the two alternative response bias scores were entered for each continuum. This problem does not apply to the analysis of A' scores, because there is only a single measure of discrimination accuracy for each continuum.

with older adults (-.13), $t(56) = 2.09$, $p = .040$. That is, older adults had a lower tendency to report angry-happy morphed faces as angry (rather than happy) compared to younger adults. The response bias for happy faces, relative to sad faces (Happy-Sad continuum) showed no significant group differences, nor for sad faces relative to angry faces (Sad-Angry continuum).

Table 4. Response bias for each continuum (B"D) for younger and older adults.

Continuum	Younger adults $N = 29$		Older adults $N = 29$	
	M	SD	M	SD
Happy-Sad	.042	.542	-.173	.521
Angry-Happy	-.421	.475	-.130	.583
Sad-Angry	.148	.544	.176	.519

3.3. Correlations.

Correlations were calculated between the signal detection measures (discrimination and response bias scores for each continuum) and the measures of mood, i.e. state- and trait-anxiety, social anxiety and social desirability, and cognitive functions; vocabulary, non verbal reasoning and facial recognition.

Pearson correlations were used as the distribution of these variables were within normal limits (Kolmogorov-Smirnov test), with the exception of the VOSP scores, for which Spearman's correlation was used. Across the whole sample there were no significant results. Within each group there were some significant results, however, these were all non-significant following Bonferroni correction.

4. Discussion.

This study compared older and younger healthy, high functioning adults on their ability to classify dominant emotions in ambiguous facial expressions. It was hypothesised that older adults would show reduced discrimination of angry and sad faces, and a greater response bias against angry and sad faces, relative to happy faces.

4.1. Summary of the findings.

4.1.1. Discrimination.

There were no age group differences in general discrimination ability. Therefore, Hypothesis 1. was not supported since there was no evidence to suggest that older adults showed poorer discrimination of negative faces, relative to positive faces, in comparison with younger adults. However, there was a non-significant trend for an interaction effect of group and continua on discrimination scores. Within-group comparisons suggested that older adults were less able to discriminate between emotion blends containing two negative emotions (anger and sadness) than emotion blends combining a negative and a positive emotion (happy/sad, or angry/happy), which did not differ.

4.1.2. Response Bias.

Significant differences were found between younger and older adults' response bias for angry faces, relative to happy faces, in that older adults were less likely to report anger. The older adults' bias scores indicated a less liberal tendency to report anger in the morphed faces (but, since their bias scores were negative this did not represent a

conservative tendency, i.e. a tendency to see happiness). The age groups did not differ on measures of response bias in the sad-angry or the happy-sad continua.

4.1.3. Other variables.

The groups were well matched on, gender, years of education, state and trait anxiety social desirability and facial recognition performance. Older adults had significantly higher levels of verbal knowledge and nonverbal reasoning than younger adults. Thus, any decline in older adult emotion processing ability, indicated in this study, was unlikely to result from lower intellectual capacity in the older adult group. Older adults reported significantly lower levels of social anxiety than younger adults. Arguably, therefore, higher levels of social anxiety in older adults were unlikely to lead to poorer emotional processing performance than in the younger adults. Despite age group differences in measures of crystallised and fluid intelligence (WASI: Vocabulary and Matrix Reasoning), visual perceptual performance (VOSP: Incomplete letters) and social anxiety (Fear Questionnaire), these factors did not correlate significantly with the signal detection measures. This indicates that these factors are unlikely to explain differences in discrimination or response bias.

4.2. Interpretation of the findings.

Despite previous reports, from studies using morphed faces, of evidence of age-related impairments in facial emotion discrimination, possibly relating to neurological decline (e.g. Malatestsa et al., 1987; Phillips et al., 2002; Calder et al., 2003; Sullivan & Ruffman, 2004), this study did not find evidence for this.

Carstensen, Fung, and Charles (2003), in socioemotional selectivity theory (SST), state that older adults reorganise their goals so as to place more emphasis on emotions and emotion regulation. Therefore, older adults would be predicted as showing increased recognition of happy and decreased recognition of angry and sad faces. This would lead to a prediction that there would be age-related differences in the discrimination of angry-happy and sad-happy faces but not in the discrimination of sad-angry faces. It is suggested that this is due to older adults being more likely to judge a face as happy, even when this is not the dominant emotion, in order to avoid negative emotional stimuli. This view was not supported by the current study since there were no significant discrimination differences between the age groups for any continuum. Furthermore, differences in discrimination ability within the older adults emerged only for angry-sad faces; again, a finding not supported by SST.

4.2.1. The importance of the contrasting emotion in discrimination.

The results of this study (i.e. a non-significant trend for older adults to show poorer discrimination of angry versus sad faces – two negative emotions) are partially consistent with Sullivan and Ruffman (2004), who found age differences in the identification of anger and sadness in a dynamic morphed faces task, and with Calder et al. (2003), who found age differences in the identification of anger in morphed images. However, Sullivan and Ruffman (2004) paired sadness and anger with mainly negative or complex emotions (i.e. sadness with fear, surprise and anger; and anger with sadness, disgust and happiness). Although Sullivan and Ruffman (2004) argue that sadness and anger show reduced discrimination with age, anger did not prove problematic when they contrasted it with happiness. Similarly, Calder et al. (2003) paired anger with disgust or happiness but then combined the results of both

these continua for the analysis, so preventing interpretation of the discrimination of anger when in a positive-negative morphed blend alone.

This study suggests that the contrasting emotion may be critical since sadness or anger contrasted with happiness did not show reduced discrimination for the older participants. This may be supported by Adolphs et al. (2001) who argues that the right brain processes negative emotions but that both hemispheres process positive emotions. Therefore, if the morphed facial expression contains a combination of one negative and one positive emotion, it could be that bilateral activation caused by the presence of a positive emotion may facilitate discrimination thus compensating for age-related difficulty with negative emotions. This is more consistent with our findings, since angry-sad discriminations were less well achieved in older adults. It is also consistent with the right hemi-ageing hypothesis (Dolcos et al. 2002). However, these conclusions must be considered tentative since there was no overall age group difference in discrimination ability for any emotion blend.

Furthermore, the contrast of two negative emotions (sad-angry) may simply be more difficult than one negative and one positive emotion (happy-sad). Physiologically the face moves in different ways for positive versus negative emotions (uptilted eyes and mouth for happy, downward for sad or angry) leading, possibly, to greater difficulty in discrimination for any age. This difficulty could be exacerbated by age related decline in the right hemisphere (Dolcos et al., 2002) which means that older adults would be relying on an area of brain which is showing ageing changes when discriminating between the most difficult emotion combination of sad-angry. Again, however, this is speculative, since there were no age differences in discrimination and

no evidence that these older adult participants were showing signs of general right hemisphere decline in that perceptual and facial recognition test performance was either within normal limits or not different between age groups and did not correlate with discrimination scores.

Another possible factor which might account for variation in findings across tasks is overall task demands. Age-related differences have been found on more complex, lengthy tasks (Sullivan & Ruffman, 2004; Calder et al., 2003), whereas the simpler discrimination task used here did not reveal these effects. This may suggest that complex or lengthy tasks and unfamiliar testing environments (neither of which were present in this study) could lead to age differences in discrimination.

4.2.2. Age differences in angry-happy faces response bias.

To my knowledge, this is the first study to reveal age-related effects in response bias for emotionally ambiguous morphed faces. Older and younger adults were equally good at discriminating between angry and happy faces. However, the bias results suggest that, when judging ambiguous emotional expressions, older adults showed a lower tendency to report anger, as opposed to happiness, than younger adults.

Age differences in differential hemispheric activation with positive versus negative emotions (Adolphs et al., 2001) and the right hemi-ageing hypothesis (Dolcos et al., 2002) might predict this effect. For example, older adults may be more likely to select a positive emotion (happy) over a negative emotion (angry or sad) since bilateral activation may lead them to report and select the positive emotion, and the reduction in negative emotion activation in the right hemisphere would enhance this.

However, these neurological arguments would also predict a similar age difference in reporting bias for the other positive-negative emotion continuum; happy-sad, and no such effect was found.

In terms of SST (Carstensen et al., 2003), it may be predicted that older adults will be more likely to select the positive emotion (happy) than the negative emotion (angry or sad) due to a desire to avoid negative emotional stimuli. This study did not find a definite bias towards happiness, only a reduced bias towards anger relative to happiness. Older participants still had a negative bias score. Furthermore, as above, this pattern was found only for the angry-happy blend and not the happy-sad blend suggesting that SST alone does not explain these results. Finally, no age-related differences in reporting bias on the angry-sad blend would be predicted by SST since there would be no opportunity to avoid a negative emotion in this combination.

4.2.3. Overall.

There was no evidence of age-related effects on discrimination of negative emotional facial expressions, relative to positive expressions. Given that this was predicted by both neurological decline theory and SST models of emotion processing, both models received no support from the present study in relation to perceptual discrimination of negative and positive emotions.

The discrimination findings showed that there was only a non-significant trend for an interaction of age group and emotion continuum which resulted from older adults' poorer discrimination ability for morphed blends containing two negative emotions. This is not entirely consistent with either a neurological decline argument or with

SST. Perhaps, due to similarities in the shape of the facial expressions involved, the differences seen in older adult discrimination abilities for those faces containing two negative emotions is related to the task difficulty presented by this combination.

The response bias findings showed age differences only for the angry-happy morphed faces; both the neurological decline arguments and SST would predict age effects on the sad-happy morphed faces also, which were not shown.

4.3. Clinical implications.

The results of this study suggest that older adults have a trend towards finding two negative emotions more difficult to discriminate than positive-negative blends. If this trend is confirmed in future research, it may have implications for health care provision in terms of how the older adult reflects or reports on negative emotional information when in negative mood or a negative emotional situation. Given that neurological change with age may be impacting on older adults' ability to discriminate between negative emotions, consideration should be given when working with older adults, to using models of treatment that are not emotionally complex and do not contain multiple, negative emotional components. For example, practitioners working with older adults who have depression and/or anxiety, or who are experiencing sadness, worry or anger, should be aware that this age group might have diminished ability to discriminate additional negative emotional information.

This study also suggests that older adults have less of a bias for anger relative to happiness, in that they were less likely than the younger adults to report anger in an angry-happy facial blend. This may be of importance in the assessment, treatment

and general care of older adults within residential and community settings. Practitioners in these environments should be aware that older adults may report anger in a manner which is biased. Reduced likelihood of reporting the threat of anger in others could lead to increased vulnerability for some older adults. Similarly, the possibility of underreported anger among older adults should be considered during assessment of mood.

4.4. Future directions.

The results from the discrimination data in this study were largely non-significant and the hypothesis for discrimination differences with age not supported. For this reason caution has been used in interpreting the non-significant trend for an interaction in the discrimination data. Methodological factors within this study which might have contributed to this are considered.

This study included 30 younger adults and 30 older adults. That significant age group differences were found only for angry-happy bias could have been due to a lack of power. Sample size calculations, with alpha .05, and 80% power, revealed that between 97 and 5647[3] participants would have been needed, per age group, to find significant differences in all other discrimination and response bias measures, suggesting that power was not a problem. In addition, the older participants recruited were high functioning. Recruitment of lower functioning older adults might help with generalising the results. However, recruitment of older adults is commonly biased in this way, since lower functioning individuals tend not to take part in studies and may find the computer based tasks too stressful (McNeely & Clements, 1994).

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[3] Sample size required, power .80, alpha .05, A/H A' = 234; H/S A' = 106; S/A A' = 212; H/S B"D = 97; S/A B"D = 5647.

The identification of fear has been shown to be a problem in older age (Sullivan & Ruffman, 2004; Calder et al., 2003). Future research could explore whether similar findings to those found in this study for sad-angry discrimination and for angry-happy bias would be found if fear were used as the negative emotion in these blends. Future research could also investigate the effect of varying the blend proportions on whether discrimination effects might be found; for example, using facial emotions in a 50%-50% morphed blend, where discrimination should be poor (because there is no correct response), but response bias might reveal age differences, dissociable from discrimination effects.

During this study older participants commented on the unusual appearance of the morphed emotional faces, particularly the occasional shadowing around the eyes and mouth, which could be a criticism of using the static morphed images. Further research could consider using dynamic stimuli. Sullivan and Ruffman (2004) used a facial expression which morphed over 12 seconds into a different expression. The participants were required to identify the final emotion, as quickly as possible. Although arguably more life-like than static images, dynamic morphed images still have the unusual appearance commented on by my participants. An alternative is to use dynamic video images, perhaps moving from showing neutral to emotional expressions. The dependent variable would then be the point at which the participant identifies the target emotion. For example, Kamachi, et al. (2001) looked at the dynamic properties that influence the perception of facial expression in adulthood. The perception of sadness was most accurately identified in slow sequences, anger was most accurately identified in medium speed sequences, whilst happiness and surprise were identified most accurately in fast sequences (Kamachi, et al., 2001).

This suggests that the speed at which the dynamic emotional face is presented differs for each emotion. This effect could be further compounded by age and would be interesting to explore.

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List of the Appendices.

Appendix A: Information for authors: The British Journal of Clinical Psychology.

Notes for Contributors

The British Journal of Clinical Psychology publishes original contributions to scientific knowledge in clinical psychology. This includes descriptive comparisons, as well as studies of the assessment, aetiology and treatment of people with a wide range of psychological problems in all age groups and settings. The level of analysis of studies ranges from biological influences on individual behaviour through to studies of psychological interventions and treatments on individuals, dyads, families and groups, to investigations of the relationships between explicitly social and psychological levels of analysis.

The following types of paper are invited:

- Papers reporting original empirical investigations;
- Theoretical papers, provided that these are sufficiently related to the empirical data;
- Review articles which need not be exhaustive but which should give an interpretation of the state of the research in a given field and, where appropriate, identify its clinical implications;
- Brief reports and comments.

1. Circulation

The circulation of the Journal is worldwide. Papers are invited and encouraged from authors throughout the world.

2. Length

Papers should normally be no more than 5,000 words, although the Editor retains discretion to publish papers beyond this length in cases where the clear and concise expression of the scientific content requires greater length.

3. Reviewing

The journal operates a policy of anonymous peer review. Papers will normally be scrutinised and commented on by at least two independent expert referees (in addition to the Editor) although the Editor may process a paper at his or her discretion. The referees will not be aware of the identity of the author. All information about authorship including personal acknowledgements and institutional affiliations should be confined to the title page (and the text should be free of such clues as identifiable self-citations e.g. 'In our earlier work...').

4. Online submission process

1) All manuscripts must be submitted online at http://bjcp.edmgr.com .

First-time users: click the REGISTER button from the menu and enter in your details as instructed. On successful registration, an email will be sent informing you of your user name and password. Please keep this email for future reference and proceed to LOGIN. (You do not need to re-register if your status changes e.g. author, reviewer or editor).
Registered users: click the LOGIN button from the menu and enter your user name and password for immediate access. Click 'Author Login'.

2) Follow the step-by-step instructions to submit your manuscript.

3) The submission must include the following as separate files:
   - Title page consisting of manuscript title, authors' full names and affiliations, name and address for corresponding author - Editorial Manager Title Page for Manuscript Submission
   - Abstract
   - Full manuscript omitting authors' names and affiliations. Figures and tables can be attached separately if necessary.

4) If you require further help in submitting your manuscript, please consult the Tutorial for Authors - Editorial Manager - Tutorial for Authors

Authors can log on at any time to check the status of the manuscript.

5. Manuscript requirements

- Contributions must be typed in double spacing with wide margins. All sheets must be numbered.
- Tables should be typed in double spacing, each on a separate page with a self-explanatory title. Tables should be comprehensible without reference to the text. They should be placed at the end of the manuscript with their approximate locations indicated in the text.
- Figures can be included at the end of the document or attached as separate files, carefully labelled in initial capital/lower case lettering with symbols in a form consistent with text use. Unnecessary background patterns, lines and shading should be avoided. Captions should be listed on a separate page. The resolution of digital images must be at least 300 dpi.
- For articles containing original scientific research, a structured abstract of up to 250 words should be included with the headings: Objectives, Design, Methods, results, Conclusions. Review articles should use these headings: Purpose, Methods, Results, Conclusions: British Journal of Clinical Psychology - Structured Abstracts Information
- For reference citations, please use APA style. Particular care should be taken to ensure that references are accurate and complete. Give all journal titles in full.
- SI units must be used for all measurements, rounded off to practical values if appropriate, with the Imperial equivalent in parentheses.
- In normal circumstances, effect size should be incorporated.
- Authors are requested to avoid the use of sexist language.
- Authors are responsible for acquiring written permission to publish lengthy quotations, illustrations etc for which they do not own copyright.

For Guidelines on editorial style, please consult the *APA Publication Manual* published by the American Psychological Association, Washington DC, USA (http://www.apastyle.org).

6. Brief reports and comments

These allow publication of research studies and theoretical, critical or review comments with an essential contribution to make. They should be limited to 2000 words, including references. The abstract should not exceed 120 words and should be structured under these headings: Objective, Method, Results, Conclusions. There should be no more than one table or figure, which should only be included if it conveys information more efficiently than the text. Title, author and name and address are not included in the word limit.

7. Publication ethics

Code of Conduct - Code of Conduct, Ethical Principles and Guidelines

Principles of Publishing - Principle of Publishing

8. Supplementary data

Supplementary data too extensive for publication may be deposited with the British Library Document Supply Centre. Such material includes *numerical data, computer programs,* fuller details of case studies and experimental techniques. The material should be submitted to the Editor together with the article, for simultaneous refereeing.

9. Post acceptance

PDF page proofs are sent to authors via email for correction of print but not for rewriting or the introduction of new material. Authors will be provided with a PDF file of their article prior to publication.

10. Copyright

To protect authors and journals against unauthorised reproduction of articles, The British Psychological Society requires copyright to be assigned to itself as publisher, on the express condition that authors may use their own material at any time without permission. On acceptance of a paper submitted to a journal, authors will be requested to sign an appropriate assignment of copyright form.

11. Checklist of requirements

- Abstract (100-200 words)
- Title page (include title, authors' names, affiliations, full contact details)
- Full article text (double-spaced with numbered pages and anonymised)
- References (APA style). Authors are responsible for bibliographic accuracy and must check every reference in the manuscript and proofread again in the page proofs.
- Tables, figures, captions placed at the end of the article or attached as separate files.

Appendix B: Ethical approval letter.

University of Southampton

School of Psychology

University of Southampton Highfield Southampton SO17 1BJ United Kingdom
Tel +44 (0)23 8059 3995
Fax +44 (0)23 8059 4597

16 February 2005

Louise Tarrant
Clinical Psychology Trainee
School of Psychology
University of Southampton
Highfield, Southampton SO17 1BJ

Dear Louise,

Re: **Emotion Processing in Older Adults**

I am writing to confirm that the above titled ethics application was approved by the School of Psychology Ethical Committee on 26 July 2004.

Should you require any further information, please do not hesitate in contacting me on 023 8059 3995.

Please quote approval reference number CLIN/03/46.

Yours sincerely,

Kathryn Smith
Secretary to the Ethics Committee

Appendix C: Advertisement for older adult participants.

Study on Mood in Facial Expression

Hello, I am Louise Tarrant a Clinical Trainee at the University of Southampton, Doctoral Programme in Clinical Psychology. I am conducting a study to explore how adults of all ages perceive a series of photographs of various facial expressions. This research hopes to contribute to a better understanding of psychological functioning throughout ageing.

I would be very keen to hear from volunteers who are over 60 years old. If you are willing, you would be asked to complete a variety of simple tasks including making judgements about pictures of faces. These tasks will take approximately 1 hour. I will be able to arrange to bring the tasks to your home if this is most convenient for you. I will be present and will be available to answer any questions and discuss your experience afterwards.

If you are interested in volunteering or would like to find out more then please contact me at: Louise Tarrant, School of Psychology, University of Southampton, SO17 1BJ; Tel: 07793 563 575; E-mail: lt902@soton.ac.uk.

Appendix D: Advertisement for younger adult participants.

Study on Mood in Facial Expression

I am conducting a study that compares how older and younger people perceive a series of photographs of various facial expressions.

I will be recruiting 30 volunteers who are aged between 18 and 30 years. Participants will be asked to complete a variety of simple tasks including making judgements about pictures of faces. It will take approximately 1 hour.

Participants will receive **4 CREDITS**.

If you are interested or would like more information, please contact me:
Louise Tarrant; Doctoral Programme in Clinical Psychology; Tel: 07793 563 575
Or E-mail: lt902@soton.ac.uk.

Appendix E: Information Sheet for older adults.

Study on Mood in Facial Expression

You are being invited to take part in a study of the relationship between mood, personality and judging facial expression.

What is the purpose of the study?
This study is exploring how people make judgements about emotions or mood from other people's expressions. It is hoped that this study will contribute to knowledge and may have implications for the assessment and treatment of mental health problems during adulthood.

Why have I been chosen?
In order to gain a variety of perspectives a wide range of people have been invited from the community and the University.

Do I have to take part?
It is entirely up to you to decide whether or not you take part. You may also change your mind or decide to stop at any time during the session.

What will happen if I take part?
You will be given some simple tasks to complete. These include questionnaires about mood and personality, problem solving and making simple judgements about pictures of faces. We will arrange a time to meet at the University or (if you prefer) at your home. The session will take approximately 1 hour.

Will my taking part in the study be kept confidential?
All information, which is collected during the course of this study, will be kept strictly confidential within the research team. In the writing up of this study no individuals will be identifiable.

What will happen to the results of the study?
A report of the study will be written and submitted as my dissertation for the Doctoral Programme in Clinical Psychology. It may also be prepared for publication in an academic journal.

Who is involved in the study?
I am a third year Clinical Trainee at the University of Southampton, Doctoral Programme in Clinical Psychology and will be carrying out this study with the staff at the School of Psychology.

Who has reviewed this planned study?
The School of Psychology Research Ethics Committee, University of Southampton has reviewed the study.

If you have any questions about your rights as a participant in this study or you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, School of Psychology, University of Southampton, Southampton, SO17 1BJ. Tel: 023 8059 3995.

Who can I contact for further information?
If you have any questions, or you wish to receive a copy of a report of the findings, please feel free to request this. You can contact me at: Louise Tarrant, School of Psychology, University of Southampton, SO17 1BJ. Tel: _____. Email: lt902@soton.ac.uk

Thank you for reading this,
Louise Tarrant.

Appendix F: Information Sheet for younger adults.

Study on Mood in Facial Expression

You are being invited to take part in a study of the relationship between mood, personality and judging facial expression.

What is the purpose of the study?
This study is exploring how people make judgements about emotions or mood from other people's expressions. It is hoped that this study will contribute to knowledge and may have implications for the assessment and treatment of mental health problems during adulthood.

Why have I been chosen?
In order to gain a variety of perspectives a wide range of people have been invited from the community and the University.

Do I have to take part?
It is entirely up to you to decide whether or not you take part. You may also change your mind or decide to stop at any time during the session.

What will happen if I take part?
You will be given some simple tasks to complete. These include questionnaires about mood and personality, problem solving and making simple judgements about pictures of faces. We will arrange a time to meet at the University. The session will take approximately 1 hour.

Will my taking part in the study be kept confidential?
All information, which is collected during the course of this study, will be kept strictly confidential within the research team. In the writing up of this study no individuals will be identifiable.

What will happen to the results of the study?
A report of the study will be written and submitted as my dissertation for the Doctoral Programme in Clinical Psychology. It may also be prepared for publication in an academic journal.

Who is involved in the study?
I am a third year Clinical Trainee at the University of Southampton, Doctoral Programme in Clinical Psychology and will be carrying out this study with the staff at the School of Psychology.

Who has reviewed this planned study?
The School of Psychology Research Ethics Committee, University of Southampton has reviewed the study.

If you have any questions about your rights as a participant in this study or you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, School of Psychology, University of Southampton, Southampton, SO17 1BJ. Tel: 023 8059 3995.

Who can I contact for further information?
If you have any questions, or you wish to receive a copy of a report of the findings, please feel free to request this. You can contact me at: Louise Tarrant, School of Psychology, University of Southampton, SO17 1BJ. Tel: _____. Email: lt902@soton.ac.uk

Thank you for reading this information sheet.

If you would like to take part in this study or would like to discuss it further:

Please send your name and preferred contact details to lt902@soton.ac.uk.

Or, contact me on _____.

Appendix G: The Health Questionnaire.

Participant Health Questionnaire

Name.	
Date of Birth (Age).	
Gender.	
Left or Right Handed.	
Occupation (previous occupation if retired; spouses occupation if housewife, etc.).	
No. years in education: 1. Age Started School? 2. Age Left School? 3. Further Education (F/T or P/T) and level of qualification?	
Are you currently on any prescription medication? Which, how long for, how often, how much?	
Do you suffer from any physical illness? What, how long for?	
Do you suffer from any emotional or mental disorder? What, how long for?	
Have you ever suffered a head injury? When, where on head, loss of consciousness?	

Appendix H: The Fear Questionnaire.

Participant Fear Questionnaire.

Choose a number from the scale below to show how much you would avoid each of the situations listed below because of fear or other unpleasant feelings. Then write the number you chose in the box opposite each situation.

0	1	2	3	4	5	6	7	8
Would not avoid it		*Slightly avoid it*		*Markedly avoid it*		*Definitely avoid it*		*Always avoid it*

Speaking or acting to an audience..... ☐

Eating or drinking with other people..... ☐

Being watched or stared at..... ☐

Talking to people in authority..... ☐

Being criticised..... ☐

Appendix I: The Social Desirability Questionnaire.

Participant Social Questionnaire.

Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is True or False as it pertains to you personally, then circle that answer.

(1)	I like to gossip at times.	TRUE FALSE
(2)	There have been occasions when I took advantage of someone.	TRUE FALSE
(3)	I am always willing to admit it when I make a mistake.	TRUE FALSE
(4)	I always try to practice what I preach.	TRUE FALSE
(5)	I sometimes try to get even rather than forgive and forget.	TRUE FALSE
(6)	At times, I have really insisted on having things my own way.	TRUE FALSE
(7)	There have been occasions when I felt like smashing things.	TRUE FALSE
(8)	I never resent being asked to return a favour.	TRUE FALSE
(9)	I have never been irked when people expressed ideas very different from my own.	TRUE FALSE
(10)	I have never deliberately said something that hurt someone's feelings.	TRUE FALSE

Appendix J: Experimental Procedure Script.

Instructions and Procedure

Introduction

Hello. I'm Louise and I'm a trainee clinical psychologist at Southampton University.
Thank you very much for agreeing to take part in this research.
We will be exploring how people make judgements about emotion and mood from other people's expressions.

It will take about 45 minutes.
If you want to stop at any time let me know. You do not have to continue if you do not wish to.
Any information that you give me is confidential. Individual's results will not be identifiable.

I have a spare copy of the Information Sheet you received if you want to see it again.

Unfortunately, I will not be able to discuss the results of the tasks you do today because I need time to score them afterwards. But I can send you a brief summary of the overall results of the study if you like.

Outline of testing

I'm going to ask you to do some brief questionnaires, some problem solving puzzles and you will be asked to make judgements about some pictures of faces.

Don't worry if you think that you are not very good at something or if something seems too easy.
You are not expected to answer all the questions correctly.
Everyone has some strengths and some weaknesses, this is healthy and normal.
So stay relaxed and just do your best.

Consent

Do you have any questions about the study? *Answer these questions.*

If you are happy to continue, please sign these consent forms.

Consent form ***signed****:*
Thank you. Please keep one for your own records.

If person wants to ***withdraw****:*
Thank you for taking the time to find out more about this study.
Deciding not to participate today does not mean that you cannot participate in other studies.

Testing

1. Classification of Emotionally Ambiguous Morphed Faces test

I am now going to ask you to make judgements about some photographs of faces.
On seeing each face you will need to make a decision about the emotion that the person is expressing and to what degree you think they are expressing that emotion.
There are three sets of 48 faces so you will be able to take a short break between sets if needed.
You might find some of these faces a little unusual but don't worry about that, just carry on.

The instructions for this task will appear on the screen.
There are some 'practice' faces for you to try before you start.
We want you to be as accurate as you can but also as fast as you can.
As soon as you have made a decision then press the button to indicate this.

The choices are at the bottom of the screen and the buttons you press when making your choice are clearly labelled here.
Show keyboard labels and name each one in full as pointing to each.

Is that clear? Do you have any questions?

Complete Morphed Faces testing.

If participant asks "why are there so many faces for me to assess?" say:
You get a better study if you use more faces.

2. The State-Trait Anxiety Inventory

I am going to give you a questionnaire, which has two parts.

Give participant the STAI Form Y-1.
In this first part there are a number of statements, which people have used to describe themselves. Read each statement and then mark in the appropriate circle to the right of the statement (*point on questionnaire to response circles*) to indicate how you feel right now, that is at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer that seems to describe your present feelings best.

Turn the questionnaire and give participant the STAI Form Y-2.
In this second part there are a number or statements, which people have used to describe themselves. Read each statement and then mark in the appropriate circle to the right of the statement (*point on questionnaire to response circles*) to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer that seems to describe how you generally feel.

3. The Vocabulary subtest (WASI)

In this task I want you to tell me the meanings of some words. Are you ready?

Place stimulus booklet (Item 9+) in front of the participant and use the same method of presentation for all words: Simultaneously point and say:

Tell me what ..... means.

If participant does not get 2 points on items 9 and 10 then administer reverse items until perfect scores on two consecutive items.

If the participant gives an unclear or vague response, say:
Tell me more about it; *or* Explain what you mean.

***Discontinue** after 5 scores of 0.*

4. The Matrix Reasoning subtest (WASI)

Now I'm going to show you some pictures. For each picture, there is a part missing. Look at all aspects of each picture carefully and choose the missing part from the five choices.

Place Sample Item A and B in the Stimulus Booklet in front of participant and say:
For example, tell me which of these pictures (*point to the response choices*) should go here (*point to the question mark*). Choose the one that best completes the pattern. If you think there is more than one correct answer to the problem, choose the best one.

If the participant responds incorrectly say:
For this item, this choice (A: response 2 / B: response 5) would best complete the pattern because they are all green triangles / this makes the bottom row the matching.

If further explanation is required:
There are a number of ways you can solve this problem.
e.g. The pictures can be separated into two rows/columns, etc.
Demonstrate how the problem can be solved by looking at columns /rows.

Then ***YA:** proceed to Items **7-35**.*
***OA 60-79:** proceed to Items **5-32**.*
***OA 80+:** proceed to Items **1-28**.*

Now tell me which of these pictures (*point to the response choices*) should go here (*point to the question mark*).

If participant does not get 2 points on first two items then administer reverse items until perfect scores on two consecutive items.
***Discontinue** after 4 scores of 0 on 5 consecutive items.*

5. Social Anxiety Measure (Fear Questionnaire)

I am going to give you a brief questionnaire now. *Give Social Anxiety Measure to participant.*

This questionnaire asks you about your feelings about social situations. I would like you to choose a number from the scale *(point to scale on questionnaire)* to show how much you would avoid each of the situations listed below because of fear or other unpleasant feelings. Write the number you choose in the box opposite each situation.

6. Incomplete Letters subtest (VOSP)

I am now going to ask you to identify some capital letters, which have some parts missing. *Place practice items F and B in front of participant.* Can you see what this capital letter is?

If unable to identify practice items F and B then abandon test.

If able to identify practice items F and B then present ***all*** *remaining letters, say:*
The next set of capital letters are rather more incomplete. Can you see what this capital letter is? Etc.

7. Social Desirability Scale

I am going to give you another brief questionnaire now. *Give Social Desirability Scale to participant.*

On this questionnaire there is a list of various statements concerning personal attitudes and traits. I would like you to read each statement and then decide whether the statement is true or false as it pertains to you personally, then circle your chosen answer here *(point to true/false selection list on questionnaire)*.

8. Benton's Facial Recognition test

This is the last task I am going to give you.

Place stimulus booklet open in front of participant. Ask them to hold the book to their best visual advantage. Present ***all*** *items.*

Pages 1-6:
You see this person? *(Point to single picture).* Show me where they are on this page. *(Point to multiple choice page).*

Pages 7-22:
You see this person? *(Point to single picture).* They are shown three times on this page. *(Point to multiple choice page).* Show me where they are. Find three pictures of them.

If participant can only find one or two corresponding pictures, say:
Select the most likely choice among the ones that are left.

If the participant wants to discontinue at any point.

Thank you for giving me your time today. Are there any questions now that you would like to ask me? *Answer any questions.*
Do not provide too much information about test materials or correct answers to avoid contaminating future participant responses.

Background information:

I would like to ask you some questions about yourself and your health. Let me know if you are uncomfortable with any of the questions.

Ask questions on Health Screen questionnaire.

If participant asks why we need to know about medications and mental health problems:
Some medications and the experience of low mood can affect the speed of a person's responses, their general abilities and their concentration. I am interested in recruiting older people who have not had any recent changes in either of these areas so as to be sure that my results aren't picking up on something else.

On completion of all tasks

Thank you very much for giving me your time. I really appreciate all the effort you have put into working with me today. Without your help studies like mine would not be possible.

Are there any questions now that you would like to ask me? *Answer any questions.*
Do not provide too much information about test materials or correct answers to avoid contaminating future participant responses.

Give Debriefing Sheets to participant.

Would you like to hear about the overall results of this study?
If 'yes': I will send you a brief summary of what we found in a little over 6 months time, which is when I will be writing up this study. *Make note of participant's name.*

Further recruitment

If you know anyone who you think would also like to participate in this study, then please give them my contact details (on the Information Sheet) and I will be happy to provide them with further information should they wish to take part.

Please do not to discuss with them the specific details of the tasks we have done today as it may influence their answers.

Appendix K: Participant Consent Form.

Consent Form

Study on Mood in Facial Expression

Please initial the boxes:

1. I confirm that I have read and understood the Information Sheet for the Study on Mood in Facial Expression. ☐

2. I understand that my participation in the study is voluntary and that I am free to withdraw my consent without having to give a reason. ☐

3. I understand that information and data collated for this study will be made anonymous. ☐

4. I agree to take part in the study. ☐

Name of Participant	Date	Signature

Name of Researcher	Date	Signature

1 copy for Participant; I copy for Researcher.

Appendix L: Participant Debriefing Sheet for older adults.

Study on Mood in Facial Expression

Theoretical Background

A review of studies examining the experience of anxiety and depression across the life span suggested that mental health problems decreased in prevalence with age (Jorm, 2000). Christensen et al. (1999) also found a decrease in anxiety and depression with age when using standardised assessments, but identified qualitative differences within self-report data, regarding how younger and older adults experience depression and anxiety.

A number of reasons have been suggested for a possible reduction in mental health problems with age. Older adults may have a reporting bias possibly relating to cohort effects, which could mean they are less likely to describe feelings of low mood and anxiety (Gross et al., 1997). Alternatively, older adults may have learnt to control their emotions and to use more effective coping strategies. For example, older adults report increased emotion control (Gross et al., 1997) and use more emotion coping strategies like positive reappraisal (Folkman, Lazarus, Pimley, and Novacek, 1987).

The neurology of emotion has been linked to the ability to encode and decode facial expressions. Therefore, research into older and younger adults' ability to decode positive and negative morphed facial expression combinations could contribute to the debate regarding the prevalence and experience of mental health problems with age.

Methodology

The present study therefore required two groups of healthy participants, aged 18-30 and 60+ in order to investigate emotion processing skills in younger and older adults. This was examined by assessing the accuracy of participants' responses to positive and negative morphed facial expressions. Tests of verbal and non-verbal intelligence, perceptual skills and levels of anxiety ensured that variables such as intellectual level, perceptual ability and anxiety did not impact on results.

Appendix M: Participant Debriefing Sheet for younger adults.

Study on Mood in Facial Expression

Theoretical Background

A review of studies examining the experience of anxiety and depression across the life span suggested that mental health problems decreased in prevalence with age (Jorm, 2000). Christensen et al. (1999) also found a decrease in anxiety and depression with age when using standardised assessments, but identified qualitative differences within self-report data, regarding how younger and older adults experience depression and anxiety.

A number of arguments have been suggested for a possible reduction in mental health problems with age. Older adults may have a reporting bias, possibly relating to cohort effects (Gross et al., 1997). Emotional responsiveness may decline with age, e.g. older adults show reduced emotion specific autonomic nervous-system activity (Levenson, Carstensen, Friesen, and Ekman, 1991) and reduced cardiovascular responses (Tsai, Levenson, and Carstensen, 2000)). Emotional control and coping strategies may increase with age, e.g. older adults report increased emotion control (Gross et al., 1997) and use more emotion coping strategies such as positive reappraisal (Folkman, Lazarus, Pimley, and Novacek, 1987).

The neurology of emotion has been linked to the ability to encode and decode facial expressions. Research has shown that older women are less able than younger or middle-aged women to decode videotaped facial expressions (Malatesta, Izard, Culver, and Nicolich, 1987) and that older adults are less able to identify facial expressions of anger and sadness from photographs (Phillips, MacLean, and Allen, 2002). Calder et al. (2003) used morphed ambiguous facial expressions and found a decrease in recognition of fear and anger, and an increase in recognition of disgust with increasing age. Differences in older adults' stimulus appraisal bias may be due to differential effects of ageing on the brain regions associated with these emotions or due to reduced processing of certain negative emotions to enhance emotion regulation (Calder et al., 2003).

Further research into older and younger adults' ability to decode positive and negative morphed facial expression combinations could contribute to the debate regarding the prevalence and experience of mental health problems with age.

Methodology

The present study therefore required two groups of healthy participants, aged 18-30 and 60+ in order to compare emotion processing skills in younger and older adults. This was examined by assessing the accuracy of participants' responses to positive and negative morphed facial expressions. Tests of verbal and non-verbal intelligence, perceptual skills and levels of anxiety ensured that variables such as intellectual level, perceptual ability and anxiety did not impact on results.

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